SETTING BIODIVERSITY CONSERVATION PRIORITIES FOR INDIA

Summary of the Findings and Conclusions of the Biodiversity Conservation Prioritisation Project

VOL. II

Edited by
Shekhar Singh, ARK Sastry, Raman Mehta & Vishaish Uppal

WWF INDIA
World Wide Fund for Nature - India
2000

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WWF
INDIA

WORLD WIDE FUND FOR NATURE - INDIA
2000

Published by WWF India on behalf of the BCPP Steering Group

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Citation

Singh *et. al* (eds.). 2000 '*Setting Biodiversity Conservation Priorities for India*' WWF-India, New Delhi, India, xxvii & 707 pp

This publication was partially supported by the Biodiversity Support Program (BSP) -- a consortium of World Wildlife Fund, The Nature Conservancy, and World Resources Institute, funded by the United States Agency for International Development (USAID) Global Bureau, under the terms of Cooperative Agreement Number DHR-A-00-88-00044-00. The opinions expressed herein are those of the authors and do not necessarily reflect the views of USAID.

Printed by Elegant Printers. A-38/2, Mayapuri Phase I, New Delhi-110064

Contents

VOLUME I

VOLUME II

Prioritising Species

Prioritisation of Endangered Species

Ajith Kumar, Sally Walker and Sanjay Molur

1. Introduction

The Importance of Species

Species are the fundamental independent building blocks of bio-diversity. Laypersons and scientists easily relate to species. Species often form the most obvious biological unit that is of substantial use to people. Species also form the unit at which a substantial part of biological research is carried out. Our concern for the survival of species has driven conservation policies and actions for many centuries. The traditional systems of conservation have by and large evolved around species that are of practical use (for food, fodder, timber, *etc.*). In contrast, till recently conservation policies of Governments (autocratic, democratic or other wise) have evolved around species that are charismatic or are of scientific interest. Even though values of other components of biodiversity have also been important, it is concern for the survival of species that has been the major driving force in conservation whether traditional or governmental. It would continue to do so, since species are the building blocks of biodiversity to which people can easily relate in terms of various values.

Even the simplest of ecosystems are species rich. In contrast, the resources in terms of area, funds and personnel that can be set apart for conservation of these species are always very limited. The need to prioritise species for allocation of such resources is therefore obvious. Conservation attempts by traditional societies and governments often reflect such prioritisation, directly or indirectly.

Species Prioritisation

Prioritisation by IUCN

The most widely published prioritisation of species for conservation action has been the threatened species categories defined by the IUCN (now World Conservation Union), and used in its Red Data Book and Red Lists. In the 30 years since its definition, the Red Data Book categories have been widely used by the IUCN, and Government and Non-Government Organisations to focus their attention on species at higher extinction risks, and have guided policy and management decisions in many countries. Many national, regional and global assessments of extinction risks in species have been published, and many other countries are in the process of compiling their own lists. Red Lists have also guided international species trade policies through CITES.

In 1984, the Species Survival Commission of the IUCN decided to revise the system in order to (a) make it more explicit and less arbitrary so that it can be applied consistently by different people; (b) include clear guidance to evaluate different risk factors so as to improve objectivity; (c) enable cross taxa comparisons; and (d) to enable a better understanding of the process of categorisation among different users of Red Lists (Mace and Stuart 1994). The new system recognises three categories of risk, Critically Endangered, Endangered, or Vulnerable. Meeting any one of a set of five criteria qualifies a taxon (species or lower) for listing at that level of threat. The five quantitative criteria aim at detecting risk factors across a broad range of organisms and the diverse life histories they exhibit. The quantitative values in each criterion were developed through consultation, but there is no formal justification for these values. Other categories resulting from the assessment are Data Deficient, Conservation Dependent (when it is only conservation action that prevents the taxon from meeting the threatened criteria), Low Risk, Extinct in the Wild, Extinct, and Not Evaluated. A description of the Categories and Criteria are given in Chapter 2. The new IUCN criteria for assessment of extinction risk is finding increasing acceptance and has been used extensively in many countries and on many taxa. IUCN has recently made a global assessment of most of the vertebrates and many invertebrates, using the revised categories and criteria (IUCN 1996). Among the Indian species, 75 mammals, 73 birds, 16 reptiles, 3 amphibians, 4 fishes and 22 invertebrates have been listed as globally threatened. The number of species that has been assessed is very low, especially in the case of lower vertebrates and invertebrates.

The new IUCN categories reflect only relative extinction risks, and does not reflect many of the values that are often considered in prioritisation; *e.g.* utility values, ecosystem functions, taxa distinctiveness, endemism and feasibility. Some of these values are, however, indirectly reflected in the categories. For example, endemic and rare species often come under threatened categories, but this need not be the case always. Another limitation is that global, national and regional assessment may not give the same results; global Low Risk taxon may fall under national Endangered category or vice versa.

Species Prioritisation in India

In recent Indian history, the most comprehensive prioritisation of species for conservation has been through the Wildlife (Protection) Act 1972, which afforded varying degrees of protection to a whole range of animal species under different Schedules. This Act has since been amended repeatedly, in 1982 to allow capture and translocation, in 1986 to prevent trade in wild animals and animal products and in 1991 to afford protection to scheduled plants apart from providing for more stringent forms of protection to animals and punishment for violations. The ratification of the Convention on International Trade in Endangered species (CITES) in 1976 extended protection from trade and related activities to species that were thought to be under threat

The Wildlife (Protection) Act of 1972 was passed at a time when a wide variety of wild animals in India were perceived to be under threat from hunting and habitat loss The species were grouped into five Schedules each of them with differing degrees of protection, with animals in Schedule I & II receiving the highest forms of protection. A Schedule was added to include endangered plants also In the almost total absence of quantitative data in the 1970's and soon after, the allocation of species to different schedules was based on expert opinions of wildlife and forest managers, biologists, and amateurs. This list has been amended periodically based on inormation generated, often moving species from lower to higher schedules affording them greater protection. This prioritisation of species, as reflected in their allocation to different schedules, has attracted a lot of criticism

1. It has been argued that the allocation of species to Schedules often does not reflect the degree of threat that the species are under. While some abundant species are in Schedule I, some rare and threatened ones are given low levels of protection.
2. It is also argued that placing of some species in Schedule V as vermin has actually resulted in their being hunted out. On the other hand, some of the Schedule I or II animals are major crop raiders causing considerable economic loss in some areas.
3. The legal provisions associated with the higher Schedules (I & II) have often led to prolonged litigation, and thus have had low feasibility
4. The Schedules are biased in favour of the larger mammals, reptiles and birds, often at the expense of smaller mammals, birds, lower vertebrates, invertebrates, and plants.
5. The inclusion of a large number of animals (including many butterflies and beetles) in the higher schedules have not allowed us to focus our attention on those that are really in need of it It has also been argued, however, that any dilution of protection would put many species at risk.
6. The allocation to Schedules does not reflect values such as important ecological functions (pollination and seed dispersal *e.g* by fruit bats), economic/social and other utility, *etc*

There has thus been an increasing feeling that the Schedules of Wildlife (Protection) Act, which reflect the prioritisation of species for conservation action, should be re-examined so that (a) it reflects the values of species to a wider spectrum of people, (b) it incorporates the quantum increase in information that has taken place in the recent years, and the modern principles of conservation biology; (c) the schedules discern among species that are really in need of attention, and (d) feasibility is an important criteria while prescribing conservation actions. It follows also that the prioritisation of species through allocation to different schedules be transparent, objective and defensible.

Apart from the Schedules of the Wildlife (Protection) Act, the Zoological Survey of India has recently produced a Red Data List of Indian animals The Botanical Survey of India has published a list of endangered Indian plants (Nayar & Sastry 1987, 1988), following the old IUCN categorisation. Even though the potential values of the plants are mentioned, this categorisation of Indian plants and the Red Data Book of Indian animals remain only assessments of threat status, without the integration of other values for prioritisation.

An attempt at prioritisation of Indian birds for conservation was made by the Salim Ali Centre for Ornithology and Natural History (SACON) in August 1993 (Vijayan 1995). Following presentations of the conservation status of different species, subgroups identified (a) five endemic species most urgently in need of action in India (b) another five species that require priority action in India in a global context; and (c) ten additional species not covered above but which nevertheless require action. The workshop also identified action needs for the above species. Apart from species, the workshop also identified important bird areas for conservation action While the workshop brought together most of the experts in the field thus ensuring the use of the best data possible, the prioritisation was not based on well-defined procedures and criteria. Currently SACON is currently assessing the conservation of status of birds using the revised IUCN categories.

The most comprehensive prioritisation of species has been recently done, on the basis of the new IUCN criteria, for the medicinal plants in south India. This prioritisation was done through three CAMP workshops co-ordinated by the Federation for Revitalisation of Local Health Traditions (FRLHT) during 1995-97, during which 139 medicinal plants of south India were assessed and assigned threat categories. These species were chosen out of a priority list of more than 350 species compiled by FRLHT based on their threat status reported in published literature (e.g. Red Data Book of Indian Plants) and an analysis of consumption of medicinal plants by the traditional medicine industry. Even though the species were chosen initially for their medicinal uses, there was no consideration of their relative values, other utility values, biological values such as endemism, and ecosystem functions, and feasibility.

Apart from the above attempts at prioritisation of threatened species by organisations and professional bodies, individuals have attempted to prioritise some taxa based on their studies. An assessment of conservation status of birds of Nicobar Islands using the new IUCN categories has been attempted by Sankaran (1996).

A review of the above attempts at prioritisation of threatened species reveal that (a) all have been based on threat or conservation status alone, and have not integrated biological values, utility values, and feasibility; and (b) these are not based on the framework now defined by the IUCN except for the assessments by FRLHT.

Biological Values In Species Prioritisation

Central to any biodiversity conservation prioritisation is the biological values attached to different levels of biodiversity. Protection of species at high risk of extinction, for example, has guided conservation prioritisation for many decades. Increasingly, however, other biological values especially biodiversity levels above the species, are being considered in conservation prioritisation (see Johnson 1995). The purpose of this section is to give a brief introduction to the biological values at genetic and species levels and the criteria for their evaluation that have been commonly used in the recent years.

Genetic Level

Genetic diversity is the variation in genes within an individual species. The greater the genetic diversity the greater the long term adaptability of the species. Allelic diversity, presence of particular rare alleles, deleterious recessives or karyotype variants are different criteria that could be used to assess the genetic diversity of different populations (Noss 1990). Genetic diversity is being increasingly considered in setting priorities for conservation of populations of highly endangered species. It is also of importance while considering wild relatives of cultivated or domesticated species.

Species Level

Among all levels of biodiversity, management and assessment activities have been mostly at the species level for several reasons e.g. species appeal to people, they are easily studied, and are legally recognised and protected.

Ecological indicators which serve as easily monitored surrogates of ecosystem structure, function and integrity.

Key-stone species which even though not forming a major part of the biomass, are pivotal to the survival of many other species in the community, for example, by providing food at critical times of the year. These species make a disproportionate contribution to the maintenance of the community in which they occur.

Umbrella species that have large area requirements and for this reason its protection also ensures the survival of many other species.

Flagship species which are charismatic species that attract popular attention.

Endemic or restricted range species is of high biological value, and is a good indicator of vulnerability to extinction. Besides focussing attention on individual species, endemics and restricted range species richness can be an important criteria in prioritisation of sites (Kershaw et al. 1995). However, this criterion is biased against widely distributed but threatened species and taxonomic groups among which endemism or restricted range distribution is low.

Threatened Species: This is not a biological value as such but often a result of human activities. There are however indications that several biological traits are associated with vulnerability to extinction (e.g. ICBP 1992, Witting & Loeschcke 1995). The revised IUCN criteria (Mace & Lande 1991) recognise three categories of threat Critically Endangered, Endangered and Vulnerable. These criteria have been used extensively in many countries and on many taxa to assess conservation status and prioritise species for conservation action.

The use of this criterion for species or area prioritisation is often a short-term measure to protect high-risk species. However, this could compromise the long-term goal of conserving a representative sample of taxa, especially if particular taxonomic or trophic categories face higher risk (Kershaw et al. 1995).

Taxonomic distinctiveness: Distinctive taxa are species (or higher taxa) with unique character states, often reflected by evolutionary distinctiveness (Vane-Wright *et al.* 1991). and are likely to be genetically more unique than other taxa. Attempts have been made to weight such unique taxa while assessing species richness by giving higher scores to species representing deep phylogenetic branches while choosing sites in sequence (Williams et al 1991). Others have used more refined measures of taxic diversity such as divergence information and phylogenetic tree topology (May 1990, Vane-Wright et al 1991, Crozier, 1992, Faith 1992, Williams et al 1992, Fjeldsa 1994).

Integration of criteria

The integration of these biological criteria presents several methodological problems, partly because the criteria often represent different levels of biodiversity that are often incompatible, or whose relationships are inconsistent or not known. At the species level, prioritisation till date has been based largely on threat status (see Section of Endangered Species Prioritisation), without considering other ecological values such as keystone functions.

A number of biological traits are associated with vulnerability to extinction (Terborgh 1974, Thomas & Mallorie 1985, ICBP 1992, Dobson et al 1995). In birds, restricted range was a major indicator of vulnerability, and endangered bird areas selected by ICBP using this indicator, also represented species richness and threatened species not only of birds, but also of other taxa such as mammals, insects and plants (ICBP 1992). A few other studies also indicate that restricted range or rarity may be a more efficient criterion than either species richness or threatened species (*e.g.* Pressey & Nicholls 1989, Margules *et al* 1988; Witting & Loeschcke 1995). Most of the restricted range species of butterflies in Morocco occurred in the most species rich areas (Thomas & Mallorie 1985) while in contrast for most British taxa, the restricted range species occurred outside the species rich areas (Prendergast *et al.* 1993).

The relationship between species richness, restricted range species, and threatened species is thus inconsistent, varying geographically as well as taxonomically. It is therefore necessary to examine this relationship before deciding upon their application in site prioritisation.

Species Prioritisation in BCPP

Recommendations of the Project Design Workshop

Prioritisation of species is an important goal of BCPP. The Project Design Workshop held on 17-18 April 1996, discussed this component in detail. The Working Group on Species recommended that the species component be divided into three groups for prioritisation; wild relatives of cultivated plants, medicinal plants, and endangered species. As far as the endangered species was concerned, the Working Group suggested that conservation status be the primary criteria in prioritising them. Other values could be used to further prioritise the endangered species. The Group also recommended that the revised IUCN criteria and categories be applied to evaluate the conservation status of species, since they have been widely used and understood. Conservation Assessment and Management Planning (CAMP) workshops were suggested as the process by which such an assessment could be made. CAMP workshops allow rapid application of the revised IUCN criteria, while ensuring the best use of most recent published and unpublished information, and personal participation of the relevant experts. The species working group appreciated that within the short period of time and funds available, and paucity of information on the enormously large number of species in India, only a few species could be taken up for assessment. It was however important that the framework for a systematic assessment of the conservation status of Indian species to be designed, and the process be initiated during this project.

The Group discussed the prioritisation of Indian taxa, to select some of them for an assessment during the project. The number of species in the taxa, prior or ongoing attempt at similar assessment, information availability, and constraints of time were considered while selecting the taxa for assessment. Mammals (as two groups, small and large mammals), reptiles, amphibians and freshwater fishes were selected during the workshop itself. An invertebrate taxon and a group of marine organisms were also selected, with the specific taxa to be decided upon later following discussion among resource persons.

Among the fauna, the account the ongoing effort by the Salim Ali Centre for Ornithology and Natural History to assess the Indian birds and decided not to duplicate the effort. Similarly, the group took into account the published assessment of Indian plants (Nayar and Sastry, 1987) and decided not to duplicate it, even though this assessment was based on the old IUCN criteria and categories. However, as an example, medicinal plants of central and northeast India, and northwest Himalaya was chosen later. This allowed a comparison of results from two methods. Moreover, it would also compliment the assessment of medicinal plants of south India by the Foundation for Revitalisation of Local Health Traditions (FRLHT). The taxa chosen in the end were medicinal plants (of central and northeast India, and northwest Himalaya), soil and aquatic invertebrates of south India (chosen after later discussion), amphibians, reptiles, mammals(small and large), mangrove organisms (chosen after coral reef was considered impractical), and freshwater fishes. Among these, the preparation for the workshop on freshwater fishes was initiated under the BCPP, but due to lack of funds in the project, the workshop was held by the National Bureau of Fish Genetic Resources, with their own funds.

Objectives

The following were the specific objectives of the endangered species prioritisation

(a) Provide an assessment of the conservation status of Indian species in selected taxa that is based on the best information that is available both published and unpublished.
(b) Provide information on the threats faced by each assessed taxon that form the reasons for their conservation status.
(c) Provide complete documentation of the information that forms the basis of the assessment.
(d) Provide information on threatened species that is necessary for prioritisation of sites.
(e) Provide an assessment of the lessons learnt during this rapid assessment of conservation status and of the reliability of the methods and process.

A detailed description of the revised IUCN categories and criteria, and the CAMP workshops is given in the next Section. This is followed by brief reports on each of the workshops, along with a list of assessed species and their IUCN Red List categories. Published results from the workshop on freshwater fishes held by NBFGR are also given. In the last Section the major results and recommendations are discussed. Detailed reports, including documentation of the information compiled during the workshop, have been prepared separately for each workshop

2. Methods

IUCN Red List Categories and Criteria

Introduction

The revised IUCN Red List categories were suggested by the Species Working Group as the indicator to assess the conservation status of the selected taxa, taking into consideration its wide acceptance and improved objectivity. The IUCN Red Data Book guides major conservation efforts all over the world. The IUCN Red List categories and criteria, in existence for over 30 years, have been revised during the last seven years in order to (a) make it more explicit and less arbitrary so that it can be applied consistently by different people; (b) include clear guidance to evaluate different risk factors so as to improve objectivity, (c) enable cross taxa comparisons, and (d) to enable a better understanding of the process of categorisation among different users of Red Lists (Mace and Stuart 1994)

The new system recognises three categories of risk, Critically Endangered, Endangered, and Vulnerable. Meeting any one of a set of five criteria qualifies a taxon (species or lower) for listing at that level of threat. The five quantitative criteria aim at detecting risk factors across a broad range of organisms and the diverse life histories they exhibit. The quantitative values in each criterion were developed through consultation, but there is no formal justification for these values. Other categories resulting from the assessment are Data Deficient, Conservation Dependent (when it is only conservation action that prevents the taxon from meeting the threatened criteria), Low Risk, Extinct in the Wild, Extinct, and Not Evaluated

For each of these threat categories, there are five criteria, A to E, which relate to extinction risk. The criteria A to D have sub-criteria that are used to justify the listing of a species under a given category and criteria. The five criteria are:

(a) Declining population (past or projected)
(b) Small distribution, fragmentation and decline or fluctuation
(c) Small population size and decline
(d) Very small population or very restricted distribution
(e) Quantitative analysis of probability of extinction

It is not intended that all criteria be applied to a given species. Although the criteria for each of the threat categories are based on quantitative thresholds, inference and projection are permitted so that taxa for which there is very little information can also be assessed.

A summary of definition of the terms, and criteria to assess different categories given below, are taken from IUCN (1996)

Definitions

Population

Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa obligately dependent on the other taxa for all or part of their cycles, biologically appropriate values for the host taxon should be used

Sub-populations

Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

Mature individuals

The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind.

(a) Where the population is characterised by natural fluctuations minimum number should be used.
(b) This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppress in the wild.
(c) In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (*e.g.* the estimated effective population size)
(d) Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (*e.g.* corals).
(e) In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

Generation

Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

Continuing decline

A continuing decline is a recent, current or projected future decline whose causes are not known or not known or not adequately controlled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

Reduction

A reduction (criterion A) is a decline in the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A reduction should not be interpreted as a part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a reduction

Extreme fluctuations

Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (*i.e.* a tenfold increase or decrease).

Severely fragmented

Severely fragmented refers to the situation where increased extinction risks to the taxon result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

Extent of occurrence

Extent of occurrence is defined as the area within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred or projected sites of present occurrences of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (*e.g.*, large areas of obviously unsuitable habitat, but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

Area of occupancy

Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon (*e.g.* colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon. The criterion includes values in sq.km

Location

Location defines a geographically or ecologically distinct area in which a single event (*e.g.* pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of subpopulations of the taxon, and is typically a small proportion of the taxon's total distribution

Quantitative analysis

A quantitative analysis is defined here as the technique of population viability analysis (PVA), or any other quantitative form of analysis, which estimates the extinction probability of a taxon or pollution based on the known life history and specified management or non-management options. In presenting the results of quantitative analyses the structural equations and the data should be explicit

The Categories

Extinct (EX)

A taxon is extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW)

A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and /or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual Surveys should be over a time frame appropriate to the taxon's life cycle and life form

Critically Endangered (CR)

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future. as defined by any of the criteria (A to E)

Endangered (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E).

Vulnerable (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future. as defined by any of the criteria (A to D)

Lower Risk (LR)

A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered. Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

Conservation Dependent (CD)

Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years

Near Threatened (NT)

Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable

Least Concern (LC)

Taxa that do not qualify for Conservation Dependent or Near Threatened

Data Deficient (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and or/distribution is lacking Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status If the range of a taxon is suspected to be relatively circumscribed. if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified

Not Evaluated (NE)

A taxon is Not Evaluated when it has not yet been assessed against the criteria.

Criteria for Critically Endangered, Endangered and Vulnerable

Critically Endangered (CR)

A taxon is Critically Endangered when it is facing an extremely highly risk of extinction in the wild in the immediate future, as defined by one of the following criteria (A to E):

A. Population reduction in the form of either of the following

1. An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generation, whichever is the longer, based on (and specifying) any of the following:

   (a) direct observation
   (b) an index of abundance appropriate for the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridisation, pathogens, pollutants. competitors or parasites

2. A reduction of at least 80 %. projected or suspected to be met within the next ten years or three generations,

whichever is the longer, based on (and specifying) any of the (b) to (e) above.

B. Extent of occurrence estimated to be less than 100 sq.km or areas of occupancy estimated to be less than 10 sq.km, and estimates indicating any two of the following

1. Severely fragmented or known to exist at only a single location.
2. Continuing decline, observed, inferred or projected in any of the following
   (a) extent of occurrence
   (b) area of occupancy
   (c) area, extent and/or quality of habitat
   (d) number of location or subpopulations
   (e) number of mature individuals
3. Extreme fluctuations in any of the following
   (a) extent of occurrence
   (b) area of occupancy
   (c) number of locations or subpopulations
   (d) number of mature individuals

C. Population estimated to number less than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or
2. A continuing decline, observed, projected or inferred, in number of mature individuals and population structure in the form of either:
   (a) severely fragmented (*i.e.* no subpopulations estimated to contain more than 50 mature individuals)
   (b) all individuals are in a single subpopulation.

D. Population estimated to number less than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer.

Endangered (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined any of the following criteria (A to E):

A. Population reduction in the form of either of the following

1. An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generation, whichever is the longer, based on (and specifying) any of the following
   (a) direct observation
   (b) an index of abundance appropriate for the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites
2. A reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of the (b) to (e) above

B. Extent of occurrence estimated to be less than 5000 sq km or areas of occupancy estimated to be less than 500 sq.km. and estimates indicating any two of the following:

1. Severely fragmented or known to exist at only a single location
2. Continuing decline, observed, inferred or projected in any of the following
   (a) extent of occurrence
   (b) area of occupancy
   (c) area, extent and/or quality of habitat
   (d) number of location or subpopulations
   (e) number of mature individuals
3. Extreme fluctuations in any of the following.
   (a) extent of occurrence
   (b) area of occupancy
   (c) number of locations or subpopulations
   (d) number of mature individuals

C. Population estimated to number less than 2500 mature individuals and either.

1. An estimated continuing decline of at least 20% within 3 years or one generation, whichever is longer or
2. A continuing decline, observed, projected or inferred, in number of mature individuals and population structure in the form of either.
   (a) severely fragmented (*i.e.* no subpopulation estimated to contain more than 250 mature individuals)
   (b) all individuals are in a single subpopulation.

D. Population estimated to number less than 250 mature individuals

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or 5 generations, whichever is the longer.

Vulnerable (VU)

A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E).

A. Population reduction in the form of either of the following

1. An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   (a) direct observation
   (b) an index of abundance appropriate for the taxon
   (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites
2. A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of the (b) to (e) above.

B. Extent of occurrence estimated to be less than 20,000 sq km. or areas of occupancy estimated to be less than 2,000 sq.km. and estimates indicating any two of the following.

1. Severely fragmented or known to exist at only a single location.
2. Continuing decline, observed, inferred or projected in any of the following
   (a) extent of occurrence
   (b) area of occupancy
   (c) area, extent and/or quality of habitat
   (d) number of location or subpopulations
   (e) number of mature individuals
3. Extreme fluctuations in any of the following:
   (a) extent of occurrence
   (b) area of occupancy
   (c) number of locations or subpopulations
   (d) number of mature individuals

C. Population estimated to number less than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or 3 generations, whichever is longer or
2. A continuing decline, observed, projected or inferred, in number of mature individuals and population structure in the form of either:
   (a) severely fragmented (*i.e.* no subpopulations estimated to contain more than 1000 mature individuals)
   (b) all individuals are in a single subpopulation.

D. Population very small or restricted in the form of either of the following:

1. Population estimated to number less than 1000 mature individuals.
2. Population is characterised by an acute restriction in its area of occupancy (typically less than 100 sq km) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and it is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years

Camp Workshops

Introduction

We decided to use the Conservation and Management Planning (CAMP) workshop process in order to make a rapid assessment of the conservation status. according to the revised IUCN criteria. Workshop enabled the rapid compilation of the vast amount of information that was relevant to the assessment, most of this information pertains to locality records, distribution, habitat preferences, threats, perceptions of population decline *etc.* This vast amount of information has mostly remained unpublished. The workshops allowed piecing together such information, in a structured manner that became useful in assessment. The discussion and consensus among the participants during the process insured that the assessment is owned by the participants as a group rather than any individual. Such group ownership is one of important advantages of the workshop process. Making use of the vast unpublished information was another. The workshops allowed a large number of resource persons to personally participate in the assessment of the conservation status of the taxa that they were familiar with. This has rarely happened before in India. Finally, the workshop was a rare opportunity for experts in a taxon to meet each other and form a net work. with a common understanding of research and conservation needs.

CAMP workshops were designed by the Conservation Breeding Specialist Group of the IUCN to facilitate objective and systematic prioritisation of research and management action needed for species conservation.

During the workshops the participants contribute, discuss, and piece together information that is relevant to; a) making an assessment of conservation status according to revised IUCN criteria; b) making recommendations on management and research needs; and c) captive breeding, if needed for conservation. The relevant information on each taxon (species or sub species) is provided on a taxon data sheet. The IUCN Red List category, and the criteria and sub-criteria on the basis of which the assessment is made, are also given in the taxon data sheet (see taxon data sheet). Other information includes relevant references to field studies, threats, and recommendations on management, research, captive breeding and the need for a population and habitat viability analysis. The CAMP works that we conducted had three phases.

Preparation

Selection of participants

During the workshop preparation period we made a preliminary list of nearly 2,000 resource persons who could participate in the assessment, by attending workshops or otherwise. A letter intimating them of the workshops, with a brief profile of BCPP, was sent to all of them. A potential list of participants for each workshop was made based on the response from resource persons, the need to cover different geographic areas and sub taxa, availability of funds, and the need to limit the participants to 30-40. The participants were finally known only when they arrived at the workshop venue.

After the invertebrate workshop, we made an attempt to collect information prior to the workshop, especially from those who could not attend it, by sending them biological information sheets. The information sent to us on these sheets was placed at the workshop.

Selection of host institutions

The institutions that could host the workshops, and collaborators, who could assist, were selected in different parts of India.

Preparation of briefing materials

The briefing materials provided to the participants included a CAMP Reference Manual, and a compilation of relevant references. The CAMP Reference Manual gave description of the revised IUCN Red List categories and criteria, and of the CAMP process. The compilation of references included review papers on the taxonomy or distribution of the taxa under consideration, which the participants needed to refer to. Besides, the relevant Flora and Fauna of India volumes and other reference books were also made available at the workshop venue.

The Workshops

We conducted six CAMP workshops, on medicinal plants in Lucknow; soil and aquatic invertebrates in Chennai; Amphibians in Bhubaneswar; Reptiles in Coimbatore; mangrove organisms in Goa; and Mammals in Bangalore. The first workshop was held in January 1997, and the last one in August 1997. The preparatory work for the workshop on freshwater fishes was done under this project, but due to lack of funds in the project, the workshop was held by the National Bureau of Fish Genetic Resources, Lucknow. Each workshop lasted for 5 days, with the following programme:

Inauguration

With a brief introduction to the background of the workshop, Endangered Species Prioritisation and BCPP.

An introductory session: with

(a) An introduction to Endangered Species Prioritisation
(b) An introduction to the revised IUCN Red List categories and criteria
(c) An introduction to the CAMP process, and ground rules of the workshop
(d) Filling up of a taxon data sheet, as an example

The filling up of taxon data sheets

Following the introductory session, which usually ended by the evening of the first day, the participants were split into 3-5 working groups, based geographical or taxonomical coverage. Each sub group was asked to take up as many as species as possible, out of a list that we had provided them with. Normally a CAMP workshop lasts three days, and covers only 12-50 species. BCPP CAMP workshops were extended to five days, in order to cover more species. Even though the first two workshops covered only 80 to 90 species, we found later that the participants could be actually pushed to cover more species. The participants were enthusiastic about completing all species in their area of specialisation and worked from early morning till late night to finish the challenging task.

Each of the sub groups had one recorder (who filled up the taxon data sheets, based on the consensus information provided by the participants), and one facilitator who resolved conflicts and ensured participation of all group members. The workshop facilitators were also available to provide clarifications and to resolve conflicts, and to ensure that the sub groups moved on rather than getting stuck on some species. Flexibility was the key, we adjusted our process and schedule as needed to achieve goals.

Review of taxon data sheets

All the taxon data sheets that were filled up by the subgroups were reviewed by the whole group, either at the end of each day, or next day morning in plenary sessions. This gave an opportunity for the whole group to criticise and contribute to the assessment, while ensuring that a large number of species were assessed.

Special issue working groups

During every CAMP workshop, the participants raised important issues related to the conservation of the taxa under conservation. These issues pertained to the revised IUCN categories, criteria, taxonomy, research needs, education, legal issues *etc*. Instead of discussing these issues as and when they were raised, one session of the workshop was dedicated to the discussion of these issues, often in subgroups The recommendations of the sub groups were reviewed at a plenary session.

Valedictory session

The valedictory session, was an occasion to thank the local host, collaborators, and the participants.

Post-workshop

The intensive schedule during the workshop, including review, ensured that taxon data sheets were error free to the extent possible, and entered in the computer. However, a draft copy of all taxon data sheets were again sent to the participants after the workshop in order to make final corrections, and to include relevant references, wherever needed. The participants were requested to return the sheets within one month. The response to this has been somewhat slow. A final report, that include the taxon data sheets for all the assessed taxa, and detailed analysis of the, data that they contain would be distributed to all participants, as well as to others. Due to the delay in reviewing taxon data sheets, and busy schedule of the workshops, the final reports are not yet ready.

In the report on the various taxa that follows, only the data from the workshops are used. Final corrections by the participants have not been incorporated. However, this is not expected to change the general trends presented here.

Scale of Assessment

The IUCN categories and criteria are ideally applied to global populations For endemics, however, regional assessment that covers the entire population would be equivalent to a global assessment. Assessment of a species that is isolated from other conspecific populations would lead to greater chances of it being given a higher threat category, depending on what proportion of the global population is regionally assessed. Assessment of a part of a contiguous population presents certain problems that are still unresolved (Gardenfors 1996). In the assessments that we facilitated under this project all species have been assessed nationally, regardless of whether populations of these species occur outside India and whether populations outside India are contiguous with those in India However, a few species have been assessed for regions within India, for various reasons. Generally, such assessments would give a higher threat status to the species, compared to an assessment of the global population.

Summary of Conservation Assessment of Species under BCPP (Table 2 1). The number of species under different Red List categories (CR = Critically Endangered; EN = Endangered, VU = Vulnerable, LR-nt = Low Risk near threatened; LR-lc = Low Risk least concern; DD = Data Deficient; NE = Not Evaluated).

Table 2.1: Summary of Conservation Assessment of Species under BCPP

Order	*CR*	*EN*	*VU*	*LR-nt*	*LR-lc*	*DD*	*NE*	*Total*
Medicinal Plants	35	16	15	7	-	2	0	75
Soil Invertebrates	18	23	16	13	14	10	1	95
Amphibians	10	42	46	57	8	39	5	207
Reptiles Mangrove	34	54	80	100	64	134	30	466
Plants	12	41	4	1	1	0	1	60
Algae	2	12	0	8	1	0	0	23
Invertebrates	1	5	4	17	14	0	1	41
Fishes	0	0	10	41	0	0	0	51
Mammals	22	33	60	76	64	115	21	373
Freshwater fish	45	91	81	66	16	26	0	323

3. Medicinal Plants

Introduction

India is among the most species rich countries of the world as far as plants are concerned. Flowering plants alone consist of nearly 15,000 species. The Working Group on Species Prioritisation during the Project Design Workshop realised that it would be impossible to assess the conservation status of even a modest percentage of even the flowering plants during the BCPP Since the objective of the assessment was to identify the threatened species and to prioritise them, it was decided to assess a group of plants that was more likely to be threatened, rather than a random taxonomic group of plants. Unlike animals, human harvesting is a major threat to wild populations of many plant species that are of use to man, especially for medicinal purposes Nearly 7,000 species of Indian plants are of such use. We therefore used human use for medicinal purpose as the best indicator of threat among the flowering plants, in order to pre-prioritise plants Orchids which was also considered was abandoned since information available was less. Moreover, the geographical coverage of India would also have been limited. The selection of medicinal plants for assessment based on the Revised IUCN Categories and Criteria offered two other advantages. Another project under the BCPP is examining the conservation status of medicinal plants using the old IUCN categories as well as a non-CAMP process. This was a golden opportunity to test whether two different methods and criteria applied to the same group of plants would yield the same results Secondly, FRLHT had initiated an assessment of medicinal plants in south India. using the revised IUCN Criteria and CAMP process By April 1996. FRLHT had completed two such workshops covering 80 pre-prioritised medicinal plants of south India A third workshop was planned for November 1996 to assess another 20 species Therefore, we decided to conduct a CAMP workshop on medicinal plants of central and northeast India, and northwest Himalaya. This would complement the effort being made by the FRLHT.

The Assessment

Nearly 45 resource persons from 25 organisations participated in the workshop on medicinal plants of central and northeast India and northwest Himalaya, held at Lucknow from 21 to 25 of January 1997. The workshop was hosted by the UP Forest Department, the National Botanical Research Institute being the major local collaborator The participants selected 77 species for assessment. and completed 75 of these; 37 species were northwest Himalaya, and 20 each were from central India and northeast India. two being common to the latter two areas. Eight species were trees, 54 were herbs, 10 shrubs and three climbers. The species were selected because they were thought to be under threat, therefore, the assessment is not an indicator of the threat status of medicinal plants in general in the area.

Out of the 75 assessed species two species were assessed for northeast and northwest Himalaya separately. In total, 69 species (92%) were categorised as threatened, 33 (44%) being Critically Endangered. 19 (22 7%) Endangered and 16 (21.3%) Vulnerable. The very high percentage of species under threat is due to the selection of species that were thought to be threatened, and thus confirms the assumption.

Reasons for Endangerment

The criteria that the participants used to categorise the species are a good indicator of the nature of the threat that they face. Nearly 70% of the threatened species were categorised based on Criterion A alone. population decline during the last decade In contrast. only 23% were assessed as threatened due to restricted distribution. population fragmentation. and decline in habitat quality (Criteria B) which has been used most in the assessment of other taxa In fact, 38 (55%) of the threatened species had range of occupancy of more than 20,000 sq km and 11 (16%) had a range between 5000 sq.km and 20,000 sq.km. Therefore. the high threatened status of medicinal plants is due to population decline, with over harvesting of the wild population being the major reason Nearly 89% of the taxa assessed were under threat from trade. Among the major threats faced. those due to use was the most frequently reported (61.4%) of the species. loss of habitat (18 7%) and habitat fragmentation (5%) not being important

The FRLHT has so far assessed the conservation status of 139 medicinal plant of south India, following the Revised IUCN Criteria and CAMP process Of these four were listed as Extinct, 17 (12.8%) as Critically Endangered. 33 (24 8%) as Endangered and 49 (36.8%) as Vulnerable. In total. 74.4% of the medicinal plants assessed in the south are Threatened. compared to 92% of the plants assessed in the central and northeast India. and northwest Himalaya. A far greater percentage of the assessed plants were listed as Critically Endangered (45 3%) in the north than in the south (12.8%) The greater endangerment of the medicinal plants might reflect differences in the selection of plants for assessment It might also reflect the greater pressure the northern. especially Himalayan. species are facing from harvesting.

Table I. List of 27 medicinal plants in central and northeast India and northwest Himalaya prioritised for conservation using revised IUCN criteria, out of 75 species that were evaluated. (CR=Critically Endangered; EN=Endangered)

Sl. No.	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
	Endemics			
1	Aconitum deinorrhizum	Ranunculaceae	CR	(A1acd; B1, 2abc)
2	Aconitum falconeri	Ranunculaceae	CR	(B1, 2abc)
3	Berberis kashmirana	Berberidaceae	CR	(A1acd, B1, 2abc)
4	Berberis petiolaris garhwalana	Berberidaceae	CR	(A1acd; B1, 2abc)
5	Coptis teeta	Ranunculaceae	CR	(A1acd)
6	Curcuma caesia	Zingiberaceae	CR	(A1acd)
7	Berberis lycium Royle var simlensis	Berberidaceae	EN	(B1, 2c)
8	Hedychium coronarium	Zingiberaceae	EN	(B1, 2c)
	Non-endemics			
9	Aconitum balfourii	Ranunculaceae	CR	(A1acd, B1, 2abc)
10	Aconitum ferox	Ranunculaceae	CR	(A1acd; B1, 2abc)
11	Aconitum heterophyllum	Ranunculaceae	CR	(B1, 2abcde)
12	Aconitum violaceum	Ranunculaceae	CR	(A1acd; B1, 2abc)
13	Angelica glauca	Apiaceae	CR	(A1acd)
14	Aquilaria malaccensis	Thymelaeaceae	CR	(A1acd)
15	Arnebia benthamii	Boraginaceae	CR	(A1acd)
16	Atropa acuminata	Solanaceae	CR	(A1acd)
17	Crateriostigma plantagineum	Scrophulariaceae	CR	(B1, 2c)
18	Dactylorhiza hatagirea	Orchidaceae	CR	(A1acd)
19	Delphinium denudatum	Ranunculaceae	CR	(A1c; B1, 2c)
20	Dioscorea deltoidea	Dioscoreaceae	CR	(A1acd)
21	Fritellaria roylei	Ariaceae	CR	(A1acd)
22	Gastrochilus longiflora	Zingiberaceae	CR	(B1, 2c)
23	Gentiana kurroo	Gentianaceae	CR	(A1acd)
24	Berberis aristata	Berberidaceae	EN	(A1acd)
25	Berberis chitria	Berberidaceae	EN	(B1, 2c)
26	Bunium persicum	Apiaceae	EN	(A1acd)
27	Gloriosa superba	Liliaceae	EN	(A1acd, B1, 2c)

Among the recommendations for management and research are habitat management (17% of the species), periodic monitoring (18.6%) and cultivation programme for all threatened species even though techniques for cultivation are yet to be developed or standardised for most species. This is particularly important because most of the critically endangered species (more than 50%) might be very difficult to be cultivated *ex situ*. Development of a cultivation programme to meet the local and trade needs have been recommended for many species.

In view of the concern that medicinal plants are being over harvested in the wild, the Ministry of Environment and Forests has adopted the assessment by the CAMP workshops as the best indicator of species under threat. The Ministry has also proposed a revision of the negative list of exports to include the critically endangered and endangered species, and the cultivation of many of these species to meet trade demands.

4. Soil and Aquatic Invertebrates of South India

Introduction

With more than 75,000 species in India and one million species world wide, invertebrates are the most species rich taxa, forming more than 95% of the fauna. Among the invertebrates, the species rich taxa are the Nematoda (more than 25,000 world wide and 2,350 in India), Mollusc (80,000 world wide and 5,000 in India), Arthropoda (one million world wide and 70,000 in India) and Annelida (13,000 world wide and 1,000 in India). Insecta is by far the richest Class and accounts for more than 80% of the invertebrates. This very high species richness itself is a deterrent to a species based conservation assessment. Moreover, our knowledge of the habitat, distribution and abundance of a vast majority of these species, especially recent trends, is very limited. In fact, our knowledge of most species goes little beyond their original description. In this scenario a species based conservation assessment is not currently possible for most Indian invertebrates taxa. This in fact is true for all tropical invertebrate taxa.

There were several reasons why such an assessment seemed attractive, however. There has been no prior assessment of the conservation status of invertebrates in India. The inclusion of many butterflies in the Schedule of Indian Wildlife Protection Act was not based on assessment of conservation status of individual species but on threats faced by the taxa as a whole from trade. There has been fears expressed in recent years, that invertebrates might be much more extinction prone due to their habitat specificity and restricted distribution. Invertebrates also play important roles in fundamental ecological process such as nutrient cycles and pollination. It was in this background that all the invertebrate specialists that we consulted felt that an assessment of the conservation status may be attempted on a select group of species as an experimental basis. Since butterflies, the taxon that is best studied, is already receiving some of protection under Wildlife Protection Act, the expert group that discussed the matter on 8.2.1997, selected soil and aquatic invertebrates of South India for assessment. This was an ecologically important group of animals on many of which we had sufficient expertise to make an assessment possible.

A rapid compilation of soil invertebrates in South India, consisted of 824 species as follows:

Earthworms - Oligochaeta	47
Centipedes - Myriapoda, Chilopoda	26
Grasshoppers - Orthoptera	93
Termites - Isoptera	99
Ants and Wasps – Hymenoptera	105 (ants)
Bugs - Hemiptera, Reduvidae	183
Scorpions - Arachnida – Scorpionidae	29
Land molluscs - Gastropoda – Mollusc	242

The Assessment

About 25 experts from 16 organisations participated in the workshops which was held at the Southern Regional Station, Zoological Survey of India (ZSI), Chennai, Dr. P.T. Cherian, Deputy Director, ZSI and host organiser of the workshop, welcomed the participants, Dr. T.N. Ananthakrishnan gave the Presidential address and Dr. A.G.K. Menon inaugurated the workshop. Following the introductory session, the participants were divided into two groups based on their expertise; Entomological group which assessed ants, termites, grasshoppers, water fleas and flies; Aquatic group which assessed molluscs, crabs and crustaceans; Non-entomological group which assessed millipedes, scorpions, and earthworms. On the fourth day the participants rearranged into different groups to discuss special topic issues.

At the end of the workshop after five days, 79 species were assessed in total, consisting of 8 ants, 8 termites, 5 grasshoppers, 3 flies, 2 water fleas, 20 molluscs, 5 crabs, 10 seed shrimps, 6 millipedes, 8 scorpions and 4 earthworms. The species were selected for assessment from the preliminary list, based on the availability of information and perception of threat. Thus none of the very common species were selected for assessment.

Of the 79 species that were assessed, 47 were categorised as threatened, of which 10 were Critically Endangered, 21 were Endangered and 16 were Vulnerable. The remaining were Low risk - near threatened (14

Table II. List of 37 soil and aquatic invertebrates prioritised for conservation based on revised IUCN criteria, out of 79 species that were evaluated. (CR=Critically Endangered; EN=Endangered)

Sl. No.	*Taxon*	*Class/Order*	*IUCN Category*	*IUCN Criteria*
1	Acanthaspis alagiriensis	Insecta / Hemiptera	CR	(B1, 2c)
2	Acanthaspis carinata	Insecta / Hemiptera	CR	(B1, 2c)
3	Drawida nilamburensis	Oligochaeta / Moniligastreda	CR	(B1, 2abc)
4	Ectrychotes bharathi	Insecta/Hemiptera	CR	(B1, 2c)
5	Edocia punctatum	Insecta / Hemiptera	CR	(B1, 2c)
6	Edocla heberii	Insecta / Hemiptera	CR	(B1, 2c)
7	Eucoptacrella ceylonica	Insecta / Orthoptera	CR	(B1, 2abc)
8	Eucypris bispinosa	Oristacca / Podocopida	CR	(B1, 2ac)
9	Haematorrhophus fovealis	Insecta / Hemiptera	CR	(B1, 2c)
10	Mesacanthaspis kovaiensis	Insecta / Hemiptera	CR	(B1, 2c)
11	Paludomus stomatodon	Pelecypoda / Megagastropoda	CR	(B1, 2b)
12	Psilacrum convexa	Insecta / Diptera	CR	(B1,2abc)
13	Sechelleptus importatus	Myriapoda / Spirostreptida	CR	(B1, 2c)
14	Synectrychotes calimerei	Insecta / Hemiptera	CR	(B1, 2c)
15	Tricimbomyia muzhiyarensis	Insecta / Diptera	CR	(B1, 2c)
16	Zarytes squalina	Insecta / Orthoptera	CR	(B1, 2ab)
17	Alstonitermes flavescens	Insecta / Isoptera	EN	(A1ac; B1, 2abc)
18	Cypris dravidensis	Oristacca / Podocopida	EN	B1, 2c
19	Cypris protubera	Oristacca / Podocopida	EN	(B1, 2ac)
20	Edocla maculatus	Insecta / Hemiptera	EN	(B1, 2c)
21	Hemihaematorrhophus planidorsatus	Insecta/Hemiptera	EN	(B1, 2c)
22	Heterometrus barberi	Arachnida / Scorpiones	EN	(B1, 2c)
23	Heterometrus keralensis	Arachnida/Scorpiones	EN	(B1, 2c)
24	Macrotermes estherae	Insecta/Isoptera	EN	(B1, 2abcd)
25	Ocnerodrilus occidentalis	Arachnida / Scorpiones	EN	(B1, 2c)
26	Ocypoda cordimana	Oristacca / Decapoda	EN	(B1, 2ac)
27	Ocypoda macrocera	Oristacca / Decapoda	EN	(B1, 2bc)
28	Paludomus monile	Pelecypoda / Megagastropoda	EN	(B1, 2b)
29	Speculitermes singalensis	Insecta / Isoptera	EN	(B1, 2c)
30	Strandesia bicornuta	Oristacca / Podocopida	EN	(B1, 2a)
31	Strandesia elongata	Oristacca / Podocopida	EN	(B1, 2a)
32	Strandesia flavescens	Oristacca / Podocopida	EN	(B1, 2a)
33	Strandesia purpurascens	Oristacca / Podocopida	EN	(B1, 2ac)
34	Streptogonopus jerdoni	Myriapoda / Polydesmida	EN	(B1, 2c)
35	Sulcospira hugeli	Pelecypoda / Megagastropoda	EN	(B1, 2ac)
36	Truxalis indica	Insecta / Orthoptera	EN	(B1, 2c)
37	Viviparus variata	Pelecypoda / Megagastropoda	EN	(B1, 2bc)

species), Low Risk - least concern (14 species) or Data Deficient (4 species). While 28 species were endemic to southern India, 13 were endemic to India. The assessment for the latter and non-endemics was only for southern India.

During the workshop we also attempted to rapidly prioritise invertebrate species on which we need to generate more information in order to make an assessment of their conservation status. A questionnaire was passed around the group to fill in data on 1) Year of description; 2) Number of studies concluded after description; 3) Number of studies concluded in the last 10 years; 4) Change in the habitat of the taxon in the last few years; and 5) endemicity of the taxon. Any taxon with more than three 'yes' was classified as 'study most urgently needed'. A total of 559 species were assessed in this manner of which 381 were grouped as 'study most urgently needed' (Table 4.1). This reflected the lack of studies on most of species especially in the last decade, recent changes in their habitat and endemicity of many species.

Table 4.1. The ratings of information needs for conservation assessment of species in some taxa of soil invertebrates based on information availability, endemism, and changes in habitat. Priority; *0* - very low, *1* - low, *2* - medium, *3* - high, *NI* - No information.

Group	*Total Spp.*	*0*	*1*	*2*	*3*	*NI*
Termites	94	3	3	7	81	0
Grass hoppers	93	32	29	7	15	0
Ants	91	0	0	0	17	74
Molluscs	241	0	0	0	240	1
Millipedes	40	1	1	3	28	7
Total	559	36	33	10	381	82

Recommendations

The important concerns of the participants and their recommendations are:

1. Lack of easily accessible documentation on standardised methods for surveying and monitoring of invertebrates in different habitats.
2. Lack of educational materials for invertebrates for conservation.
3. Lack of taxonomic expertise for many taxa in India.
4. Difficulties in accessing taxonomic collections (such as type specimens) and references due to loss, poor curation standards, and bureaucratic procedures.
5. The need for reference collections and literature to be maintained also at regional levels and for these to be made easily accessible.
6. Lack of funds for taxonomic studies.

5. Amphibians

Introduction

The amphibian fauna of India consists of 216 species. Among the relatively well-known taxa, India has the highest species richness and endemism among the amphibians, with two major centres of distribution; northeast India and Western Ghats. It is in the latter that amphibian species richness and endemism reach their peak. Of the 216 species reported from India, 120 species occur in the Western Ghats, 93 of them being endemic. Species richness and endemism are very high among some taxa e.g. 14 of 16 species of limbless amphibians (Caecilians) 29 out of 35 species of *Rhacophorus* or tree frog, and 35 out of nearly 50 species of Ranidae. Almost all the species are found in the rain forest all the endemics are confined to it. The amphibians are considered the true autochthonous elements of peninsular India unlike the higher vertebrates which are relatively recent arrivals from the northeast or northwest India. With limited powers of dispersal, the amphibians of the peninsular India underwent extensive speciation over the long period of time that they have been in the area. The amphibians in India are beginning to be studied in detail (Dutta 1997), and several species are being discovered even now. Many of the species still remain single locality records, dating back often up to 100 years when these species were originally described. The taxonomic status of many of the species (*e.g.* the *Philautus* species complex) is even now far from clear. The limbless amphibians or caecilians are another example. The life history, microhabitat preference, and the factor affecting the distribution of most species are unknown.

It is now being increasingly realised that the amphibians, along with many of the reptiles and other lower vertebrates and invertebrates, might have considerable patchiness in their distribution. It emerges from the last few years of research that the overall high species richness is due to a high turnover of species from one area to another. This patchiness in distribution has major implications in the design and management of protected area networks.

The Assessment

The CAMP workshop on amphibians was held Bhubaneswar from 21 to 26 April 1997, Dr. Sushil Dutta, Utkal University and Orissa Forest Department being the local hosts. A total of 25 experts from as many organisations participated in the workshop. The workshop venue was the Institute of Cooperative Management. A total of 207 species complied by Dr. Sushil Dutta was placed before the participants.

Out of 207 species, 40 species were Data Deficient and four more were Not Evaluated (Table 5.1). Out of the 163 species that were evaluated, 93 (57.1%) were categorised as threatened, 10 (6.1%) being Critically Endangered, 42 (25.8%) Endangered, and 41 (25.1%) Vulnerable. Out of 100 endemics that were assessed 73 were threatened, 10 being Critically Endangered, 24 Endangered, and 39 Vulnerable. In contrast, only 20 (30.3%) of the 66 non-endemics were threatened, none being Critically Endangered. Thus the endemics are more likely to be threatened than non-endemics. This is not surprising since restricted distribution was one of the major criteria used in the assessment of amphibians.

As expected, the major centres of threatened species are the Western Ghats, northeast India and Himalaya (almost all species being in Eastern Himalaya) (Table 5.2). One species *Hoplobatrachus tigerinus* was assessed regionally vulnerable in northeast India. Andean and Nicobar Islands have five threatened species. The greater number of Critically Endangered species in the northeast is due to very restricted distribution (often single records) of many species and decline in habitat quality.

Of the 10 families of amphibians in India, Ranidae alone accounts for 83 species, and Rhacophoridae for 60 species. The other most speciose Families are Bufonidae (22 species) and Microhylidae (17 species). The three Families of limbless amphibians (Ichthyophidae, Uraeotyphlidae and Caecilidae) together have 18 species. The number of threatened species in these major Families is given in Table 5.3.

There were some differences among the Families in the number of threatened species. All 18 species of caecilians (in 3 Families) were threatened, as also 56% of the 40 assessed species in Rhacophoridae (tree frogs). In contrast, only 33.3% each of Bufonidae (18 assessed species) and Microhylidae (15 assessed species) were threatened. Ranidae also had fewer species that are threatened, 50% of the 66 assessed species. This to a large extent reflects the higher level of endemism and restricted distribution (mostly to wet evergreen forest) in rhacophorids and caecilians, and their greater sensitivity to ecological changes. In contrast, bufonids and microhylids are widely distributed and are tolerant of ecological changes.

Table 5.1. List The number of species of endemic and non-endemic amphibians in the different IUCN Red Categories

Category	*Endemics*	*Non-endemics*	*Total*
Critically Endangered (CR)	10	0	10
Endangered (EN)	24	18	42
Vulnerable (VU)	39	2	41
Low risk-nt (LR-nt)	20	40	60
Low risk-lc (LR-lc)	7	6	13
Data Deficient (DD)	30	10	40
Not evaluated (NE)	3	1	4
Total	133	77	210

Table 5.2. The distribution of threatened species of amphibians in the different biogeographic zones (Rodgers & Panwar 1988)

	Biogeographic Zone	*CR*	*EN*	*VU*	*Total*
1	Trans-Himalaya	-	-	-	-
2	Himalayas	-	10	5	15
3	Deserts	-	-	-	-
4	Semi-arid	-	-	-	-
5	Western Ghats	1	17	31	49
6	Deccan Peninsula	-	-	-	-
7	Gangetic plains	-	-	-	-
8	Northeast	8	16	4	28
9	Islands	-	5	-	5
10	Coast	-	-	-	-

Reasons for Endangerment

Criterion B was the most frequently used while assessing amphibians, forming more than 50% of the assessments as the single criterion used and a further 30% in combination with criteria C and A. Criterion A (population decline) was used for only five species (*e.g. Hoplobatrachus tigerinus*) that have been extensively harvested. Except for these, harvesting from the wild was not considered a major threat for any species. The most frequently reported threats were population fragmentation for almost all the species that occur in the Western Ghats and northeast, and reduction in habitat quality. The latter results from degradation of forests, excessive use of insecticides in agricultural fields, changes in soil pH due to use of lime in coffee estate (*e.g.* Caecilians), excessive use of pesticides and fertilisers in tea estates *etc*. The global decline in amphibian populations due to various reasons (increased UV radiation, pesticides, diseases, *etc.*) was also a general concern.

Recommendations

1. The CAMP workshop process allowed sharing of hitherto unpublished information and thus enabled as assessment of many more species than what was thought possible. However nearly 20% of the species

Table III. List of 34 amphibians prioritised for conservation based on revised IUCN criteria out of 163 species that were evaluated. (CR=Critically Endangered; EN=Endangered)

Sl. No	*Species*	*Family*	*IUCN Category*	*IUCN Criteria*
	Endemics			
1	Bufoides meghalayanus	Bufonidae	CR	(B1, 2a, 2b, 2c)
2	Indotyphlus battersbyi	Caeciliidae	CR	(B1, 2b, 2c)
3	Limnonectes mawlyndipi	Ranidae	CR	(B1, 2a, 2c)
4	Limnonectes mawphlangensis	Ranidae	CR	(B1, 2a, 2c)
5	Limnonectes mysorensis	Ranidae	CR	(B1, 2c)
6	Pedostibes kempi	Bufonidae	CR	(B1, 2a, 2b, 2c)
7	Philautus garo	Rhacophoridae	CR	(B1, 2b, 2c)
8	Philautus kempiae	Rhacophoridae	CR	(B1, 2a, 2b, 2c)
9	Philautus shillongensis	Rhacophoridae	CR	(B1, 2a, 2b, 2c)
10	Rana senchalensis	Ranidae	CR	(B1, 2a, 2b, 2c)
11	Ansonia ornata	Bufonidae	EN	(B1, 2c)
12	Ansonia rubigina	Bufonidae	EN	(B1, 2c, 3b)
13	Bufo koynayensis	Bufonidae	EN	(B1, 2c)
14	Euphlyctis ghoshi	Ranidae	EN	(B1, 2a, 2b, 2c)
15	Gegeneophis ramaswamii	Caeciliidae	EN	(B1, 2c)
16	Ichthyophis bombayensis	Ichthyophiidae	EN	(B1, 2c)
17	Ichthyophis tricolor	Ichthyophiidae	EN	(B1, 2c)
18	Limnonectes murthii	Ranidae	EN	(B1, 2c)
19	Limnonectes nilagirica	Ranidae	EN	(B1, 2c)
20	Limnonectes shompenorum	Ranidae	EN	(B1, 2a, 2b, 2c)
21	Megophrys robusta	Pelobatidae	EN	(B1, 2c)
22	Micrixalus gadgili	Ranidae	EN	(B1, 2c)
23	Micrixalus thampii	Ranidae	EN	(B1, 2c)
24	Nyctibatrachus humayuni	Ranidae	EN	(B1, 2c)
25	Nyctibatrachus sanctipalustris	Ranidae	EN	(B1, 2c)
26	Philautus bombayensis	Rhacophoridae	EN	(B1, 2c)
27	Philautus cherrapunjiae	Rhacophoridae	EN	(B1, 2a, 2c)
28	Philautus temporalis	Rhacophoridae	EN	(B1, 2c)
29	Phrynoglossus borealis	Ranidae	EN	(B1, 2c)
30	Polypedates insularis	Rhacophoridae	EN	(B1, 2a, 2b, 2c)
31	Rana garoensis	Ranidae	EN	(B1, 2a, 2b, 2c)
32	Rana khare	Ranidae	EN	(B1, 2c)
33	Rhacophorus lateralis	Rhacophoridae	EN	(B1, 2c)
34	Uraeotyphlus malabaricus	Uraeotyphlidae	EN	(B1, 2c)

Table 5.3. The number of species in different categories of threat in the major amphibian families in India.

Family	*CR*	*EN*	*VU*	*DD*	*Assessed*
Ranidae	8	12	13	17	83
Rhacophoridae	3	12	11	20	60
Caecilians	1	4	13	-	18
Bufonidae	2	3	1	-	22
Microhylidae	-	2	3	2	17

were totally data deficient even with reference to distribution and habitat. The large number of species with restricted distribution, which were assessed on that basis, was also of concern since it was felt that a comprehensive survey might widen their distribution. The recent discovery of *Melanobatrachus indicus* from Kalakkad, nearly 300 km from its known distribution locality is a typical example. Therefore a comprehensive survey needs to be initiated, focussed on the data deficient species and those with very restricted distribution

2. The almost total lack of information on microhabitat preferences, population densities, and life history is a matter of concern. This information would enable a more reliable assessment and monitoring of species. There is thus an urgent need to promote such studies.
3. Periodic monitoring of populations of amphibians needs to be initiated in forested areas and outside.
4. Taxonomy of certain groups such as *Philautus* complex and caecilians needs to be researched so that current ambiguities can be removed. The lack of field guide to the identification of species was a serious handicap to the field ecologists. Taxonomic ambiguities are also a major hindrance while carrying out field ecological studies.
5. The loss of type specimens and inaccessibility to reference collections were major problems. The need for an easily accessible central repository for type specimens and regional repositories were identified as solutions. The loss of type specimens of 13 species described by C.N.Rao in 1937, highlights the problems of poor and declining curation standards.
6. Several species have been recommended for captive breeding with an assessment of the level of difficulty. The current lack of interest in exhibits of amphibians in Indian zoos needs to be addressed. Species that are harvested in the wild for laboratory use and food have also been recommended for captive breeding.
7. Involvement of local people, especially students, in periodic monitoring or "frog watch" would not only enable monitoring but also increase conservation awareness.
8. Given that decreasing quality of the habitat of species with restricted distribution is the main threat, the major management recommendations pertain to habitat management. The activities include prevention of forest degradation especially wet evergreen forest in the Western Ghats and northeast India, control of the use of pesticides, and promotion of amphibian friendly agriculture crops near forested areas (*e.g.* coffee instead of tea and rubber).

6. Reptiles

Introduction

India has a rich reptile fauna with nearly 490 species. Endemism is also remarkably high, being about 40%. As in the case of amphibians, Western Ghats and northeast India (including eastern Himalayas) form the two major centres of reptile distribution. The Western Ghats has nearly 180 species with about 50% endemism. Among the notable endemic groups are the fossorial shield tail snakes or uropeltids, with 33 endemic species and pit vipers (7 endemics) and agamid lizards (7 endemics). Species richness is equally high in northeast India but as is the case with other animals, endemism is low since most species are also found in the neighbouring countries of Bhutan, Myanmar, and Bangladesh.

Unlike the amphibians, reptile species richness is also high in the other biogeographic zones of India, especially the Deccan peninsula and Gangetic plains. This is due to the presence of crocodiles (3 species), several species of turtles and tortoises associated with the major river systems, and several species of snakes. The coastal zone is also species rich because of marine turtles. Several species of snakes and a few lizards are also found in the desert and semi-arid zones. The only area that is relatively species poor is the Trans-Himalaya zone.

Unlike amphibians and most of the other animal taxa, many species of reptiles are harvested from the wild for food (*e.g.* turtles), skins (many species of snakes, crocodiles and monitor lizards) medicine (*e.g. Uromastyx*), and pet trade (*e.g.* turtles and snakes) or for other uses. This has been a major reason for the decline in the population of some of these species (*e.g.* crocodiles) in the wild.

Even though a few species (crocodiles and turtles) have been the subject of considerable research and conservation action (such as captive breeding and release) the distribution and ecology of most of the reptiles have remained unstudied except for surveys by ZSI and recent studies in the Western Ghats (Easa *et al.* In prep; Anon 1997). However, our current knowledge of reptiles is limited to distribution and macro habitat preferences.

Assessment

The CAMP workshop on reptiles was held in the State Forest Service College, Coimbatore, from 19 to 23 May 1997. Nearly 40 experts from 23 organisations participated in the workshop. A list of 495 species prepared by Dr.Indraneil Das was placed before the participants for assessment. Of these 133 species (55 endemics and 78 non-endemics) were considered Data Deficient and 26 non-endemics were not evaluated for want of concerned experts. For some widely distributed species only regional assessments were made.

Table 6.1. The number of species of endemic and non-endemic reptiles in the different IUCN Red List Categories

Category	*Endemics*	*Non-endemics*	*Total*
Critically Endangered (CR)	18	16	34
Endangered (EN)	34	20	54
Vulnerable (VU)	35	45	80
Low risk-nt (LR-nt)	31	65	96
Low risk-lc (LR-lc)	26	46	73
Data Deficient (DD)	55	78	133
Not evaluated (NE)	0	26	26
Total	199	296	495

Of the 362 species that were assessed, 168 species (46.4%) were categorised threatened, 34 (9.4%) being Critically Endangered, 54 (14.9%) Endangered and 80 (22.1%) Vulnerable. Reptiles in India belong to 26 families. However, six families form 260 species out of the 362 that were assessed. These families are Agamidae (28 species), Bataguridae (26 species), Colubridae (107 species), Geckonidae (43 species), Scincidae (38 species) and Uropeltidae (18 species). There were no major differences among these families in threatened status, the percentage of threatened species varying from 38.5% to 61 %. In all families, the endemics had a higher percentage of threatened species (57% to 68%) than non-endemics (14% to 50%). This is only expected however since the endemics have a restricted distribution and hence are more likely to be threatened according to the criterion (criterion B) that was used extensively while assessing reptiles.

As in the case of other taxa, the Western Ghats, north-east India, and Himalaya (especially Eastern Himalaya) harbour the largest numbers of threatened reptiles, reflecting the high species richness in these areas. However other zones also have moderate numbers of threatened reptiles, largely because of the turtles, crocodiles and few snakes that are in these zones. Especially important are the Deccan peninsula and Gangetic plains, Coast and Islands.

Reasons for endangerment

Most species (135) were considered threatened due to their restricted distribution, fragmented population and declining habitat quality (criterion B). Population decline (criterion A) was the reason for the threatened status of 17 species These included four species of marine turtles (*Dermochelys coracea, Lepidochelys oilvacea, Geoclamys hamiltoni* and *Handella thurjI*) and nine species of island turtles (*Kachuga kachuga, K. dhongoka, K.sylhetensis, K.tentoria, Geochelone elegans*, etc.), two species of agamid lizards (*Uromastyx hardwickii* and *Chamaeleo zeylanicus*), *Varanus benghalensis* and *Erix conicus*. Trade was considered a major factor in only four species (*Geochelone elegans, Chamaeleo zeylanicus, Varanus bengalensis* and *Eryx conicus*). Harvesting for food was a major factor for 11 species, most of these were assessed on criterion A (population decline). Harvest for medicinal use was a major factor in the case of *Uromastyx hardwickii*.

Table 6.2. The distribution of threatened species of reptiles in the different biogeographic zones of India (Rodgers & Panwar 1988).

	Biogeographic Zone	*CR*	*EN*	*VU*	*Total*
1	Trans-Himalaya	-	-	-	-
2	Himalayas	10	6	17	33
3	Deserts	-	-	4	4
4	Semi-arid	-	-	7	7
5	Western Ghats	8	22	33	63
6	Deccan Peninsula	3	7	16	26
7	Gangetic plains	1	1	14	16
8	Northeast	8	10	33	51
9	Islands	5	6	2	13
10	Coast	2	6	2	10

Recommendations

The major recommendations given for management and research of reptiles include:

1. Survey of data deficient and restricted range species, as in the case of amphibians.
2. Inclusion of some species in Schedules of Wildlife Protection Act that gives better protection.
3. Captive breeding for release into the wild for species that have been over harvested in the wild.
4. Periodic monitoring of species that have shown population decline.
5. Better taxonomic and curation standards, as in the case of amphibians.

Table IV. List of 84 reptiles prioritised for conservation based on revised IUCN criteria, out of 336 species that were evaluated. (CR=Critically Endangered; EN=Endangered)

Sl. No	*Taxon*	*Common name*	*Family*	*IUCN Category*	*IUCN Criteria*
	Endemics				
1	Chalcides pentadactylus	5-toed skink	Scincidae	CR	(B1, 2b)
2	Cnemaspis goaensis	Goa day gecko	Gekkonidae	CR	(B1, 2c)
3	Cnemaspis nairi Inger	Ponmudi day gecko	Gekkonidae	CR	(B1, 2ac)
4	Cyrtodactylus malcolmsmithi	Smith's bent-toed gecko	Gekkonidae	CR	(B1, 2c)
5	Cyrtodactylus mansarulus	Jammu bent-toed gecko	Gekkonidae	CR	(B1, 2c)
6	Eumeces poonaensis	Pune mole skink	Scincidae	CR	(B1, 2abc)
7	Japalura major	Large mountain lizard	Agamidae	CR	(B1, 2c)
8	Lycodon tiwarii	Tiwari's wolf snake	Colubridae	CR	(B1, 2c)
9	Lygosoma pruthi	Pruth's supple snake	Scincidae	CR	(B1, 2c)
10	Mictopholis austeniana	Abor Hills agama	Agamidae	CR	(B1, 2c)
11	Naja sagittifera	Andaman cobra	Elapidae	CR	(B1, 2c)
12	Oligodon nikhili	Palni Hills kukri snake	Colubridae	CR	(B1, 2cde)
13	Rhabdops olivaceus	Olive forest snake	Colubridae	CR	(B1, 2c)
14	Trimereurus huttoni	Hutton's pit viper	Viperidae	CR	(B1, 2c)
15	Typhlops tennuicollis	Slender necked worm snake	Typhlopidae	CR	(B1, 2c)
16	Uropeltis dindigalensis	Dindigal shield-tail snake	Uropeltidae	CR	(B1, 2c)
17	Ahaetulla perroteti	Bronze-headed vine snake	Colubridae	EN	(B1, 2c)
18	Barkudia insularis	Barkud Island limbless skink	Scincidae	EN	(B1, 2c)
19	Boiga dightoni	Travancore cat snake	Colubridae	EN	(B1, 2c)
20	Brachyophidium rhodogaster	Red-bellied shield-tail snake	Uropeltidae	EN	(B1, 2c)
21	Bronchocela danieli	Daniel's forest lizard	Agamidae	EN	(B1, 2c)
22	Calliophis bibroni	Bibron's coral snake	Elapidae	EN	(B1, 2c)
23	Calodactylodes aureus	Indian golden gecko	Gekkonidae	EN	(B1, 2bd)
24	Cnemaspis sisparensis	Sispara day gecko	Gekkonidae	EN	(B1, 2ac)
25	Cnemaspis wynadensis	Wynad day gecko	Gekkonidae	EN	(B1, 2bc)
26	Dasia nicobarensis	Nicobar tree skink	Scincidae	EN	(B1, 2abc)
27	Dibamus nicobaricum	Nicobar worm lizard	Dibamidae	EN	(B1, 2c)
28	Dinodon gammiei	Sikkim false wolf snake	Colubridae	EN	(B1, 2c)

Contd. . . .

Sl. No	*Taxon*	*Common name*	*Family*	*IUCN Category*	*IUCN Criteria*
29	Enhydris dussumieri	Dussumier's smooth water snake	Colubridae	EN	(B1, 2c)
30	Hemidactylus prashadi	Prashad's gecko	Gekkonidae	EN	(B1, 2c)
31	Hemidactylus subtriedrus	Jerdon's gecko	Gekkonidae	EN	(B1, 2c)
32	Mabuya allapallensis	Allapalli grass skink	Scincidae	EN	(B1, 2c)
33	Mabuya clivicola Inger	Ponmudi skink	Scincidae	EN	(B1, 2c)
34	Mabuya nagarjuni	Nagarjunasagar grass skink	Scincidae	EN	(B1, 2c)
35	Oligodon juglandifer	Darjeeling kurki snake	Colubridae	EN	(B1, 2bcd)
36	Oligodon travancoricum	Travancore kukri snake	Colubridae	EN	(B1, 2abc)
37	Oriocalotes paulus	Small forest lizard	Agamidae	EN	(B1, 2c)
38	Platyplectrurus madurensis	Madura shield-tail snake	Uropeltidae	EN	(B1, 2c)
39	Salea anamallayana	Anamalai spiny lizard	Agamidae	EN	(B1, 2ac)
40	Salea horsfieldii	Horsfield's (Nilgiri) spiny lizard	Agamidae	EN	(B1, 2ac)
41	Sepsophis punctatus	Spotted Eastern Ghats skink	Scincidae	EN	(B1, 2bd)
42	Typhlops oligolepis	Wall's worm snake	Typhlopidae	EN	(B1, 2c)
43	Uropeltis liura	Ashambu shield-tail snake	Uropeltidae	EN	(B1, 2c)
44	Uropeltis maculatus	Red-sided shield-tail snake	Uropeltidae	EN	(B1, 2c)
45	Uropeltis pulneyensis	Palani shield-tail snake	Uropeltidae	EN	(B1, 2c)
46	Uropeltis rubromaculatus	Red-spotted shield tail snake	Uropeltidae	EN	(B1, 2c)
47	Uropeltis woodmasoni	Black-bellied shield tail snake	Uropeltidae	EN	(B1, 2c)
48	Xylophis stenorhynchus	Gunther's arrow-headed snake	Colubridae	EN	(B1, 2c)
	Non-endemics				
49	Batagur baska baska	Common river terrapin	Bataguridae	CR	(C2a)
50	Calotes versicolor farooqi	Kashmir garden lizard	Agamidae	CR	(B1, 2c)
51	Chrysopelea paradisi	Red-spotted flying snake	Colubridae	CR	(B1, 2c)
52	Dasia halianus	Haly's tree skink	Scincidae	CR	(B1, 2abc)
53	Homalopsis buccata	Puff-faced water snake	Colubridae	CR	(B1, 2c)
54	Japalura kumaonensis	Kumaon mountain lizard	Agamidae	CR	(B1, 2c)
55	Kachuga sylhetensis	Assam roofed turtle	Bataguridae	CR	(A1ac)
56	Lygosoma bowringai	Bowring's supple skink	Scincidae	CR	(B1, 2c)

Contd. . . .

Sl. No	*Taxon*	*Common name*	*Family*	*IUCN Category*	*IUCN Criteria*
57	Naja oxiana	Black cobra	Elapidae	CR	(B1, 2c)
58	Ophiodrys doriae	???? snake	Colubridae	CR	(B1, 2c)
59	Pareas macularius	Darjeeling snail-eater	Colubridae	CR	(B1, 2c)
60	Ptychozoon kuhli	Kuhl's gliding gecko	Gekkonidae	CR	(B1, 2c)
61	Salea kakhienensis	Kakhyen hills spiny lizard	Agamidae	CR	(B1, 2c)
62	Trachischium guentheri	Gunther's oriental slender snake	Colubridae	CR	(B1, 2c)
63	Trachischium monticolum	Assam oriental slender snake	Colubridae	CR	(B1, 2c)
64	Trachischium tenuiceps	Orange-bellied oriental slender snake	Colubridae	CR	(B1, 2c)
65	Ahaetulla prasina	Oriental vine snake	Colubridae	EN	(B1, 2c)
66	Amphiesma modesta	Gunther's keelback	Colubridae	EN	(B1, 2c)
67	Amphiesma parallela	Boulenger's keelback	Colubridae	EN	(B1, 2c)
68	Chelonia mydas	Green turtle	Chelonidae	EN	(B1, 2c)
69	Crocodylus porosus	Salt-water crocodile	Crocodylidae	EN	(B1, 2c; C2a)
70	Dasia oliveceae	Olive tree skink	Scincidae	EN	(B1, 2acd)
71	Dendrelaphis bifrenalis	???? tree snake	Colubridae	EN	(B1, 2c)
72	Dermochelys coriacea	Leather-back sea turtle	Dermochelyidae	EN	(A1cd)
73	Dinodon septentrionalis	Gunther's false wolf snake	Colubridae	EN	(B1, 2c)
74	Eretmochelys imbricata	Hawk's bill sea turtle	Chelonidae	EN	(A1c)
75	Gavialis gangeticus	Gharial	Gavialidae	EN	(B1, 2c; C2a)
76	Lepidochelys olivacea	Olive Ridley sea turtle	Chelonidae	EN	(A1c)
77	Mabuya multicarinata	???? skink	Scincidae	EN	(B1, 2c)
78	Mabuya rudis	Lined grass skink	Scincidae	EN	(B1, 2c)
79	Melanochelys trijuga thermalis	Red-spotted black turtle	Bataguridae	EN	(B1, 2c)
80	Oligodon cinereus	Black-barred kukri snake	Colubridae	EN	(B1, 2c)
81	Oligodon cyclurus	??? kukri snake	Colubridae	EN	(B1, 2c)
82	Oligodon erythrogaster	Red-bellied kukri snake	Colubridae	EN	(B1, 2c)
83	Ptyctolaemus gularis	Green fan-throated lizard	Agamidae	EN	(B1, 2c)
84	Takydromus sexlineatus khasiensis	Khasi hills long-tailed lizard	Lacertidae	EN	(B1, 2c)

7. Mangrove Organisms

Introduction

The need to assess the conservation status of marine organisms was strongly felt during the Project Design Workshop of BCPP held in April 1996. Even though some of the marine organisms would be covered while assessing mammals and reptiles, these would form only a very small part of the species rich marine ecosystem. Coral reef was therefore suggested as a marine ecosystem that could be assessed. Later, however, this was found to be not feasible due to several reasons. The very high species richness itself was a problem, the lack of experts on most of these being another. Yet another problem was that the concept of species itself was debatable for many taxa. It was at this stage that assessing organisms of the mangrove ecosystem itself was suggested by National Institute of Oceanography, especially Dr. A.G.Untawale. This was more attractive than the coral reef for several reasons. Mangrove is a unique ecosystem, which plays very important ecological roles, from a human perspective. It prevents sea erosion, and is an important breeding ground for many fishes and invertebrates of food value to man. Recently, its importance in the context of global warming has also been recognised. Mangroves in India has undergone tremendous reduction in area and is in most places reduced to small isolated patches, the exceptions being Sunderbans , Bitarkanika, and Andean and Nicobar Islands. Along the west coast, the mangroves have almost totally been lost in Kerala and Karnataka, and only highly disturbed patches remain in Goa, Maharashtra and Gujarat. It is in this context that the urgent need to conserve this ecosystem has been recently recognised and several conservation measures initiated by several agencies. However, no assessment of the conservation status of the species that make the mangrove ecosystem has been made. It was in this context that we conducted the CAMP workshop on organisms of the mangrove ecosystem.

The mangroves are unique otherwise too. Because of the harsh environment, species richness is relatively low especially among the plants. Like most other marine organisms, mangrove organisms disperse over long distances, are widely distributed and hence show low levels of endemism. Many plant species are however endemic to the mangrove ecosystem. With high dispersal capabilities the concept of population fragmentation is often a difficult concept to apply to mangrove organisms. Finally, while most of the mangrove plants belonging to very few Families are mostly confined to mangroves, the animal species are also found elsewhere, except for a few species. It is likely, however, that many species pass their critical life history stages in the mangroves. This is very little known. Indeed, while mangrove plants have been relatively well studied, this is not the case with animal species. Among the forested ecosystems, mangroves are the most disturbed by man, through clear felling, logging,, grazing, fishing, and by damming and pollution of rivers upstream.

Assessment

The CAMP workshop on mangrove organisms was held from 21 to 25 July 1997, at the National Institute of Oceanography, Goa, Dr.A.G.Untawale being the local host. About 40 experts from 25 organisations participated. The participants were divided into several working groups; two for mangrove plant, one group each for mangrove algae, invertebrates and fishes. In total 176 species were assessed, 60 plants, 23 algae, 41 invertebrates, and 51 fishes.

Given the uniqueness of the mangrove ecosystem all the participants were of the opinion that the components of the system should not be evaluated in isolation of the system as a whole.

Mangrove Plants

A total of 60 species were considered of which 59 species were assessed. The only species reportedly endemic mangrove plant in India, *Rhizophora annamalayana* from Pichavaram in the east coast, was not evaluated. The participants concluded that this was a sterile hybrid between *R. apiculata* and *R. mucronata*, and thus may not be a valid species.

All the mangrove plants that occur in India are widely distributed in the world especially in the Malaysian and Australian region, many extending to Africa and South America. Thus, the mangroves in India (as elsewhere) are relatively species poor (59 species), as well as poor in endemics. However, within the Indian political boundary, 57 out of 59 assessed species were categorised as threatened. Compared to other taxa, a large percentage of these were also in higher threatened categories; 12 (20.3%) were Critically Endangered and 42 (71.1%) were Endangered. This reflected the extensive loss of mangrove forests, hence the population decline of many species (criterion A), and restricted and fragmented distribution of most species within India (criterion B). The extensive loss of mangrove along the west coast compared to the east coast was also reflected in the distribution of species; 17 species occur only in the east coast compared to only 3 species reported only from the west coast within India. Two species have been reported only from the Andean and Nicobar Islands. Only a few species occur in the east and west coasts and Andean and Nicobar Islands (11 species), while 26 species occur in the east and west coast. The patchiness on the distribution of species is partly due to the lack of studies, especially in the Andean and Nicobar Islands. It is also due to local extinctions especially along the west coast. It is likely that nearly 15 species might have become extinct from the west coast.

Reasons for Endangerment

Even though there has been extensive loss of mangroves in the last many decades only 8 species were categorised using the population decline criterion (criterion A). In contrast, most species were categorised as threatened on the basis of criterion B either alone (43 species) or in combination with other criteria. Thus highly restricted distribution of most species is considered the major threat. The decline in habitat quality due to pollution, siltation, timber harvesting, was the assessed sub criteria. However, over exploitation especially for timber and firewood is identified as a major threat, with local trade in most of the species. A few species (5) are over exploited for medicinal use and some as fodder (2 species) or a few other uses (5 species). Thus mangroves have relatively few species but nearly all of these are threatened and more than half of these are used or over exploited for timber, fire wood, fodder, medicinal use and for other use.

Table 7.1. The number of species of mangrove plants, algae, invertebrates and fishes in different IUCN Red List Categories

Category	*Plants*	*Algae*	*Invertebrates*	*Fishes*
Critically Endangered (CR)	12	2	1	-
Endangered (EN)	42	12	4	1
Vulnerable (VU)	3	-	3	9
Low risk-nt (LR-nt)	1	8	17	40
Low risk-lc (LR-lc)	1	1	15	2
Data Deficient (DD)	-	-	-	-
Not evaluated (NE)	1	1	1	-
Total	60	23	41	76

Mangrove algae

Out of 624 species of marine macro algae that occur along the Indian coast, 48 species have been reported from the mangrove. Of these, 23 species belonging to three major groups were assessed: green algae (Chlorophyta), brown algae (Phaeophyta) and red algae (Rhodophyta). Marine algae have important industrial applications as dyes and bioactive substances. The Algae subgroup felt that the information available on marine algae of the Indian coast was very limited, and this might affect the quality of assessment. Moreover many of the species that were assessed might also occur in the open sea. Out of the 23 species that were assessed 14 were threatened, two being Critically Endangered and 12 being Endangered. As in the case of plants, all assessed algae are widely distributed in the world. There was no major difference between the east and west coasts, with two species reported only from the east coast and three from west coast. This is more likely a result of inadequate survey as indicated by the few species (11) reported from Andean and Nicobar Islands.

Reasons for Endangerment

All 14 species were assessed threatened applying criterion B, restricted and fragmented population in combination with declining habitat quality. However, as the participants observed, many of these algae might also occur in the open sea and thus may not have fragmented population. Only one of the assessed species, *Gracilaria verrrucosa*, had usage, in agar industry.

Invertebrates

About 500 species of invertebrates occur in the Indian mangroves. Insects constitute more than half of these but most of them are visitors than residents. Mollusc, Crustaceans, and Polychaetes form most of the resident invertebrates. The working group on invertebrates mostly concentrated on the resident invertebrate fauna, rather than the visitors. The assessed species consisted of Mollusc (17 species), Crustacean, (mostly shrimps, 9 species), crabs (13 species), moths (3 species) and one butterfly. Among these only eight species were categorised as threatened, one being Critically Endangered, 4 Endangered and 3 Vulnerable. Only two of the threatened species were harvested (*e.g. Geloinea crosa* and *Meretrix casta* both mangrove clams). Most of the assessed species were widely distributed in the world. The species probably endemic to India include the wild silk moth (*Attacus mcmulleri*) endemic to the Andean Islands, and the Andean blue Nawab butterfly (*Polyura schreiber*). Criterion B was again the most frequently used criterion (for 8 species). The major reason for only a few species to be threatened was that most of the assessed invertebrates also occurred outside the mangroves. Crabs were the most likely to be threatened (4 out of 13 species) than others.

Fishes

A total of 52 species of fishes of mangrove were assessed of which none was Critically Endangered, only one was Endangered and 9 were Vulnerable. Excessive harvesting

Table V. List of 75 mangrove organisms prioritised for conservation based on revised IUCN criteria, out of 176 species that were evaluated. (CR=Critically Endangered; EN=Endangered).

Sl.No	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
	Algae			
	Endemics			
1	Dichotomosiphon salina	Codiaceae	CR	(B1, 2bcd)
	Non-endemics			
2	Ulva patengansis	Ulvaceae	CR	(B1, 2c)
3	Bostrychia tenella	Polysiphonaceae	EN	(B1, 2c)
4	Caloglossa leprieurii	Catnellaceae	EN	(B1, 2c)
5	Catnella impudica	Catnellaceae	EN	(B1, 2c)
6	Catnella repens	Catnellaceae	EN	(B1, 2c)
7	Chaetomorpha linum	Cladophoraceae	EN	(B1, 2abc)
8	Codium fragile	Codiaceae	EN	(B1, 2c)
9	Dictyota indica	Dictyotaceae	EN	(B1, 2a)
10	Gracilaria verrucosa	Gracilariaceae	EN	(B1, 2bc)
11	Monostroma oxyspermum	Monostromataceae	EN	(B1, 2c)
12	Rhizoclonium ciperium	Rhizocloniaceae	EN	(B1, 2c)
13	Ulva reticulata	Ulvaceae	EN	(B1, 2c)
14	Vaucheria prescottii	Vaucheraiceae	EN	(B1, 2c)
	Marine fishes			
	Non-endemics			
15	Boleophthalmus dussumieri	Gobiidae	EN	(B1, 2c)
16	Scartelaos viridis	Gobiidae	EN	(A1ac; B1, 2c)
	Mangrove Invertebrates			
	Non-endemics			
19	Cardisoma carnifex	Gecarcinidae	CR	(A1c)
20	Geloina erosa	Geloindae	EN	(B1, 2c)
21	Macrophthalmus convexus	Ocypodidae	EN	(B1, 2c)

Contd....

Sl.No	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
22	Pilodius nigrocrinitus	Xanthidae	EN	(B1, 2c)
23	Uca tetragonon	Ocypodidae	EN	(B1, 2c)
	Mangrove - Plants			
	Endemics			
24	Heretiera kanikensis	Sterculiaceae	CR	(B1, 2c; C2b; D)
25	Urochondra setulosa	Poaceae	EN	(B1, 2c)
	Non-endemics			
26	Acanthus ebracteatus	Acanthaceae	CR	(B1, 2c)
27	Acanthus volubilis	Acanthaceae	CR	(B1, 2c)
28	Avicennia alba	Avicenniaceae	CR	(A1a, 1c)
29	Avicennia marina var. resinifera	Avicenniaceae	CR	(B1, 2bcd; D)
30	Bruguiera gymnorrhiza	Rhizophoraceae	CR	(A1cd)
31	Bruguiera parviflora	Rhizophoraceae	CR	(A1cd)
32	Finlaysonia obovata	Asclepiadaceae	CR	(B1, 2c)
33	Lumnitzera littorea	Combretaceae	CR	(B1, 2c)
34	Rhizophora lamarckii	Rhizophoraceae	CR	(B1, 2c; C2a)
35	Rhizhophora stylosa	Rhizophoraceae	CR	(B1, 2c)
36	Sonneratia griffithii	Sonneratiaceae	CR	(B1, 2c)
37	Acanthus ilicifolius	Acanthaceae	EN	(B1, 2c)
38	Aegialitis rotundifolia	Plumbaginaceae	EN	(B1, 2c)
39	Aegiceras corniculatum	Myrsinaceae	EN	(B1, 2c)
40	Aeluropus lagopoides	Poaceae	EN	(B1, 2b)
41	Aglaia cuculata	Meliaceae	EN	(B1, 2c)
42	Avicennia marina var. acutissima	Avicenniaceae	EN	(A1c, 1d)
43	Avicennia officinalis	Avicenniaceae	EN	(B1, 2b)
44	Brownlowia tersa	Tiliaceae	EN	(B1, 2c)
45	Bruguiera cylindrica	Rhizophoraceae	EN	(A1cd, 2d; B1, 2c)

Contd. . . .

Sl.No	Taxon	Family	IUCN Category	IUCN Criteria
46	Cenchrus ciliaris	Poaceae	EN	(B1, 2c)
47	Cerbera manghas	Apocynaceae	EN	(B1, 2c)
48	Ceriops decandra	Rhizophoraceae	EN	(A1cd, A2d; B1, 2c)
49	Ceriops tagal	Rhizophoraceae	EN	(B1, 2ac)
50	Clerodendrum inerme	Verbenaceae	EN	(B1, 2c)
51	Cynometra ramiflora	Fabaceae	EN	(B1, 2c)
52	Derris heterophylla	Fabaceae	EN	(B1, 2c)
53	Derris trifoliata	Fabaceae	EN	(B1, 2c)
54	Halophila beccarii	Hydrocharitaceae	EN	(B1, 2cd)
55	Heretiera fomes	Sterculiaceae	EN	(B1, 2bc)
56	Heretiera littoralis	Sterculiaceae	EN	(A2bcd; B1, 2c, 2d)
57	Kandelia candel	Rhizophoraceae	EN	(B1, 2c)
58	Lumnitzera racemosa	Combretaceae	EN	(B1, 2c)
59	Myriostachya wightiana	Poaceae	EN	(B1, 2c)
60	Nypa fruticans	Arecaceae	EN	(B1, 2abc)
61	Phoenix paludosa	Arecaceae	EN	(B1, 2c)
62	Rhizophora apiculata	Rhizophoraceae	EN	(A2bd)
63	Scyphiphora hydrophyllacea	Rubiaceae	EN	(B1, 2c)
64	Sesuvium portulacastrum	Aizoaceae	EN	(B1, 2c)
65	Sonneratia alba	Sonneratiaceae	EN	(A2c, 2d)
66	Sonneratia apetala	Sonneratiaceae	EN	(A2bdc; B1, 2c)
67	Sonneratia caseolaris	Sonneratiaceae	EN	(A2bcd; B1, 2c)
68	Sporobolus virginicus	Poaceae	EN	(B1, 2c)
69	Suaeda maritima	Chenopodiaceae	EN	(B1, 2bc)
70	Suaeda monoica	Chenopodiaceae	EN	(B1, 2abc)
71	Suaeda nudiflora	Chenopodiaceae	EN	(B1, 2ac)
72	Tamarix troupii	Tamaricaceae	EN	(B1, 2bcd)
73	Xylocarpus granatum	Meliaceae	EN	(A1acd; A2bcd; B2ac)
74	Xylocarpus mekongensis	Meliaceae	EN	(B1, 2c)
75	Xylocarpus moluccensis	Meliaceae	EN	(B1, 2c)

was a major threat to six species. Unlike the other taxa, criterion A was the most frequently used criterion (for 8 species), the decline resulting from over-harvesting. The participants examined fish catch records for the past several years in order to assess whether population decline of any species was evident from catch per unit effort. For most of the species that were threatened, data was not available. There was also some concern that the available data might not be a good indicator of population change.

The only species that were assessed as truly dependent on the mangrove forest were the mudskippers (two species of *Boleophthalmus*). For others it was felt that mangrove may be an important feeding ground or shelter for a part of the population or for a part of the life history. This is because most of the species that were assessed have a wide global distribution, out side mangrove areas.

Table 7.2. The number of assessed mangrove species threatened by human activities other than habitat lost and pollution

	Harvest	*Grazing*	*Trade*	*Medicine*	*Others*
Plants	28	7	21	6	7
Algae	1	1	-	-	-
Invertebrates	2	-	-	2	-
Fish	6	-	-	5	-

Thus, the assessment of mangrove organisms brought into sharp focus the opinion the participants had expressed at the beginning of the workshop that the assessment should view mangrove as a unique ecosystem rather than merely examine its components. The sharp decline in the mangrove forests in India during the last decades is reflected in the very high threatened status of the plants. All the plants are widely distributed elsewhere and therefore would not be globally threatened.

Most of the invertebrates and fishes in the mangroves are widely distributed even within the Indian coast, out side of the mangroves. Thus, very few of them are threatened. But it is the unique combination of species and complex relationship among them that make mangrove a unique ecosystem, serving many ecological functions, many of them important to the welfare of man.

8. Mammals

Introduction

Among 12 megadiversity countries, India with nearly 400 species and a few distinct subspecies ranks seventh in terms of mammalian species richness. With about 47 endemics, India ranks eighth in endemism among mammals. The major reason for high species richness but low endemism is that the three major zoogeographic realms, the Palaearctic, Ethiopian and Indo-Malayan, overlap in India. While this has led to a high species richness, endemism is relatively low because most species in India also occur in the neighbouring countries. This is particularly true of northeast India, and eastern Himalaya, both areas of high species richness, but low endemism. In contrast, the Western Ghats, though second to the above two areas in species richness, has more endemics.

Among the most speciose mammalian Orders in India are the Chiroptera (bats) and Rodentia (rodents). With 109 and 99 species respectively, these two orders account for more than 50% of the Indian mammalian fauna. However, the Indian rodent fauna is relatively species poor, forming only 25% of the Indian mammals, compared to about 40% the world over. Bats and rodents are among the least studied, compared even to the lower vertebrates. Even species lists are not available for most of the areas. Similarly, the Order Carnivora, the third most speciose mammalian Order in India, is also among the least studied, except for the larger species. The lesser carnivores (the civets, mongoose, martens, weasels, and lesser cats), yet to be properly surveyed. The marine mammals, mostly belonging to the Order Cetacea, with 23 species also yet to be studied. Thus our knowledge about the mammals is very limited and confined to the larger inland species.

Unlike in the case of taxa that we have examined till now, considerable effort has been expended on gathering data for monitoring the conservation status of large mammals in India. Wildlife monitoring received an impetus in India with the launch of Project Tiger in 1972. Among with various measures to protect tiger, its prey base and their habitats in Project Tiger Reserves wildlife monitoring through periodic census was initiated. Similar periodic census was also initiated in several protected areas (Pas) other than Project Tiger areas in many states. In most states the periodic census consisted of (a) an estimation of tiger population through identification of individuals from their pug marks; (b) total counts of all mammals seen during one or a few days of census walks by a large number of census teams in each PA. The focus has been on the larger mammals, especially elephants and major preys of tiger. This monitoring effort has been in operation now for two decades in most states. Several drawbacks of the monitoring effort has long been recognised and these have attracted increased attention in recent years. The major drawbacks are:

1. The census methods for tiger and its prey have no statistical base, and are often not objective and verifiable. The census projects a total population for each species without statistics that reflect sampling errors, visibility differences among different vegetation types etc. The pug mark census demands a

high degree of expertise in the identification of individual tigers from pug marks. Even with a high expertise several habitat features (such as soil type, soil moisture *etc.*) could make this method highly arbitrary.

2. A major drawback has been that no efforts have been taken to monitor the habitat, even though this is perhaps the component that is the easiest to monitor.
3. The monitoring has had no framework for systematic analysis and interpretation of monitoring data that provides a feedback to management.
4. Even though a considerable amount of resources has been spent on monitoring, this effort has not been designed to provide the managers, researchers and the general public a better understanding of the seasonal and long term dynamics of tiger-prey base-habitat relationships within the PA. This understanding is necessary for management of populations and habitat, as well as the socio-economic issues involved in tiger conservation.

Census methods for ungulates and tigers have received considerable research attention recently in India. The use of transect methods that are based on statistical theory is gaining increased acceptance for the estimation of ungulate and large mammals. Another suggestion, yet to be put within a framework has been to use the present 'total counts' as indicators of relative abundance rather than as absolute population. There are also ongoing attempts to evolve methods for estimation of tiger population using camera traps. There are thus ongoing methods to devise better census methods to monitor populations of tiger and its prey base. In contrast, monitoring of habitats at the PA level and analysis of monitoring data so as to provide a feedback to management and a better understanding of tiger-prey base-habitat interactions has received no attention.

Assessment

The CAMP workshop on mammals was held in Bangalore from 26 to 30 August, with the Centre for Ecological Sciences, Jawaharlal Nehru Centre for Advanced Scientific Research, and Karnataka Forest Department being the local hosts. Nearly 45 experts from 28 institutions participated. A list of 406 mammal species compiled by Mr. P.O. Nameer of Kerala Agricultural University was placed for assessment . Some of these species were dropped as not occurring in India, and a few others added as valid subspecies to be assessed.

In total, 386 species were considered for assessment of which 104 were Data Deficient and 54 were not evaluated. The latter were species for which data might probably be available but the concerned experts were not present in the workshop. Four species were listed as Extinct, 18 as Critically Endangered, 30 as Endangered, 46 as Vulnerable and 130 as Low Risk (Table 8.1). Thus, among the 228 species that were evaluated (excluding DD and NE species), 94 (41.2%) were categorised as threatened.

The greater richness of the threatened species in Himalaya (including Eastern Himalaya), northeast India and Western Ghats to a large extent reflects the greater species richness in these areas. However, many species in the species poor zones such as Trans-Himalaya, deserts and coasts (marine mammals) have not been evaluated. Nonetheless, the Himalaya, northeastern and Western Ghats contain large numbers of threatened species even if we were to consider all species. However, among those that are threatened a greater proportion is either Critically Endangered or Endangered in the species poor zones, except for islands. In contrast, most of the threatened species in the species rich areas are Vulnerable.

The number of species threatened in each mammalian Order is given in Table 8.2. .Among the most speciose mammalian Orders (Chiroptera, Carnivora, Artiodactyla and Rodentia) 32 to 52% are threatened. The taxonomically unique species such as dugong (Order Sirenia, 1 species), elephant (Order Proboscidea, 1 species) and all 3 species of Perissodactyla that were evaluated were all Endangered, the only exception being pangolin (*Manis crassicaudata*, Order Pholidota). Among the most data diffident Orders are Chiroptera (55 out of 106), Cetacea (15 out of 23 species), Rodentia (18 out of 99) and Carnivora (18 out of 61).

Reasons for Endangerment

Mammals were assessed applying four of the five criteria (except E, Quantitative analysis) and four combinations (B+C, B+D, A+D+C). In contrast other taxa were assessed primarily using criteria B, and to a certain extent A, C and D being not used at all. A total of 34 combinations of sub criteria were used while categorising 94 species as threatened indicating the diversity of information that was available and used. In contrast only 15 to 25% combinations of subcriteria were used in the categorisation of other taxa.

Out of the 94 threatened species, 24 were categorised using criterion B, due to restricted distribution, population fragmentation and decline in habitat quality. Seven more species also had small populations that were declining. Very small populations (<100 animals), along with very small area of occupancy (criterion D) was the next most used criterion (27 species). Criterion C (small population size and decline) was also frequently used (19 species). There were taxonomic differences in the application of criteria; most of the small mammals (insectivores, bats and rodents) were assessed using criterion D (a highly

Table 8.1. The number of mammalian species in three Red List categories of threat in the 10 biogeographic zones in India

	Biogeographic Zone	*CR*	*EN*	*VU*	*Total*
1	Trans-Himalaya	5	6	2	13
2	Himalayas	5	7	27	39
3	Deserts	-	-	-	-
4	Semi-arid	1	1	2	4
5	Western Ghats	3	4	15	22
6	Deccan Peninsula	1	1	9	11
7	Gangetic plains	2	3	5	10
8	Northeast	5	3	24	35
9	Islands	-	1	5	6
10	Coast	1	3	-	4

restricted distribution or <5 locations), while carnivores were assessed on criteria B and C, and Artiodactyla were assessed using criteria B.

Even though population decline was perceived as a problem for many species, this criterion was applied alone only on three species and on five other species in combination with other criteria. Thus, the major reasons for the threatened status of mammals are highly restricted distribution (for most of the small mammals such as shrews, bats and rodents), small distribution both fragmented or declining population, and habitat degradation (for most carnivores) and small declining population size for most artiodactyls.

Among the 94 threatened species, trade (including animal parts) was reported to be a major factor only in 21 species; seven of these are carnivores, four each are cetaceans and rodents; hunting was a major factor in 29 species, especially in artiodactyls (13 species), carnivores (9 species) and rodents (6 species or subspecies of large squirrels). Other factors were poisoning of carnivores (five species) and fishing (3 species of cetaceans).

Recommendations

The recommendations pertain to management of habitat and population and research.

1. As in the other taxa, the need to conduct comprehensive survey of species assessed on criteria B and D (restricted distribution) in order to get better information on distribution was strongly felt. This is necessary for 54 species.
2. The need to conduct at least baseline surveys of species that are now totally data deficient. Particularly important in this regard are the bats, lesser carnivores, all the marine mammals and the small mammals.
3. The participants also recommended that the species which have been given a category that seems lower than that they currently occupy in wildlife legislation should not be down graded in the latter. The IUCN categories should not be used by vested interests to permit exploitation of the species.
4. There is a need to periodically monitor the distribution and abundance of many species especially the threatened species (including those DD species that may be categorised as threatened in future). This would enable us to periodically assess and evaluate their conservation status.

Table 8.2. The number of species in different Red List categories in each mammalian Order in India

Order	*EX*	*CR*	*EN*	*VU*	*LR-nt*	*LR-lc*	*DD*	*NE*	*Total*
Insectivora	-	-	-	3	-	3	-	19	25
Scandentia	-	-	-	-	-	-	-	4	4
Chiroptera	-	2	3	11	24	9	55	2	106
Primates	-	2	3	1	3	3	-	2	15
Carnivora	1	2	5	11	17	7	10	8	61
Cetacea	-	2	4	-	2	-	15	-	23
Sirenea	-	1	-	-	-	-	-	-	1
Proboscidea	-	-	-	1	-	-	-	-	1
Perissodactyla	2	-	1	-	-	-	2	-	3
Artiodactyla	-	7	4	3	6	7	-	6	33
Pholidota	-	-	-	-	1	-	1	-	2
Rodentia	1	1	8	18	13	31	18	9	99
Lagomorpha	-	-	1	-	3	1	5	1	11
Total No.	4	18	30	46	69	61	104	54	386

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restricted distribution or <5 locations), while carnivores were assessed on criteria B and C, and Artiodactyla were assessed using criteria B.

Even though population decline was perceived as a problem for many species, this criterion was applied alone only on three species and on five other species in combination with other criteria. Thus, the major reasons for the threatened status of mammals are highly restricted distribution (for most of the small mammals such as shrews, bats and rodents), small distribution both fragmented or declining population, and habitat degradation (for most carnivores) and small declining population size for most artiodactyls.

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1. As in the other taxa, the need to conduct comprehensive survey of species assessed on criteria B and D (restricted distribution) in order to get better information on distribution was strongly felt. This is necessary for 54 species.
2. The need to conduct at least baseline surveys of species that are now totally data deficient. Particularly important in this regard are the bats, lesser carnivores, all the marine mammals and the small mammals.
3. The participants also recommended that the species which have been given a category that seems lower than that they currently occupy in wildlife legislation should not be down graded in the latter. The IUCN categories should not be used by vested interests to permit exploitation of the species.
4. There is a need to periodically monitor the distribution and abundance of many species especially the threatened species (including those DD species that may be categorised as threatened in future). This would enable us to periodically assess and evaluate their conservation status.

Table 8.2. The number of species in different Red List categories in each mammalian Order in India

Order	*EX*	*CR*	*EN*	*VU*	*LR-nt*	*LR-lc*	*DD*	*NE*	*Total*
Insectivora	-	-	-	3	-	3	-	19	25
Scandentia	-	-	-	-	-	-	-	4	4
Chiroptera	-	2	3	11	24	9	55	2	106
Primates	-	2	3	1	3	3	-	2	15
Carnivora	1	2	5	11	17	7	10	8	61
Cetacea	-	2	4	-	2	-	15	-	23
Sirenea	-	1	-	-	-	-	-	-	1
Proboscidea	-	-	-	1	-	-	-	-	1
Perissodactyla	2	-	1	-	-	-	2	-	3
Artiodactyla	-	7	4	3	6	7	-	6	33
Pholidota	-	-	-	-	1	-	1	-	2
Rodentia	1	1	8	18	13	31	18	9	99
Lagomorpha	-	-	1	-	3	1	5	1	11
Total No.	4	18	30	46	69	61	104	54	386

Table VI. List of 56 mammals prioritised for conservation based on revised IUCN criteria, out of 228 species that were evaluated. (CR=Critically Endangered; EN=Endangered).

Sl. No.	*Taxon*	*Common name*	*Family*	*IUCN Category*	*IUCN Criteria*
	Endemics				
1	Cuon alpinus laniger	Ladakh dole	Canidae	CR	(C2b)
2	Cervus duvaucelli branderi	Barasingha	Cervidae	CR	C2b
3	Cervus elaphus hanglu	Hangul	Cervidae	CR	(B1, 2cd; C2b)
4	Cervus eldi eldi	Sangai (Manipur brow-antlered deer)	Cervidae	CR	(C2b; B1, 2c)
5	Panthera leo persica	Asiatic lion	Felidae	CR	(C2b)
6	Otomops wronghtoni	Wroughton's free-tail bat	Molossidae	CR	(B1, 2c)
7	Biswamoyopterus biswasi	Namdapha flying squirrel	Sciuridae	CR	(B1, 2c)
8	Viverra civettina	Malabar civet	Viverridae	CR	(A1bc)
9	Bubalus arnee	Wild buffalo	Bovidae	EN	B1, 2c
10	Hemitragus hylocrius	Nilgiri tahr	Bovidae	EN	(B1, 2acd; C2a)
11	Ovis vignei vignei	Shapu (Ladakh urial)	Bovidae	EN	(C2a)
12	Macaca silenus	Lion-tailed macaque	Cercopithecidae	EN	(B1, 2c; C2a)
13	Herpestes palustris	Bengal mongoose	Herpestidae	EN	(B1, 2abcd)
14	Atherurus macrouru assamensis	Brush-tailed porcupine	Hystricidae	EN	(B1, 2bcd)
15	Mus famulus	Mouse	Muridae	EN	(B1, 2c)
16	Latidens salimalii	Salim Ali's bat	Pteropodidae	EN	(B1, 2a; C2a)
17	Crocidura hispida	Andaman spiny shrew	Soricidae	EN	(B1, 2c)
18	Tupaia nicobarica	Nicobar tree shrew	Tupaiidae	EN	(B1, 2c)
	Non-endemics				
19	Balaenoptera musculus	Blue whale	Balaenoptridae	CR	(A1bd)
20	Bos grunniens	Yak	Bovidae	CR	(C2a)
21	Capra falconeri falconeri	Markhor	Bovidae	CR	(C2b)
22	Capra falconeri kashmeriensis	Markhor	Bovidae	CR	(C2b)
23	Cuon alpinus adjustes	Dhole (Asiatic wild dog)	Canidae	CR	(C2b)
24	Dicerorhinus sumatrensis	Sumatran rhinoceros	Rhinocerotidae	CR	(D)
25	Dugong dugon	Dugong	Dugongidae	CR	(A1acd; D)
26	Macaca fascicularis umbrosa	Long-tailed macaque	Cercopithecidae	CR	(C2a)

Contd....

Sl. No.	*Taxon*	*Common name*	*Family*	*IUCN Category*	*IUCN Criteria*
27	Moschus chrysogaster	Musk deer	Moschidae	CR	(A1d)
28	Ovis ammon	Argali (nayan)	Bovidae	CR	(C2a)
29	Pantholops hodgsoni	Chiru (Tibetan antelope)	Bovidae	CR	(C2b)
30	Platanista gangetica	Gangetic river dolphin	Platanistidae	CR	(A1acd; C1, C2a)
31	Procapra picticaudata picticaudata	Tibetan gazelle	Bovidae	CR	(D)
32	Rhinolophus subbadius	Chestnut horse-shoe bat	Rhinolopidae	CR	(B1, 2c)
33	Sus salvanius	Pygmy hog	Suidae	CR	(C2a)
34	Trachypithecus geei	Golden langur	Cercopithecidae	CR	(C2a)
35	Berylmys bowersi	???	Muridae	EN	(B1, 2c)
36	Cervus duvaucelli duvaucelii	Swamp deer	Cervidae	EN	(C2a)
37	Cricetulus migratorius	Ladakh hamster	Muridae	EN	(B1, 2c)
38	Crocidura pergrisea	???? shrew	Soricidae	EN	(B1, 2c)
39	Diomys crumpi	Crump's rat	Muridae	EN	(B1, 2c)
40	Eubalaena glacialis	Right whale	Balaenidae	EN	(C1, C2b)
41	Hylobates hoolock	Hoolock gibbon	Hylobatidae	EN	(C2a)
42	Ia io	Great evening bat	Vespertilionidae	EN	(B1, 2c)
43	Lynx lynx	Lynx	Felidae	EN	(B1, 2bc)
44	Marmota bobak	Himalayan marmot	Sciuridae	EN	(B1, 2abc & 3ab)
45	Melogale moschata	Small toothed ferret badger	Mustelidae	EN	(B1, 2c)
46	Myotis longipes	???? bat	Vespertilionidae	EN	(B1, 2c)
47	Niviventer brahma	???? rat	Muridae	EN	(B1, 2c)
48	Ochotona curzoniae	Black-lipped pika	Ochotonidae	EN	(B1, 2ab)
49	Orcaella brevirostris	Irrawady dolphin	Delphinidae	EN	(B1, 2c)
50	Ovis orientalis	Shapu (Ladakh urial)	Bovidae	EN	(B1, 2c)
51	Panthera tigris	Tiger	Felidae	EN	(C2a)
52	Ratufa macroura dandolena	Grizzled giant squirrel	Sciuridae	EN	(B1, 2c; C1)
53	Rhinocerous unicornis	Great Indian rhinoceros	Rhinocerotidae	EN	(B1, 2d)
54	Sousa chinensis	Hump-backed dolphin	Delphinidae	EN	(A1acd, 2b)
55	Trachypithecus phayrei	Phayre's leaf monkey	Cercopithecidae	EN	(C1, 2a)
56	Uncia uncia	Snow leopard	Felidae	EN	(C2a)

5. There are serious taxonomic ambiguities in some taxa, which need to be resolved through making systematic taxonomic studies. The important taxa in this regard are bats, ground shrews and rodents (especially murids).
6. Much against the popular perception, mammals as a group with nearly 27% data deficient species is only as little studied as the lower vertebrates or even less. The major reason has been the large number of studies that have addressed one or a few species. In contrast, studies on the other taxa such as plants, amphibians and reptiles have been mostly community studies. Thus, even though there have been relatively very few studies on the latter taxa, the amount of information available for conservation assessment is almost as high as in the case of mammals. There is thus a need to promote community studies on mammals.

9. Fresh Water Fishes

Introduction

Fishes are the most speciose vertebrate taxa, with nearly 20,000 species world wide. India has a vast network of water bodies, that consist of nearly 30,000 km of rivers, 113,000 km of canals, 17,000 sq. km of reservoirs and 25,000 sq. km of lakes and ponds, besides a vast coastal area and oceans. Nearly 2,200 species of fishes occur in these waters, nearly 700 of them in the freshwater bodies. This rich freshwater fish fauna has immense value, in local use and trade, as well as domestic and international trade. Among the animal habitats in India, it has been the freshwater habitats that have been most adversely affected by human activities. These impacts come from deforestation, damming of rivers, pollution, insecticides and fertilisers, and draining and levelling of wetlands for agriculture and construction. Since freshwater fishes form an important source of protein, over harvesting and incidental catches have depleted many species. The introduction of exotic species has also depleted many native species. As in the case of many amphibians and reptiles, highly restricted distribution of many species make them highly extinction prone.

Freshwater fishes have been studied to a greater detail compared to other lower vertebrates or even mammals and birds. Most of these studies have been surveys, therefore, we have considerable information on the distribution of many species, especially in the Western Ghats. Several recent studies in the Western Ghats have reported local extinction of many species, due to loss of forest, damming *etc.* A comprehensive assessment of the conservation status of freshwater fish fauna in India has been long overdue. The CAMP workshop on freshwater fishes was initially to have been conducted under the BCPP. The initial preparations were also done. However, due to lack of funds it was conducted by the National Bureau of Fish Genetic Resources, and the credit goes entirely to them, especially its Director Dr. A.G. Ponniah.

Assessment

The workshop on fresh water fishes was conducted by the National Bureau Fish Genetic Resources, Lucknow, from 22 to 26 September 1997. This did not form part of BCPP, as it provided only the initiation of the workshop. The following report is a summary of the workshop based on a report by Dr. A.G. Ponniah, Direct or, NBFGR (CBSG, India News, Vol II). Nearly 50 resource persons from 25 organisations participated in the workshop. The participants were split into six working groups (Gangetic region I & II, upland Himalaya, northeast and peninsular India, and east and west flowing rivers of the Western Ghats. Out of nearly 700 taxa (species and sub species) of freshwater fishes in India, 323 were taken up for assessment at the workshop. Among those assessed, 217 species (70.2%) were categorised as threatened, 14.6% being Critically Endangered, 29.4% Endangered, and 26.2% being Vulnerable.

As in the case of other taxa, criterion B was the most used on fresh water fishes also. Criterion A was also used for many species, especially those in the plains. Thus, the very high percentage of threatened fresh water fishes is primarily due to the restricted distribution, population fragmentation and decline in habitat quality (mostly for hill stream fishes), and population decline in the fishes of the plains. The decline in habitat quality has been mostly due to damming, siltation, pollution, poisons *etc.* Population decline has been due to over harvesting. The taxon data on assessed species has not been finalised for a detailed analysis.

Recommendations

The special working groups considered major issues that pertain to the conservation of fresh water fishes, and made the following recommendations.

Legal issues

Fishes are an important source of protein, and of immense commercial and employment value. Present fisheries regulations were framed nearly a century ago and do not reflect current status of fishes and capture fisheries. Powers vested with enforcement authorities are inadequate and also not comprehensive.

1. The proposed model Fisheries Act reported to be under preparation should be made available for a wide

review by all interested sections of society before adoption.

2. The Act should provide for the creation and management of sanctuaries for conservation of all threatened species and maintenance of genetic variability.
3. The Act should include schedules of protected species that reflected their endangerment status assessed objectively.
4. The Act should provide sufficient enforcement powers at local level, and sufficiently severe penalties for offences involving threatened species.
5. Since fishing gears used are non-selective, there is a need to exercise caution with regard to adding endangered species of fish to any Schedule of Wildlife Protection Act. People dependent on fishing for their livelihood should not be adversely affected when "endangered" species are caught inadvertently in their gears.
6. Since fishes have been classified as a wildlife (animals in Schedules I to V are defined as wild animals), in the Wildlife Protection Act (1972), fishes are wildlife only when they occur in the wild, and not when they are brought out of a wild area. This restricts the protection that can be given to fishes and their habitat. Therefore, fishes should be deleted from the definition of "wildlife" and included as "wild animals".
7. Fishes categorised as threatened according to IUCN criteria need to be included in the appropriate Schedules of the Wildlife Protection Act.
8. Information provided by the participants to CAMP workshop indicates a thriving international trade in fresh water fish. Inclusion of threatened species in Schedules of Wildlife Protection Act would provide a legal frame work for their protection unless cultivated.

Exotic Fishes

Nearly 300 exotic species of fish, most of them ornamental, have been introduced into India. Among the various taxa, the loss of species due to introduction of exotics, has been highest in the fishes. Extinction of local species results from competition as well as predation. Among the introduced cold water fishes, *Cypronus carpis* and *Xar specularis* are posing a threat to *Shizothorax* species in Dal Lake in Kashmir, and *Osteobrama belangeri* in Loktok lake in Manipur. Among commercial species, the introduction of silver carp and tilapia has resulted in the decline of several native species (especially *Catla* species) in the reservoir and other water bodies.

There is at present no effective regulation of the introduction of exotic species, ornamental or commercial. There should be a quarantine for importing any species that might introduce diseases to native species (such as grass carp species, *Puntius pulchelus*, cat fishes like *Pangasuis pangasuis*, *Aorichthys seenghala*, *A. aor*, and *Wallago attu*). Introduction of exotics should be screened by a regulating body, considering biology, habit and habitat and potential impacts on native species.

Research

1. Make stock assessment and periodic monitoring in major Indian river systems, in four regions northeast, western Himalaya, Eastern Ghats and Western Ghats.
2. Standardise methodology for assessment and monitoring.
3. Studies on management of fish habitat, impacts of exotic species, and quarantine measures for transplantation into new habitats.
4. Brood stock management, and captive breeding and release of Critically Endangered and Endangered species.
5. Assess breeding behaviour and spawning habitats to establish fish sanctuaries.
6. Assess peninsular carps for aqua culture.
7. New species should be deposited with ZSI.
8. When changes are made in the nomenclature of a taxon, the recent valid names along with the old one should be mentioned, giving reasons. If a taxon is synonymised, they should clearly state the reasons for doing so, giving characters.
9. A list of valid names to be published annually by one organisation (NBFGR?).
10. Biochemical and genetic studies on species of disputed taxonomic status.
11. Create a database on and facilitate the networking of individuals and organisations carrying out activities related to fish conservation.

Table VII. List of 145 fishes prioritised for conservation based on revised IUCN criteria out of 327 species that were evaluated. (CR=Critically Endangered; EN=Endangered) (This assessment was carried out by National Bureau of Fish Genetic Resources, Lucknow, but initiated by CAMP)

Sl. No.	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
	Endemics			
1	Aborichthys garoensis	Balitoridae	CR	(B1, 2c)
2	Amblypharyngodon chakaiensis	Cyprinidae	CR	(A1, 2c)
3	Barilius corbetti	Cyprinidae	CR	(B1, 2c)
4	Barilius dimorphicus	Cyprinidae	CR	(B1, 2c)
5	Channa micropeltes	Channidae	CR	(A1a, 1b, 1c, 1d; B1, 2c)
6	Dayella malabarica	Clupeidae	CR	(A1a, 1c, 1d, 2c, 2d)
7	Erethistoides montana pipri	Sisoridae	CR	(B1, 2a, 2b, 2c, 2d)
8	Garra litanensis	Cyprinidae	CR	(B1, 2c)
9	Garra manipurensis	Cyprinidae	CR	(B1, 2c)
10	Glyptothorax alaknandi	Sisoridae	CR	(B1, 2c)
11	Glyptothorax anamalaiensis	Sisoridae	CR	(B1, 2c)
12	Glyptothorax dakpathari	Sisoridae	CR	(B1, 2c)
13	Glyptothorax davissinghi	Sisoridae	CR	(B1, 2c)
14	Glyptothorax garhwali	Sisoridae	CR	(B1, 2c)
15	Glyptothorax stoliczkae	Sisoridae	CR	(B1, 2c)
16	Homaloptera montana	Baletoridae	CR	(B1, 2c)
17	Horabagrus nigricollaris	Bagridae	CR	(B1, 2c)
18	Horaglanis krishnai	Claridae	CR	(D2; B1, 2a, 2c)
19	Hyporhamphus xanthopterus	Hemiramphidae	CR	(A1a, 1b, 1c, 1d; B1, 2c)
20	Kryptopterus indicus	Siluridae	CR	(B1, 2c)
21	Labeo ariza	Cyprinidae	CR	(B1, 2c)
22	Labeo rajasthanicus	Cyprinidae	CR	(B1, 2c)
23	Laguvia kapuri	Sisoridae	CR	(B1, 2a, 2c, 2d)
24	Lepidocephalus goalparensis	Cobitidae	CR	(B1, 2c)
25	Lepidopygopsis typus	Schizothoracinae	CR	(B1, 2c)
26	Monopterus eapeni	Symbranchidae	CR	(B1, 2c)
27	Moringua hodgarti	Moringuidae	CR	(B1, 2b, 2c, 2d, 2e)
28	Neolissochilus wynaadensis	Cyprinidae	CR	(B1, 2c)
29	Ompok malabaricus	Siluridae	CR	(B1, 2c)
30	Osteochilichthys longidorsalis	Cyprinidae	CR	(B1, 2c)
31	Pinniwallago kanpurensis	Siluridae	CR	(B1, 2c)
32	Proeutropiichthys taakree	Schilbeidae	CR	(A1a, 1d, 2d)
33	Psilorhynchus micropthalmus	Psilorhynchidae	CR	(B1, 2c)
34	Puntius arulius tambraparniei	Cyprinidae	CR	(B1, 2c)
35	Puntius bovanicus	Cyprinidae	CR	(B1, 2c)

Contd. . . .

Sl. No.	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
36	Puntius deccanensis	Cyprinidae	CR	(B1, 2c)
37	Puntius mudumalaiensis	Cyprinidae	CR	(B1, 2b, 2c; D2)
38	Puntius narayani	Cyprinidae	CR	(B1, 2c)
39	Puntius ticto punctatus	Cyprinidae	CR	(B1, 2c)
40	Schistura singhi	Homalopteridae	CR	(B1, 2a, 2c)
41	Silurus wynaadensis	Siluridae	CR	(B1, 2c)
42	Stenogobius malabaricus	Gobiidae	CR	(B1, 2c)
43	Tor khudree malabaricus	Cyprinidae	CR	(A1a, 1c; B1, 2c)
44	Tor mussullah	Cyprinidae	CR	(A1a, 1c, 1d)
45	Travancoria elongata	Balitoridae	CR	(B1, 2c)
46	Aborichthys elongatus	Balitoridae	EN	(B1, 2c)
47	Aborichthys tikaderi	Balitoridae	EN	(B1, 2a, 2b, 2c)
48	Barbus carletoni	Cyprinidae	EN	(B1, 2c)
49	Barilius dogarsinghi	Cyprinidae	EN	(B1, 2a, 2b, 2d)
50	Batasio travancoria	Bagridae	EN	(A1b; B1, 2b)
51	Bhavania australis	Balitoridae	EN	(B1, 2c)
52	Botia lohachata	Cobitidae	EN	(B1, 2c)
53	Botia striata	Cobitidae	EN	(B1, 2c)
54	Chaudhuria khajuriai	Chaudhuriidae	EN	(B1, 2b, 2c)
55	Clarias dayi	Claridae	EN	(B1, 2c)
56	Clupisoma bastari	Schilbeidae	EN	(B1, 2c)
57	Euchiloglanis kamengensis	Sisoridae	EN	(B1, 2c, 2d)
58	Garra gotyla stenorhynchus	Cyprinidae	EN	(B1, 2c)
59	Garra hughi	Cyprinidae	EN	(A1a, 1c)
60	Garra surendranathanii	Cyprinidae	EN	(B1, 2c)
61	Glyptothorax nelsoni	Sisoridae	EN	(B1, 2c)
62	Glyptothorax saisii	Sisoridae	EN	(B1, 2c)
63	Hara horai	Sisoridae	EN	(A1a, 1c, 1d; B1, 2c)
64	Horabagrus brachysoma	Bagridae	EN	(A1a, 1c, 1d)
65	Horadandia atukorali brittani	Cyprinidae	EN	(B1, 2c)
66	Hypselobarbus curmuca	Cyprinidae	EN	(A1d, 1c, 1d, 1e)
67	Hypselobarbus dubius	Cyprinidae	EN	(B1, 2c, 2d)
68	Hypselobarbus jerdoni	Cyprinidae	EN	(B1, 2c)
69	Hypselobarbus kolus	Cyprinidae	EN	(A1a; B1, 2c)
70	Hypselobarbus lithopides	Cyprinidae	EN	(A1a, 1c, 1d; B1, 2c)
71	Hypselobarbus micropogon periyarensis	Cyprinidae	EN	(B1, 2a, 2b, 2c)
72	Hypselobarbus kurali	Cyprinidae	EN	(B1, 2c)
73	Hypselobarbus thomassi	Cyprinidae	EN	(B1, 2c)
74	Labeo kontius	Cyprinidae	EN	(B1, 2c)

Contd....

Sl. No.	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
75	Laguvia shawi	Sisoridae	EN	(B1, 2c)
76	Mesonoemacheilus reticulofasciatus	Homalopteridae	EN	(B1, 2c)
77	Monopterus fossorius	Symbranchidae	EN	(B1, 2c)
78	Mystus malabaricus	Bagridae	EN	(A1a, 2b, 2c, 2d)
79	Mystus punctatus	Bagridae	EN	(B1, 2c)
80	Nemacheilus carletonii	Balitoridae	EN	(B1, 2c)
81	Nemacheilus chindwinicus	Balitoridae	EN	(B1, 2c)
82	Nemacheilus doonensis	Balitoridae	EN	(B1, 2c)
83	Nemacheilus himachalensis	Balitoridae	EN	(B1, 2c)
84	Nemacheilus kangrae	Balitoridae	EN	(B1, 2c)
85	Nemacheilus keralensis	Balitoridae	EN	(B1, 2c, 2d)
86	Nemacheilus monilis	Balitoridae	EN	(B1, 2c)
87	Nemacheilus montanus	Balitoridae	EN	(B1, 2c)
88	Nemacheilus nilgiriensis	Balitoridae	EN	(B1, 2c)
89	Neolissochecilus spinulosus	Cyprinidae	EN	(B1, 2c)
90	Osteobrama bakeri	Cyprinidae	EN	(B1, 2c)
91	Osteobrama brevipectoralis	Cyprinidae	EN	(B1, 2c)
92	Osteochilus brevidorsalis	Cyprinidae	EN	(B1, 2c)
93	Parambassis dayi	Chandidae	EN	(B1, 2c)
94	Psilorhynchus sucatio nudithoracicus	Psilorhynchidae	EN	(A1a; B1, 2c)
95	Puntius arulius	Cyprinidae	EN	(A1a, 1c, 1d, 2c, 2d; B1, 2c)
96	Puntius chilinoides	Cyprinidae	EN	(A1a, 1c, 1d)
97	Puntius clavatus clavatus	Cyprinidae	EN	(A1a, 1c; B1, 2c)
98	Puntius denisonii	Cyprinidae	EN	(B1, 2c)
99	Puntius fasciatus	Cyprinidae	EN	(B1, 2c)
100	Puntius jayarami	Cyprinidae	EN	(A1a, 1c; B1, 2c)
101	Puntius melanostigma	Cyprinidae	EN	(B1, 2c)
102	Puntius ophicephalus	Cyprinidae	EN	(B1, 2c, 2d)
103	Puntius parrah	Cyprinidae	EN	(B1, 2c)
104	Rita chrysea	Bagridae	EN	(B1, 2c)
105	Rita pavimentatus	Bagridae	EN	(B1, 2c)
106	Salmostoma orissaensis	Cyprinidae	EN	(B1, 2c)
107	Schistura devdevi	Homalopteridae	EN	(B1, 2c)
108	Schistura elongatus	Homalopteridae	EN	(B1, 2c)
109	Schistura nagaensis	Homalopteridae	EN	(B1, 2a, 2c)
110	Schistura pavonaceus	Homalopteridae	EN	(B1, 2c)
111	Silonia childreni	Silinidae	EN	(B1, 2c)
112	Tetraodon travancoricus	Tetrodontidae	EN	(B1, 2a, 2b)
113	Travancoria jonesi	Balitoridae	EN	(B1, 2c)

Contd....

Sl. No.	*Taxon*	*Family*	*IUCN Category*	*IUCN Criteria*
	Non-endemics			
114	Pangasius pangasius	Pangasiidae	CR	(A1a, 1b, 1c, 1d)
115	Periophthalmus weberi	Gobiidae	CR	(B1, 2c)
116	Anguilla bengalensis	Anguillidae	EN	(A1a, 1c, 1d; B1, 2c)
117	Botia almorhae	Cobitidae	EN	(B1, 2c)
118	Botia berdmorei	Cobitidae	EN	(A1a, 1c, 1d)
119	Eutropiichthys vacha	Schilbeidae	EN	(A1a, 1b, 1c, 1d, 2b, 2c,2d)
120	Glyptosternum reticulatum	Sisoridae	EN	(B1, 2c)
121	Glyptothorax cavia	Sisoridae	EN	(A1a, 1c, 1d)
122	Glyptothorax kashmirensis	Sisoridae	EN	(B1, 2c)
123	Johnius gangaticus	Sciaenidae	EN	(B1, 2c)
124	Labeo dussumieri	Cyprinidae	EN	(A1a, 1c, 1d, 1e, 2c, 2d,2e)
125	Lepidocephalus berdmorei	Cobitidae	EN	(A1c; B1, 2c)
126	Mystus microphthalmus	Bagridae	EN	(B1, 2c; A1a, 1c)
127	Nemacheilus multifasciatus	Balitoridae	EN	(B1, 2c)
128	Notopterus chilata	Notopteridae	EN	(A1a, 1b, 1c, 1d, 2c, 2d)
129	Ompok bimaculatus	Siluridae	EN	(A1a, 1c, 1d, 2c, 2d)
130	Ompok pabda	Siluridae	EN	(A1a, 1c, 1d, 2c, 2d
131	Pseudeutropius atherinoides	Schilbeidae	EN	(A1a, 1c, 1d)
132	Puntius clavatus	Cyprinidae	EN	(B1, 2c)
133	Puntius dorsalis	Cyprinidae	EN	(B1, 2c)
134	Raiamas guttatus	Cyprinidae	EN	(B1, 2c)
135	Schistura arunachalensis	Homalopteridae	EN	(B1, 2c)
136	Schistura peguensis	Homalopteridae	EN	(B1, 2a, 2b)
137	Schistura sikmaiensis	Homalopteridae	EN	(B1, 2c)
138	Schistura vinciguerrae	Homalopteridae	EN	(B1, 2c)
139	Schizothorax labiatus	Cyprinidae	EN	(B1, 2c)
140	Semiplotus modestus	Cyprinidae	EN	(B1, 2b, 2c, 2d)
141	Silurus afghana	Siluridae	EN	(B1, 2c)
142	Sisor rhabdophorus	Sisoridae	EN	(B1, 2c)
143	Tor mosal	Cyprinidae	EN	(A1a, 1c, 1d; B1, 2c)
144	Tor putitora	Cyprinidae	EN	(A1a, 1c, 1d)
145	Tor tor	Cyprinidae	EN	(A1a, 1c, 1d)

10. Discussion

Which are the Priority Species ?

An inherent risk in providing lists of species under threat is that they give the impression that species that are not assessed are not under threat. This is far from true. In the past, this has often happened in the case of lower vertebrates and invertebrates, when assessments were mostly centred on larger vertebrates and plants. In this project we have made special efforts to cover the lower vertebrates and a few of the invertebrates. It has to be pointed out that most of the remaining lower taxa might face extinction risks as high as that faced by those that we assessed or even greater, given their restricted distribution and habitat specificity.

A species based assessment has inherent limitations, given the sheer number of species that exist or might exist. Mammals and birds around which most of the assessment has been made cover only 30% of the vertebrates, and only 0.8% of the named species (1.5 to 1.8 millions). Even though there has been a sharp increase in the number of lower vertebrates and invertebrates that have been globally assessed (IUCN 1996), assessment of all species is still a daunting task. It is in this light that this project has made an assessment of more than 80% of the inland vertebrate taxa of India over such a short period of time. This we consider a great achievement. And a modest beginning has been made in the case of invertebrates.

The prioritisation that have been done through the CAMP workshops have used the threat status, as indicated by the revised IUCN categories, as the only criteria. However, information on use values at various levels (local use, local trade, domestic trade *etc.*) has been recorded for the species that we assessed. The compilation of comprehensive lists of all Indian species (higher vertebrates) allows us to assess some biological values such as taxonomic uniqueness, endemism, *etc.*, These are also recorded on the taxon data sheets. However, integration of these biological and use values order to further prioritise threatened species poses several methodological and conceptual problems.

1. *Direct use values:* Several species have been reported to be of use for food, medicines, fuel wood *etc.* There were considerable differences among the species groups that we assessed in use values. For example, all medicinal plants were obviously of use value. Most of the mangrove plants were of some use, while only some of the invertebrates and fishes were of use. Among reptiles, direct use value is limited to many turtles and crocodile, and a few snakes and lizards. Among amphibians, very few species have been reported to be of use (*e.g. Hoplobatrachus tigerinus*). Among mammals, relatively few species were reported to have direct use values, as was the case with soil and aquatic invertebrates. These information are recorded in the taxon data sheets. The incorporation of use values could thus give some taxa, even at the level of Class, greater priority. It should be noted that the impact of the use value on the conservation status of a species is already incorporated, if there has been a population decline due to use. Further weightage for use value may thus be a bias.

Another problem with including direct use values to further prioritise species was that there was no quantitative assessment of the value. Often, this was not possible without further research. Threatened species with direct use values could be given greater priority (within the categories of threat), regardless of the quantum of use. The conflicting types of direct use values, (*e.g.* local use vs international trade), and quantum of use (little used *vs* heavily used), make the integration of these values with conservation status, highly arbitrary, and the results difficult to be interpreted. The information is provided in the taxon data sheets, should it be needed.

2. *The ecological values*: The ecological values (such as key stone function) of most species are unknown. The identification of such values would be a major bias in favour of species that are well known. Such a bias is already present in the assessment of the threat status.

3. *Endemism*: There is a good correlation between endemism and threat status. This is because most of the endemics are likely to have a restricted distribution, and to be highly sensitive to ecological changes *e.g.* amphibians. The value represented by endemism is therefore already incorporated into the assessment.

4. *Taxonomic uniqueness*: The appropriate taxonomic level (at species, genus, family *etc.*) at which taxonomic uniqueness (which is a surrogate for genetic uniqueness) need to be considered may vary from one taxa to another, depending on the evolutionary history of the taxa. Thus, the difference between two genera in one Family, may be greater than between sub families in another Family. Moreover, periodic taxonomic revisions, can alter conservation priorities, even though there may not be any difference in the field conditions. For this reason, taxonomic uniqueness has not been considered in further prioritisation of threatened species.

5. *Major threat*: Further prioritisation of threatened species, based on other values, may not be very relevant for another important reason, which became clear as the workshops progressed. The criterion that was used in assessing species is a good indicator of the reason for the threatened status. In all taxa that were assessed, criterion B was the most frequently used to categorise species as threatened. Its usage ranged from 34% (of the threatened species) to as mush as 85% in the case of reptiles. Thus, restricted distribution, population fragmentation, along

with decline habitat quality was assessed to be the major threats to most species. The restricted distribution could either be natural as in many amphibians or man made as in the case of most mangrove plants. Thus, restricted range is a major reason for the greater threaten status among the amphibians, and reptiles compared to mammals. Only about 9% of the mammals have been recorded from one location, in contrast to 34.8% of amphibians and 22.0% of reptiles. Nearly 62% of the mammals have been recorded from more than 10 locations, compared to only 17.4% of amphibians, and 28.6% of the reptiles. This highly restricted range of herpetofauna, the major reason for their threatened status, might be partly due to lack of comprehensive surveys. Many species have not been recorded since their original description. However, recent studies in the Western Ghats show that, herpetofauna might actually have highly restricted distribution (Anon 1997). Habitat fragmentation that has followed, and continuing degradation of such fragments are major subcriteria that have been used for many species.

A large number of mammalian species (27) were assessed on criterion D, which was rarely used for the other taxa. It must be noted that this criteria is very similar to criterion B, but categorises the species as Vulnerable even in the absence of threat. Population decline (criterion A) was rarely used, and was mostly used for species that were over harvested. Five species of amphibians, 3 mammals, 17 reptiles, and mangrove plants and fishes (8 species each).

In this background, the major conservation action that needs to be taken is habitat protection and management that would benefit an assemblage of species rather than individual species. This may not be true for species assessed on the basis of population decline (due to harvesting, either A or C), where conservation action that need to be taken are single-species oriented, such as inclusion in Wildlife Protection Act, captive breeding and restocking in the wild. It is among those species that inclusion of use and other values may help further prioritisation meaningfully. Such species are relatively few, and include turtles, monitor lizards, very few amphibians, and few mammals, and many fishes and medicinal plants.

Another area where further prioritisation of threatened species might be needed is research, in order to focus our effort and resources. The important recommendation at all workshops has been that research should collect data on the distribution of several species that according to current information have a highly restricted distribution. This restricted distribution has been a reason for their threatened status. In order to make best use of resources, the participants suggested community based studies (assemblage of species in the locality) rather than studies on the individual species. On this ground also, therefore, further prioritisation of species would be of little use.

6. *The priority species:* Thus, it is best that conservation status be the only criterion that is used for prioritisation of species at present. Critically Endangered is the highest priority species, Endangered being the next *etc.* It should also be noted that use values of species have been the primary consideration in prioritisation of wild relatives of cultivated plants.

Where are the Threatened Species ?

As conservation assessment covers more species that has hitherto been less known, the number of species that are threatened is increasing geometrically. In the assessment that we made 61 % of amphibians 51 % of reptiles, and 72% of fishes are assessed as threatened. The major reasons for this surprising levels of threat to the lower taxa are their restricted range and declining habitat quality (not habitat loss). Clearly, a species based conservation action is a daunting, if not an unnecessary, task. Extension of PA network to cover areas with high overlap in the distribution of threatened taxa and specific habitat management are the required actions (Statterfield 1996). As expected the areas of importance as far as the number of threatened species are concerned, are the biogeographic zones of Western Ghats, northeast, and Himalaya particularly Eastern Himalaya. This is because;

(a) these are the areas of high species richness;
(b) many of the lower vertebrates and invertebrates that occur here have patchy or restricted distribution, even within the zones;
(c) there have been extensive fragmentation of the habitat;
(d) the species in these zones are highly sensitive to habitat quality (not loss), *e.g.* amphibians.

There are also other biogeographic zones that are important for some threatened species, even though these are few. The distribution of threatened species in different biogeographic zones has been given separately for each taxon. The low number of species in Trans-Himalaya and desert is mostly because these areas are relatively species poor, and to a lower extent because many species in these zones were not assessed.

The distribution map of threatened species at a finer scale (with reference to biogeographic provinces or protected areas) was difficult to make. This was because the localities or habitats of most species were often vaguely recorded, especially of those that have been reported decades ago. However, the endemics which have been recorded only from one protected area and from less than 10 protected areas, have been identified and included in the prioritisation of protected areas.

Achievements and Recommendations

1. The objective of the project was to make the best possible use of data that was currently available, in order to make an assessment of the conservation status of taxa, which had never been systematically, assesses before. Despite of all the limitations (see below) the participants strongly felt that such an assessment was necessary and in the workshop process in which it was done. It was felt that rather than staying away from an assessment due to lack of data of high quality an assessment should be made using the data available to the fullest extent possible, in order to highlight the urgency for collecting data of better quality. That we have been able to assess nearly 1500 species that includes most of the vertebrates other than birds, within a period of one year is a unique achievement. It is also unique that nearly 400 resource persons from about 100 organisations have actively participated in the assessment. Periodic assessments are necessary in order to monitor and evaluate the changing conservation status of species with time. The quality of data used for assessment is also expected to change, hopefully to improve. Thus, the assessment that we have done is the first of a series of assessment to be made in the future.

2. Conservation policies and actions in India to date have been based o especially mammals. As the results from this assessment show, species in the lower taxa are at greater extinction risk (50 to 72%, for lower vertebrates), than mammals (45%), due to the former's restricted distribution and greater sensitivity to habitat changes. This is similar to the results from global assessment by IUCN (1996). Conservation of large mammals (and a few large reptiles) is thus no guarantee to the survival of the smaller animals. An assessment of their conservation status based on however little data has made us aware of the nature and magnitude of the problem.

3. The list of species under various degrees of threat, the categories of threat faced by them and conservation actions suggested would facilitate appropriate action being taken. These actions pertain to greater protection of the species *per se* (*e.g.* from poaching or collection), captive breeding, increase of habitat in protected area net work, better protection and management of habitat, pollution control, negative list of exports, *etc.* The use by the Ministry of Environment and Forests of the results from the assessment of medicinal plants in order to amend the negative lists of exports and Schedules of the Wildlife Protection Act is a good example. Threats shared by several taxa and its geographical distribution would lead to broader policy decisions. These would consist of re-examination of protected area net work to include areas of high threatened species richness, criteria for EIA, use of pesticides, trade, CITES, *etc.*

4. The basic information on the distribution, habitat, population *etc.*, of the species that has been documented would lead to a better understanding of the geographic distribution of these species and the factors governing their distribution, especially in relation to various disturbances.

5. Contrary to popular belief, mammals in India have been less well studied than the lower vertebrates; 31% of mammals were data deficient, compared to only 19% of amphibians and 21% of reptiles. This is due to the fact that most of the mammalian studies in India have been ecological studies on a few large mammals at the expense of the smaller mammals especially rodents and bats that form more than 50% of the mammalian species in India. On the other hand, most of the studies on the lower vertebrates and the limited studies on the invertebrates have all been community studies. The utility of community studies in conservation assessment is thus obvious.

6. The application of the IUCN criteria has brought to light several gaps in our information on most taxa. Several taxa have been identified on which there is a total lack of information other than vague locating names that followed their original description several decades ago. These are the data deficient species, which ranged from 10% to 30% for taxa that have completely covered. Several species have also been identified that have apparently very restricted distribution but for which resurveys would lead to range expansion. These two groups are those that require intensive surveys.

In general, the assessment also brought to light the need for data that is appropriate for an assessment to be made, even for the relatively well known taxa. Based on these information gaps the research needs has been identified for each taxa. It is hoped that this would direct research interest as well as funding in the coming years. One of the major achievements of the assessment has been a common understanding among the field biologists of the kind of data that need to be collected for making conservation assessment.

7. All the participants felt that since monitoring biodiversity is a natural responsibility according to Rio Convention collecting data that allows such monitoring should also be a natural responsibility. This responsibility is best entrusted with national institutions (*e.g.* ZSI, BSI) whose task it is already to periodically survey Indian flora and fauna. The data need to be collected within a frame work that allows systematic monitoring and evaluation, perhaps using the IUCN revised criteria. The participants also identified the total lack of data on population densities, habitat requirements and basis life histories of most taxa that were assessed. Besides enhancing our understanding of the basic ecology of the species these data also gives us predictable impacts of habitat changes. There is an urgent need to actively promote gathering of data that is necessary

to make conservation assessment more reliable. This need to be done through capacity building especially in national institutions such as ZSI and BSI, universities *etc.* greater allocation of funds to periodically gather such data and through better facilitation of research in protected areas, and other forests and habitats (*e.g.* speedy grants of research permits).

8. With shift in focus to biodiversity the importance of taxonomic expertise is being increasingly recognised. It is in this context that all participants expressed great concern over the rapidly declining standards in taxonomic expertise and curation. The rapid depletion of taxonomists in the country especially in national institutions such as ZSI and BSI in the last decades has already affected our ability to identify species. There were fears that with the retirement of the current experts and lack of junior staff to carry on the taxonomic knowledge, which is often considered a tradition, our taxonomic expertise on most taxa would soon be irrevocably lost.

There was also concern about the declining standards in curation, the preservation of type and voucher specimens, and making them accessible to experts and others. There is an urgent need to rediscover this role of national institutions such as ZSI and BSI. There is also a need for type specimens of new species that are described to be declared as national properties and deposited in national institutions such as ZSI and BSI. Currently these are retained by individuals, universities, *etc.* which has resulted in the loss of type specimens in several cases.

9. The assessment that we made is a major test of the revised IUCN Red List categories and criteria. We have been able to identify several methodological and conceptual problems which are discussed below. Even with the constraints, the revised categories provide the best indicator that can be used to assess the conservation status of species. As mentioned earlier, there is a need to periodically collect the data that is required for such an assessment. We also found that the CAMP workshops provide the best way of rapidly making an assessment of several species, while also ensuring the active participation of most resource persons. Thus, revised IUCN categories and CAMP workshops provide ideal tools for a rapid assessment of conservation status of species not only in India but also elsewhere.

10. Within a short period of time we have been able to assess more than 1,500 species. More importantly, by generating a better understanding of the revised IUCN categories and the CAMP process among the various resource persons, policy makers, and managers, this project has initiated the process of systematic assessment of the conservation status of Indian species. Several CAMP workshops are already scheduled to assess other taxa. It is also hoped that the taxa that have been assessed already would be reassessed probably five years from now, after more systematic data have been collected.

Problems with Iucn Categories and Criteria

The several workshops that we held provided an excellent forum to critically evaluate the IUCN categories and criteria especially in the context of their use in India. The workshop also provided a forum to evaluate the process of conservation assessment. The following were the major concerns:

1. *Applicability across taxa*: The applicability of the criteria and subcriteria across different taxa was a matter of concern to participants in all workshops, even though this is stated as one of the advantages of the revised criteria. Animals and plants differ considerably in their life history, especially mode of reproduction, rate of reproduction, population density, habitat requirements at different life history stages (*e.g.* amphibians). In the light of these, the applicability of same threshold values of population size, area of occupancy, rate of population decline, life history strategies, is questionable.

2. *Applicability to tropical areas*: It was felt that the criteria have been developed primarily using temperate taxa as model, especially mammals. These may not be therefore applicable to tropical taxa. Tropical species generally have smaller distribution ranges, at least latitudinally, compared to temperate species. Similarly many tropical species also occur at lower densities than temperate species. The net result of both would be that more tropical species would be categorised as threatened. Given the low densities of tropical species, applying area of occupancy as a surrogate for adult population size, tropical species are likely to be under evaluated. For example, the population in 20,000 sq.km. in tropics may be the same as in, say, 2000 sq.km. in temperate regions.

3. *Disagreement with perception*: In many cases the criteria gave categories that the participants were not prepared to accept because of it did not agree with their perception (This is when some of the participants felt that the criteria were not applicable to tropics, especially India). This happened in the case of species such as elephants, leopards and tigers, which on the basis data provided by the participants were classified as Endangered and not as Critically Endangered. While the population decline criteria was clearly not met, the participants were also not prepared to project population decline into the future. At the same time the participants felt that the species were Critically Endangered in terms of the threats that they faced and conservation action that they demanded. It was also felt that Conservation Dependent was an inappropriate category for such species.

4. *Definition of Area of Occupancy*: Definition of area of occupancy, a criterion often used, was difficult for taxa that were sedentary (*e.g.* plants) or confined to micro habitats (*e.g.* fishes). In the case of mobile animals such as mammals area of occupancy was taken as the area of the habitat in which they lived. This did not clearly relate to some taxa such as plants that are sedentary, and fishes which have linear habitats.

5. *Lack of quantitative thresholds in subcriteria*: The applicability of same criteria and threat values to taxa with diverse life histories was a matter of concern. Most participants, however, appreciated the need for quantitative criteria, since this would generate better common understating of the taxa that were assessed. Criterion B was the most widely used, accounting for more than 50% of the species that were categorised. For most of the lesser known taxa, this is the criterion most likely to be used. The subcriteria under this are however the least quantitative among all the criteria.

6. *Conservation Dependent category*: This was a category that few participants felt familiar with. Other than captive breeding -release program, the participants were unsure whether conservation measures such as control of poaching, protected area net work, wildlife schedules *etc.* would make a species conservation dependent. This is especially go since the survival of many species is dependent on such conservation measures

7. *The concept of generation length*: The concept of generation length was not easily understood by most participants, even though this is used extensively in population ecology to compare taxa of different body size and life span. The application of this criteria can lead to many plants being assessed as threatened as happened in the case of mangrove plant. Long generation time of many trees and some animals can lead to recent trends including recovery being ignored.

8. *The concept of population fragmentation*: The concept of population fragmentation as opposed to the number of locations was easily understood for some taxa (*e.g.* terrestrial vertebrates) where both were the same. In some taxa *e.g.* mangrove plants, these two were not the same because of the high dispersal capabilities of the taxa concerned.

9. *Changes in habitat quality*: While using criteria B it was assumed that any changes in habitat quality is necessarily not good for the species. This is not always the case since moderate disturbances to the habitat often increase the abundance of many species.

10. *Inference and extrapolation*: The revised IUCN categories has improved objectivity by providing numerical thresholds for most criteria with guidelines on evaluation of different factors that affect risk of extinction (Stattersfield 1996). However, data to evaluate the threshold were lacking even in the best studied species (*e.g.* larger mammals) as has been found to be the case in global assessment of birds (*op cit*). Hence the need for inference and extrapolation. The inference and extrapolation applied to different taxa varied. For example, the herpetologists are more often conversant with the micro habitats and macrohabitats of the taxa they studied, but rarely with population densities or numbers. They have therefore used area of occupancy (derived from habitat area) and perceived changes in the quality of the habitat (*e.g.* logging, degradation, soil characteristics) or criteria B as the basis for assessment. In contrast, mammalogists applied a wide variety of criteria and subcriteria

11. *Problems of scale:* The application of IUCN categories at regional or national scale presents certain problems, when population of species extent outside the region or nation for which the assessment is being made. This is so because the IUCN categories have been developed primarily for assessment of the entire population of the species *i.e.* global assessment (Gardenfors 1996), clear guidelines are yet to come by. Global and regional assessments give the same results if the species is endemic to the region under assessment. For non-endemics demographic interactions between the region of assessment and neighbouring populations if any could enhance the survival or reduce extinction risk (Gardenfors 1996). Due to problems of scale regional assessment would give an extinction risk to species that is higher than global assessment

12. *Data quality*: Almost all participants were unsatisfied with the quality of data that was used to categorise species. Pooling of unpublished data held by different individuals made available data on many species that there previously thought to be non-existent. The accuracy of data that was used for almost all criteria was far from satisfactory. However, the most reliable estimates were those on area and range of occupancy (as required by criteria B). This was the most frequently used criterion. However, as mentioned earlier, the subcriteria under this are the most qualitative. Even in cases where data existed. *e.g.* many large mammals, fisheries, Forest Survey of India's State of the Forest Reports, the participants felt that the data quality or details did not allow it to be used for assessment using the revised IUCN criteria.

Data on the abundance of large mammals (elephants, ungulates, and carnivores) are available for many protected areas in India, especially Project Tiger areas, for the last two decades. There were several concerns about this data as a result of which this was mostly not used for assessment. First, being limited to protected areas, this data set did not represent the situation in the rest of India. For example, while the population of large mammals may have increased in the protected areas as shown by the data, the perception of the participants was that it has gone down in the areas outside. Second, the methods that have been used to estimate abundance have been questioned for their statistical rigour (see Section 8.1).

Some data was available on fish catch for the last several years. However data on species which were taken up for assessment were often not available. The participants also felt that this data do not represent the depletion that many species have undergone. This is because fishing fleets often moved on to another locality after depleting one. The State of the Forest Reports produced periodically by the Forest Survey of India (FSI), also were of little use while making an assessment of habitat loss (or to assess Criteria B). This was because the assessment by FSI is based on broad categories of canopy cover with out references to vegetation type. Animal ecologists often associate species with habitat types. Inferences on changes in distribution and population can be made in relation to loss or changes in quality of habitat or vegetation type. Such data was however not available from FSI reports.

Another data set that was available was from records of trade, legal and illegal. Such records are available for medicinal plants, animal parts confiscated *etc.* However there was no framework for incorporating this into the assessment.

13. *Other difficulties*: Other difficulties encountered included those discussed by Collar *et al.* (1994); application of criterion D, species with wide distribution being Critically endangered because of habitat changes compared to highly restricted species with no habitat change; and difficulties in separating Least Concern from Near Threatened under Low Risk.

14. *Documentation*: The need to document the details and appropriate references on the basis of which the assessment was made was emphasised by everybody. This document should be widely circulated.

Comparison with Global Assessment

It is worth while to compare the assessments done under this project with that done by IUCN (1996). Such a comparison is possible only for mammals, since birds not were assessed under the project, and most of the other taxa were not assessed under the IUCN assessment. A total of 75 Indian mammals have been categorised as globally threatened by IUCN, 8 as Critically Endangered, 21 as Endangered and 46 as Vulnerable. It is not known how many Indian mammals were actually assessed. Of these 75 species, 56 were also assessed under this project, the remaining being data deficient (10 species), or not evaluated (7 species). Of the 56 species, 46 (82.1%) were also abscessed as threatened under this project. There is thus considerable overlap between both the assessments. However, only 43.0% species (24 species) were given the same category as the IUCN category, while 32% (18 species) were given a lower category and 25% (14 species) were given a higher category. Most of the higher category were for those species that also occur outside India, while those that were given a lower category were mostly Indian endemics, or those found in India, Nepal, Bhutan and Bangladesh. It is expected that due to problems of scale, national or regional assessment would give a higher category than global assessment for those species that also occur outside the nation or region. The assignment of lower categories to species of India or Indian subregion indicates that, generally the assessment has been conservative, compared to IUCN global assessment. The unexpectedly high percentage of threatened species, not only in mammals (45.3%) but also in the other taxa, therefore, is probably an underestimate. The percentage of threatened species among the mammals that we assessed (45.3han the assessment by IUCN for mammals of the world (30%). This is mostly due to the national assessment of many species, and also because we included many Indian endemics that may not have been assessed by IUCN. The threatened species in the lower vertebrates in India is far greater, compared to that is reported globally, 20% for reptiles, 25% for amphibians and 34% for fishes. Only 16 reptiles, 3 amphibians, 4 fishes and 22 invertebrates of India have been listed as threatened by the IUCN. The major reason for this large difference is perhaps the low coverage of tropical species by IUCN's global assessment, as also greater endangerment of Indian species.

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Appendix 1. Alphabetical list of Medicinal Plants assessed at the workshop

Taxon	*Family*	*Category**	*Criteria***
Aconitum balfourii Stapf	Ranunculaceae	CR	(A1acd; B1, 2abc)
Aconitum deinorrhizum Stapf	Ranunculaceae	CR	(A1acd; B1, 2abc)
Aconitum falconeri Stapf	Ranunculaceae	CR	(B1, 2abc)
Aconitum ferox Wall. Ex Ser.	Ranunculaceae	CR	(A1acd; B1, 2abc)
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	CR	(B1, 2abcde)
Aconitum violaceum Jacq. ex Stapf	Ranunculaceae	CR	(A1acd; B1, 2abc)
Acorus calamus L.	Araceae	VU	(B1, 2bc)
Angelica glauca Edgew.	Apiaceae	CR	(A1acd)
Aquilaria malaccensis Lam.	Thymelaeaceae	CR	(A1acd)
Arnebia benthamii (Wall. ex G.Don) Johnston	Boraginaceae	CR	(A1acd)
Atropa acuminata Royle ex Lindl.	Solanaceae	CR	(A1acd)
Baliospermum montanum Muell.-Arg.	Euphorbiaceae	LR nt	
Berberis aristata DC.	Berberidaceae	EN	(A1acd)
Berberis chitria Lindl.	Berberidaceae	EN	(B1, 2c)
Berberis kashmirana Ahrendt.	Berberidaceae	CR	(A1acd; B1, 2abc)
Berberis lycium Royle var. *simlensis* Ahrendt.	Berberidaceae	EN	(B1, 2c)
Berberis petiolaris Wall. ex G.Don var. *garhwalana* Ahrendt.	Berberidaceae	CR	(A1acd; B1, 2abc)
Bergenia ciliata (Haw.) Sternb.	Saxifragaceae	VU	(A1acd; B1, 2c)
Bunium persicum Boiss Fedtsch.	Apiaceae	EN	(A1acd)
Butea monosperma var. *lutea* (Witt.) Maheswari	Papilionaceae	DD	
Celastrus paniculata Willd.	Celastraceae	LR nt	
Cinnamomum tamala (Ham.) Nees & Eberm.	Lauraceae	LR nt	
Clerodendrum colebrookianum	Verbenaceae	VU	(A1acd)
Clerodendrum serratum (L.) Moon	Verbenaceae	VU	(A1c)
Coptis teeta Wall.	Ranunculaceae	CR	(A1acd)
Cordia rothii Roem & Schultz	Ehretiaceae	LR nt	
Costus lacerus	Zingiberaceae	DD	
Crateriostigma plantagineum Hochst.	Scrophulariaceae	CR	(B1, 2c)
Curculigo orchioides Gaertn.	Amaryllidaceae	VU	(A1acd)
Curcuma angustifolia Roxb.	Zingiberaceae	LR nt	
Curcuma caesia Roxb.	Zingiberaceae	CR	(A1acd)
Dactylorhiza hatagirea D.Don	Orchidaceae	CR	(A1acd)
Delphinium denudatum Wall. ex Hook.f. & Thoms.	Ranunculaceae	CR	(A1c; B1, 2c)
Dioscorea deltoidea Wall. ex Kunth.	Dioscoreaceae	CR	(A1acd)
Drymia indica (Roxb.) Jessop.	Liliaceae	VU	(A1acd)
Evolvulus alsinoides L.	Convolvulaceae	LR nt	
Fritellaria roylei Hook.	Ariaceae	CR	(A1acd)
Gastrochilus longiflora	Zingiberaceae	CR	(B1, 2c)
Gentiana kurroo Royle	Gentianaceae	CR	(A1acd)
Gloriosa superba L.	Liliaceae	EN	(A1acd; B1, 2c)
Gymnema sylvestre (Retz) R. Br.	Asclepiadaceae	VU	(A1acd; B1, 2c)
Hedychium coronarium Koering	Zingiberaceae	EN	(B1, 2c)

* Ex: Extinct; EW: Extinct in the Wild; CR: Critically Endangered; EN: Endangered; VU: Vulnerable; LR: Lower Risk; CD: Conservation Dependent; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated

Appendix 2. Alphabetical list of Soil Invertebrates assessed at the workshop

Species	*Class/Order*	*Category*	*Criteria*
Acanthaspis alagiriensis	Insecta / Hemiptera	CR	(B1, 2c)
Acanthaspis carinata	Insecta / Hemiptera	CR	(B1, 2c)
Acanthaspis minutum	Insecta / Hemiptera	VU	(D2)
Acanthaspis nigripes	Insecta / Hemiptera	VU	(D2)
Acanthaspis pedestris	Insecta / Hemiptera	LR-nt	
Acanthaspis siruvani	Insecta / Hemiptera	VU	(D2)
Alstonitermes flavescens	Insecta / Isoptera	EN	(A1ac; B1, 2abc)
Amblyopone bellii	Insecta / Hymenoptera	DD	
Aularchis miliaris	Insecta / Orthoptera	LR-nt	
Bellamya bengalensis	Pelecypoda / Megagastropoda	LR-nt	
Bellamya dissimilis	Pelecypoda / Megagastropoda	LR-nt	
Bithynia stenothyroides	Pelecypoda / Megagastropoda	VU	(B1, 2ac)
Chondromorpha kelaarki	Myriapoda / Polydesmida	LR-lc	
Corbicula regularis	Pelecypoda/Eulamellibranchiata	DD	
Crematogaster rogenhoferi	Insecta / Hymenoptera	LR-lc	
Cypris dravidensis	Oristacca / Podocopida	EN	B1, 2c
Cypris protubera	Oristacca / Podocopida	EN	(B1, 2ac)
Cypris subglobosa	Oristacca / Podocopida	LR-nt	
Dichogaster curgensis	Oligochaeta / Lumbricina	LR-lc	
Drawida nilamburensis	Oligochaeta / Moniligastreda	CR	(B1, 2abc)
Ectrychotes bharathi	Insecta/Hemiptera	CR	(B1, 2c)
Edocia punctatum	Insecta / Hemiptera	CR	(B1, 2c)
Edocla heberii	Insecta / Hemiptera	CR	(B1, 2c)
Edocla maculatus	Insecta / Hemiptera	EN	(B1, 2c)
Eucoptacrella ceylonica	Insecta / Orthoptera	CR	(B1, 2abc)
Eucypris bispinosa	Oristacca / Podocopida	CR	(B1, 2ac)
Gyraulus convexiusculus	Pelecypoda / Basommatophora	VU	(B1, 2ac)
Gyraulus saigonensis	Pelecypoda / Basommatophora	LR-nt	
Haematorrhophus fovealis	Insecta / Hemiptera	CR	(B1, 2c)
Haematorrhophus ruguloscutellaris	Insecta / Hemiptera	VU	(D2)
Hemihaematorrhophus planidorsatus	Insecta/Hemiptera	EN	(B1, 2c)
Heterometrus barberi	Arachnida / Scorpiones	EN	(B1, 2c)
Heterometrus keralensis	Arachnida/Scorpiones	EN	(B1, 2c)
Heterometrus malapuramensis	Arachnida / Scorpiones	VU	(A1c, B1, 2ac)
Heterometrus swammerdami	Arachnida / Scorpiones	VU	(A1a, 1c)
Ilyocryptus spinifer	Oristacca / Cladocera	LR-nt	
Indoplanorbis exustus	Pelecypoda / Basommatophora	LR-nt	
Isometrus brachycentrus	Arachnida / Scorpiones	VU	(B1, 2ac)
Lamellidens marginalis	Pelecypoda /Eulamethibranchia	LR-nt	
Lychas tricarinatus	Arachnida / Scorpiones	LR-lc	

Contd. . . .

Species	*Class/Order*	*Category*	*Criteria*
Lymnaea acuminata	Pelecypoda / Basommatophora	NE	
Lymnaea luteola	Pelecypoda / Basommatophora	LR-nt	
Macrotermes estherae	Insecta/Isoptera	EN	(B1, 2abcd)
Macrothrix laticornis	Oristacca / Cladocera	LR-nt	
Melania scabra	Pelecypoda / Megagastropoda	VU	(A1c)
Melania tuberculata	Pelecypoda / Megagastropoda	VU	(A1c)
Meranoplus bellii	Insecta / Hymenoptera	DD	
Mesacanthaspis kovaiensis	Insecta / Hemiptera	CR	(B1, 2c)
Mesobuthus hendersoni	Oligochaeta / Lumbricina	LR-lc	
Microcerotermes fletcheri	Insecta / Isoptera	VU	(A1ac; B1, 2abc)
Mysorella costigera	Pelecypoda / Megagastropoda	LR-nt	
Nasutitermes indicola	Insecta / Isoptera	VU	(A1ac; B1, 2ac)
Ocnerodrilus occidentalis	Arachnida / Scorpiones	EN	(B1, 2c)
Octochaetona serrata	Oligochaeta / Lumbricina	VU	(B1, 2ce)
Octonochaeta rosea	Oligochaeta / Lumbricina	Lr-nt	(B1, 2c)
Ocypoda ceratophthalma	Oristacca / Decapoda	LR-nt	
Ocypoda cordimana	Oristacca / Decapoda	EN	(B1, 2ac)
Ocypoda macrocera	Oristacca / Decapoda	EN	(B1, 2bc)
Ocypoda platytarsis	Oristacca / Decapoda	VU	(A1c)
Odontotermes brunneus	Insecta / Isoptera	VU	(A1ac; B1, 2ac)
Odontotermes wallonensis	Insecta / Isoptera	VU	(B1, 2c)
Oecophylla smaragdina	Insecta / Hymenoptera	LR-lc	
Paludomus monile	Pelecypoda / Megagastropoda	EN	(B1, 2b)
Paludomus stomatodon	Pelecypoda / Megagastropoda	CR	(B1, 2b)
Paludomus tanschaurica	Pelecypoda / Megagastropoda	VU	(A1c)
Parreysia corrugata	Pelecypoda/Eulamelibranchiata	VU	(B1, 2ac)
Perionyx excavatus	Oligochaeta / Lumbricina	LR-nt	
Phyllogonostreptus nigrolabiatus	Myriapoda / Spirostreptida	LR-nt	
Pila globosa	Pelecypoda / Megagastropoda	VU	(A1c)
Pila virens	Pelecypoda / Megagastropoda	VU	(B1, 2ac)
Plagiolepis jerdonii	Insecta / Hymenoptera	LR-lc	
Poekilocerus pictus	Insecta / Orthoptera	LR-lc	
Polydrepanum tamilum	Myriapoda / Polydesmida	LR-nt	
Psilacrum convexa	Insecta / Diptera	CR	(B1,2abc)
Sechelleptus importatus	Myriapoda / Spirostreptida	CR	(B1, 2c)
Speculitermes singalensis	Insecta / Isoptera	EN	(B1, 2c)
Strandesia bicornuta	Oristacca / Podocopida	EN	(B1, 2a)
Strandesia elongata	Oristacca / Podocopida	EN	(B1, 2a)
Strandesia flavescens	Oristacca / Podocopida	EN	(B1, 2a)
Strandesia indica	Oristacca / Podocopida	VU	(B1,2ac)
Strandesia labiata	Oristacca / Podocopida	LR-nt	

Contd. . . .

Species	*Class/Order*	*Category*	*Criteria*
Strandesia purpurascens	Oristacca / Podocopida	EN	(B1, 2ac)
Streptogonopus jerdoni	Myriapoda / Polydesmida	EN	(B1, 2c)
Sulcospira hugeli	Pelecypoda / Megagastropoda	EN	(B1, 2ac)
Synectrychotes calimerei	Insecta / Hemiptera	CR	(B1, 2c)
Tetramorium rossi	Insecta / Hymenoptera	DD	
Tetraponera aitkeni	Insecta / Hymenoptera	LR-lc	
Thelyphonus sepiaris	Arachnida / Uropygi	LR-nt	
Tricimbomyia muzhiyarensis	Insecta / Diptera	CR	(B1, 2c)
Trinervitermes biformis	Insecta / Isoptera	VU	(A1ac; B1, 2c)
Truxalis indica	Insecta / Orthoptera	EN	(B1, 2c)
Velitra neelai	Insecta / Hemiptera	DD	
Viviparus variata	Pelecypoda / Megagastropoda	EN	(B1, 2bc)
Xenobolus acuticonus	Myriapoda / Spirobolida	LR-nt	
Zarytes squalina	Insecta / Orthoptera	CR	(B1, 2ab)

Appendix 3. Alphabetical list Amphibians assessed at the workshop

Species	*Family*	*IUCN*	*Criteria*
Ansonia kamblei Ravichandan & Pillai	Bufonidae	DD	--
Ansonia ornata Günther	Bufonidae	EN	(B1, 2c)
Ansonia rubigina Pillai & Pattabhiraman	Bufonidae	EN	(B1, 2c, 3b)
Bufo abatus Ahl	Bufonidae	DD	--
Bufo beddomii Günther	Bufonidae	LRlc	--
Bufo brevirostrisRao	Bufonidae	DD	--
Bufo camortensis Mansukhani & Sarkar	Bufonidae	VU	(D2)
Bufo hololius (Günther)	Bufonidae	LR-nt	--
Bufo koynayensis Soman	Bufonidae	EN	(B1, 2c)
Bufo parietalis Boulenger	Bufonidae	LRnt	--
Bufo silentvalleyensis Pillai	Bufonidae	VU	(D2)
Bufoides meghalayanus(Yazdani & Chanda)	Bufonidae	CR	(B1, 2a, 2b, 2c)
Chirixalus dudhwaensis Ray	Rhacophoridae	VU	(D2)
Euphlyctis ghoshi (Chanda)	Ranidae	EN	(B1, 2a, 2b, 2c)
Gegeneophis carnosus (Beddome)	Caeciliidae	VU	(B1, 2c)
Gegeneophis fulleri (Alcock)	Caeciliidae	VU	(B1, 2a, 2c)
Gegeneophis ramaswamii Taylor	Caeciliidae	EN	(B1, 2c)
Ichthyophis beddomei Peters	Ichthyophiidae	VU	(A1a, 1c; B1, 2c)
Ichthyophis bombayensis Taylor	Ichthyophiidae	EN	(B1, 2c)
Ichthyophis longicephalus Pillai	Ichthyophiidae	VU	(B1, 2c)
Ichthyophis malabarensis Taylor	Ichthyophiidae	VU	(B1, 2c)
Ichthyophis peninsularis Taylor	Ichthyophiidae	VU	(B1, 2c; D2)
Ichthyophis sikkimensis (Taylor)	Ichthyophiidae	VU	(B1, 2c)
Ichthyophis subterrestris Taylor	Ichthyophiidae	VU	(B1, 2c)
Ichthyophis tricolor Taylor	Ichthyophiidae	EN	(B1, 2c)
Indirana beddomii Günther	Ranidae	VU	(A1a, 1c)
Indirana brachytarsus (Günther)	Ranidae	VU	(B1, 2b)
Indirana diplostictus (Günther)	Ranidae	VU	(B1, 2c)
Indirana gundia Dubois	Ranidae	DD	--
Indirana leithii (Boulenger)	Ranidae	LR-nt	--
Indirana leptodactylus (Boulenger)	Ranidae	VU	(B1, 2c)
Indirana phrynoderma	Ranidae		
Indirana semipalmatus (Boulenger)	Ranidae	VU	(A1a, 1c; B1, 2c)
Indirana tenuilingua (Rao)	Ranidae	DD	--
Indotyphlus battersbyi Taylor	Caeciliidae	CR	(B1, 2b, 2c)
Kaloula baleata ghoshi Cherchi	Microhylidae	VU	(D2)
Limnonectes andamanensis (Stoliczka)	Ranidae	LR-lc	--
Limnonectes brevipalmatas (Peters)	Ranidae	LR-nt	--
Limnonectes keralensis (Dubois)	Ranidae	LR-nt	--
Limnonectes khasiensis (Anderxon)	Ranidae	DD	--
Limnonectes mawlyndipi (Chanda)	Rhacophoridae	CR	(B1, 2a, 2c)
Limnonectes mawphlangensis (Pillai & Chanda)	Ranidae	CR	(B1, 2a, 2c)
Limnonectes murthii Pillai	Ranidae	EN	(B1, 2c)

Contd. . . .

Species	Family	IUCN	Criteria
Limnonectes mysorensis Rao	Ranidae	CR	(B1, 2c)
Limnonectes nilagirica (Jerdon)	Ranidae	EN	(B1, 2c)
Limnonectes sauriceps (Rao)	Ranidae	DD	--
Limnonectes shompenorum Das	Ranidae	EN	(B1, 2a, 2b, 2c)
Megophrys robusta (Boulenger)	Pelobatidae	EN	(B1, 2c)
Melanobatrachus indicus Beddome	Microhylidae	VU	(B1, 2c, 3c; D2)
Micrixalus fuscus (Boulenger)	Ranidae	LR-nt	--
Micrixalus gadgili Pillai & Pattabiraman	Ranidae	EN	(B1, 2c)
Micrixalus nudis Pillai	Ranidae	VU	(B1, 2c)
Micrixalus phyllophilus (Jerdon)	Ranidae	VU	(B1, 2c)
Micrixalus saxicola (Jerdon)	Ranidae	LR-nt	--
Micrixalus silvaticus (Boulenger)	Ranidae	VU	(B1, 2c)
Micrixalus thampii Pillai	Ranidae	EN	(B1, 2c)
Microhyla chakrapani Pillai	Microhylidae	VU	(D2)
Nyctibatrachus aliciae Inger, Shaffer, Koshy & Bakdd	Ranidae	VU	(B1, 2c)
Nyctibatrachus beddomii (Boulenger)	Ranidae	LR-nt	--
Nyctibatrachus deccanensis Dubois	Ranidae	VU	(B1, 2c)
Nyctibatrachus humayuni Bhaduri & Kripalani	Ranidae	EN	(B1, 2c)
Nyctibatrachus kempholeyensis (Rao)	Ranidae	DD	--
Nyctibatrachus major Boulenger	Ranidae	LR-nt	--
Nyctibatrachus minor Inger, Shaffer, Koshy & Bakde	Ranidae	VU	(B1, 2c; D2)
Nyctibatrachus sanctipalustris Rao	Ranidae	EN	(B1, 2c)
Nyctibatrachus sylvaticus Rao	Ranidae	DD	--
Pedostibes kempi (Boulenger)	Bufonidae	CR	(B1, 2a, 2b, 2c)
Pedostibes tuberculosus Günther	Bufonidae	VU	(B1, 2c)
Philautus beddomii (Günther)	Rhacophoridae	VU	(B1, 2c)
Philautus bombayensis (Annandale)	Rhacophoridae	EN	(B1, 2c)
Philautus chalazodes Günther	Rhacophoridae	VU	(B1, 2c, D2)
Philautus charius Rao	Rhacophoridae	LR-nt	--
Philautus cherrapunjiae Roonwall & Kripalani	Rhacophoridae	EN	(B1, 2a, 2c)
Philautus crnri Dutta	Rhacophoridae	DD	--
Philautus elegans Rao	Rhacophoridae	DD	--
Philautus flaviventris (Boulenger)	Rhacophoridae	DD	--
Philautus garo (Boulenger)	Rhacophoridae	CR	(B1, 2b, 2c)
Philautus glandulosus (Jerdon)	Rhacophoridae	VU	(B1, 2c)
Philautus hassanensis Dutta	Rhacophoridae	DD	--
Philautus kempiae (Boulenger)	Rhacophoridae	CR	(B1, 2a, 2b, 2c)
Philautus kottigeharensis Rao	Rhacophoridae	DD	--
Philautus leucorhinus (Lichtenstein & Martens)	Rhacophoridae	LR-nt	--
Philautus melanensis Rao	Rhacophoridae	DD	--
Philautus namdaphaensis Sarkar & Sanyal	Rhacophoridae	VU	(B1, 2c, D2)
Philautus narainensis Rao	Rhacophoridae	DD	--
Philautus nobeli (Ahl)	Rhacophoridae	DD	--
Philautus parkeri (Ahl)	Rhacophoridae	DD	--

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Philautus pulcherimus (Ahl)	Rhacophoridae	VU	(B1, 2c)
Philautus shillongensis Pillai & Chanda	Rhacophoridae	CR	(B1, 2a, 2b, 2c)
Philautus shyamrupus Chanda & Ghosh	Rhacophoridae	VU	(B1, 2c; D2)
Philautus signatus (Boulenger)	Rhacophoridae	VU	(B1, 2c)
Philautus swamianus Rao	Rhacophoridae	DD	--
Philautus temporalis Günther	Rhacophoridae	EN	(B1, 2c)
Philautus travancoricus (Boulenger)	Rhacophoridae	DD	--
Philautus variabilis (Günther)	Rhacophoridae	LR-nt	--
Phrynoglossus borealis (Annandale)	Ranidae	EN	(B1, 2c)
Polypedates cruciger (Blyth)	Rhacophoridae	VU	(B1, 2c,D2)
Polypedates insularis Das	Rhacophoridae	EN	(B1, 2a, 2b, 2c)
Ramanella anamalaiensis Rao	Microhylidae	DD	--
Ramanella minor Rao	Microhylidae	DD	--
Ramanella montana Jerdon	Microhylidae	LRnt	--
Ramanella mormorata Rao	Microhylidae	VU	(B1, 2b, 2c,D2)
Ramanella obscura	Rhacophoridae		
Ramanella palmatus	Rhacophoridae		
Ramanella triangularis (Günther)	Microhylidae	VU	(B1, 2c; D2)
Rana aurantiaca (Boulenger)	Ranidae	LR-nt	--
Rana curtipes Jerdon	Ranidae	LR-nt	--
Rana danieli Pillai & Chanda	Ranidae	LR-nt	--
Rana garoensis Boulenger	Ranidae	EN	(B1, 2a, 2b, 2c)
Rana khare (Kiyasetuo & Khare)	Ranidae	EN	(B1, 2c)
Rana malabarica Tschudi	Ranidae	LR-nt	--
Rana senchalensis Chanda	Ranidae	CR	(B1, 2a, 2b, 2c)
Rana travancorica Annandale	Ranidae	DD	--
Rhacophorus calcadensis Ahl	Rhacophoridae	DD	--
Rhacophorus jerdonii (Günther)	Rhacophoridae	VU	(B1, 2c; D2)
Rhacophorus lateralis Boulenger	Rhacophoridae	EN	(B1, 2c)
Rhacophorus malabaricus Jerdon	Rhacophoridae	LR-nt	--
Rhacophorus namdaphaensis Sarkar & Sanyal	Rhacophoridae	VU	(B1, 2c; D2)
Rhacophorus naso Annandale	Rhacophoridae	DD	--
Rhacophorus pleurostictus (Günther)	Rhacophoridae	VU	(B1, 2c)
Rhacophorus taeniatus Boulenger	Rhacophoridae	LR-nt	--
Rhacophorus tuberculatus (Anderson)	Rhacophoridae	LRnt	--
Scutiger occidentalis Dubois	Pelobatidae	DD	--
Tomopterna dobsonii	Ranidae	NE	
Tomopterna leucorhynchus Rao	Ranidae	DD	--
Tomopterna parambikulamana Rao	Ranidae	DD	--
Tomopterna rufescens (Jerdon)	Ranidae	LR-nt	--
Uraeotyphlus malabaricus (Beddome)	Uraeotyphlidae	EN	(B1, 2c)
Uraeotyphlus menoni Annandale	Uraeotyphlidae	VU	(B1, 2c; D2)
Uraeotyphlus narayani Seshachar	Uraeotyphlidae	VU	(B1, 2c)
Uraeotyphlus oxyurus (Dumeril & Bibron)	Uraeotyphlidae	VU	(B1, 2c)

Appendix 4. Alphabetical list of Reptiles assessed at the workshop

Taxon	*Family*	*IUCN*	*Criteria*
INDIAN ENDEMICS			
Ahaetulla dispar (Gunther)	Colubridae	LR-nt	-
Ahaetulla perroteti Dumeril, Bibron & Dumeril	Colubridae	EN	(B1, 2c)
Alsophylax boehmi Szczerbak	Gekkonidae	VU	(D2)
Amphiesma beddomei (Gunther)	Colubridae	LR-nt	-
Amphiesma khasiensis (Boulenger)	Colubridae	VU	(B1, 2c)
Amphiesma monticola (Jerdon)	Colubridae	VU	(B1, 2c; D2)
Amphiesma nicobariensis (Sclater)	Colubridae	DD	-
Amphiesma pealii (Sclater)	Colubridae	DD	-
Amphiesma xenura (Wall)	Colubridae	DD	-
Aspideretes leithii (Gray)	Trionychidae	VU	(A1b)
Barkudia insularis Annandale	Scincidae	EN	(B1, 2c)
Boiga andamanensis (Wall)	Colubridae	DD	-
Boiga dightoni (Boulenger)	Colubridae	EN	(B1, 2c)
Brachyophidium rhodogaster Wall	Uropeltidae	EN	(B1, 2c)
Bronchocela danieli (Tiwari & Biswas)	Agamidae	EN	(B1, 2c)
Bufoniceps laungwalansis (Sharma)	Agamidae	VU	(D2)
Bungarus andamanensis Biswas & Sanyal	Elapidae	VU	(D2)
Calliophis beddomei (Smith)	Elapidae	VU	(B1, 2c; D2)
Calliophis bibroni (Jan)	Elapidae	EN	(B1, 2c)
Calliophis melanurus nigrescens Gunther	Elapidae	LR-nt	-
Calodactylodes aureus (Beddome)	Gekkonidae	EN	(B1, 2bd)
Calotes ellioti Gunther	Agamidae	LR-nt	-
Calotes andamanensis Boulenger	Agamidae	VU	(D2)
Calotes grandisquamis Gunther	Agamidae	LR-nt	-
Calotes nemoricola Jerdon	Agamidae	VU	(B1, 2ac)
Calotes rouxii Dumeril & Bibron	Agamidae	LR-nt	-
Chalcides pentadactylus (Beddome)	Scincidae	CR	(B1, 2b)
Cnemaspis beddomei (Theobald)	Gekkonidae	VU	(B1, 2c; D2)
Cnemaspis boiei (Gray)	Gekkonidae	DD	-
Cnemaspis goaensis Sharma	Gekkonidae	CR	(B1, 2c)
Cnemaspis indica (Gray)	Gekkonidae	VU	(B1, 2ac; D2)
Cnemaspis jerdonii jerdonii (Theobald)	Gekkonidae	VU	(B1, 2bc; D2)
Cnemaspis littoralis (Jerdon)	Gekkonidae	LR-nt	-
Cnemaspis mysoriensis (Jerdon)	Gekkonidae	DD	--
Cnemaspis nairi Inger, Marx & Koshy	Gekkonidae	CR	(B1, 2ac)
Cnemaspis ornatus (Beddome)	Gekkonidae	VU	(B1, 2c)
Cnemaspis sisparensis (Theobald)	Gekkonidae	EN	(B1, 2ac)
Cnemaspis wynadensis (Beddome)	Gekkonidae	EN	(B1, 2bc)
Coluber bholanathi Sharma	Colubridae	VU	(D2)
Coluber gracilis (Gunther)	Colubridae	LR-nt	-

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Coronella brachyura (Gunther)	Colubridae	LR-nt	-
Coryphophylax subcristatus (Blyth)	Agamidae	LR-lc	-
Cyrtodactylus fasciolatus (Blyth)	Gekkonidae	VU	(D2)
Cyrtodactylus gubernatoris (Annandale)	Gekkonidae	DD	-
Cyrtodactylus khasiensis khasiensis (Jerdon)	Gekkonidae	VU	(B1, 2c; D2)
Cyrtodactylus lawderanus (Stoliczka)	Gekkonidae	VU	(D2)
Cyrtodactylus malcolmsmithi (Constable)	Gekkonidae	CR	(B1, 2c)
Cyrtodactylus mansarulus (Duda & Sahl)	Gekkonidae	CR	(B1, 2c)
Cyrtodactylus rubidus (Blyth)	Gekkonidae	VU	(D2)
Das*ia nicobarensis* Biswas & Sanyal	Scincidae	EN	(B1, 2abc)
Das*ia subcaeruleum* (Boulenger)	Scincidae	DD	-
Dendrelaphis grandoculis Boulenger	Colubridae	VU	(B1, 2c)
Dendrelaphis humayuni Tiwari & Biswas	Colubridae	VU	(D2)
Dendrelaphis pictus andamanensis (Anderson)	Colubridae	VU	(D2)
Dibamus nicobaricum (Fitzinger in: Steindachner)	Dibamidae	EN	(B1, 2c)
Dinodon gammiei (Blanford)	Colubridae	EN	(B1, 2c)
Draco dussumieri (Dumeril & Bibron)	Agamidae	LR-nt	-
Echis carinatus carinatus (Schenider)	Viperidae	LR-nt	-
Elaphe helena monticollaris Schulz	Colubridae	VU	(B1, 2c)
Enhydris dussumieri Dumeril, Bibron & Dumeril	Colubridae	EN	(B1, 2c)
Eryx whitakeri Das	Boidae	VU	(B1, 2c)
Eumeces poonaensis Sharma	Scincidae	CR	(B1, 2abc)
Gekko verreauxi (Tylter)	Gekkonidae	VU	(D2)
Geckoella dekkanensis (Gunther)	Gekkonidae	VU	(B1, 2c)
Geckoella jeyporensis (Beddome)	Gekkonidae	DD	-
Geckoella nebulosa (Beddome)	Gekkonidae	VU	(B1, 2c; D2)
Geoemyda silvatica Henderson	Bataguridae	VU	(B1, 2abc)
Gonglylosoma nicobariensis Stoliczka	Colubridae	DD	-
Hemidactylus anamallensis (Gunther)	Gekkonidae	VU	(B1, 2c; D2)
Hemidactylus giganteus Stoliczka	Gekkonidae	LR-nt	-
Hemidactylus gracilis Blanford	Gekkonidae	VU	(D2)
Hemidactylus maculatus maculatus Dumeril & Bibron	Gekkonidae	LR-lc	-
Hemidactylus mahendrai Shukla	Gekkonidae	VU	(D2)
Hemidactylus porbandarensis Sharma	Gekkonidae	VU	(D2)
Hemidactylus prashadi Smith	Gekkonidae	EN	(B1, 2c)
Hemidactylus reticulatus Beddome	Gekkonidae	LR-nt	-
Hemidactylus subtriedrus Jerdon	Gekkonidae	EN	(B1, 2c)
Hemiphyllodactylus typus aurantiacus Beddome	Gekkonidae	VU	(B1, 2c; D2)
Indotestudo forstenii (Schlegel & Muller)	Testudinidae	LR-nt	-
Japalura major (Jerdon)	Agamidae	CR	(B1, 2c)
Kachuga tentoria circumdata Mertens	Bataguridae	VU	(A1ac)
Kachuga tentoria tentoria (Gray)	Bataguridae	LR-nt	-

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Lipinia macrotympanum Stoliczka	Scincidae	VU	(D2)
Lycodon flavomaculatus Wall	Colubridae	VU	(B1, 2c)
Lycodon mackinnoni Wall	Colubridae	VU	(B1, 2bcd; D2)
Lycodon tiwarii Biswas & Sanyal	Colubridae	CR	(B1, 2c)
Lycodon travancoricus (Beddome)	Colubridae	LR-nt	-
Lygosoma ashwamedhi (Sharma)	Scincidae	VU	(D2)-
Lygosoma goaensis (Sharma)	Scincidae	DD	-
Lygosoma guentheri (Peters)	Scincidae	LR-nt	-
Lygosoma lineata (Gray)	Scincidae	LR-nt	-
Lygosoma pruthi (Sharma)	Scincidae	CR	(B1, 2c)
Mabuya allapallensis Schmidt	Scincidae	EN	(B1, 2c)
Mabuya andamanensis Smith	Scincidae	VU	(D2)
Mabuya clivicola Inger, Shaffer, Koshy & Bakde	Scincidae	EN	(B1, 2c)
Mabuya gansi Das	Scincidae	VU	(D2)
Mabuya innotatus (Blanford)	Scincidae	DD	-
Mabuya nagarjuni Sharma	Scincidae	EN	(B1, 2c)
Mabuya trivittata (Hardwicke & Gray)	Scincidae	LR-lc	-
Mabuya tytlerii (Tytler's in : Theobald)	Scincidae	VU	(D2)
Melanochelys trijuga coronata (Anderson)	Bataguridae	VU	(A1c)
Melanochelys trijuga trijuga (Schweigger)	Bataguridae	LR-nt	-
Melanophidium bilineatum Beddome	Uropeltidae	DD	-
Melanophidium punctatum Beddome	Uropeltidae	VU	(B1, 2c)
Melanophidium wynaadensis (Beddome)	Uropeltidae	DD	-
Mictopholis austeniana (Annandale)	Agamidae	CR	(B1, 2c)
Naja sagittifera Wall	Elapidae	CR	(B1, 2c)
Oligodon affinis Gunther	Colubridae	LR-nt	-
Oligodon brevicaudus Gunther	Colubridae	LR-nt	-
Oligodon erythrorhachis Wall	Colubridae	DD	-
Oligodon juglandifer (Wall)	Colubridae	EN	(B1, 2bcd)
Oligodon melaneus Wall	Colubridae	DD	-
Oligodon melazonotus Wall	Colubridae	DD	-
Oligodon nikhili Whitaker & Dattatri	Colubridae	CR	(B1, 2cde)
Oligodon travancoricum Beddome	Colubridae	EN	(B1, 2abc)
Oligodon venustum Jerdon	Colubridae	LR-nt	-
Oligodon woodmasoni (Sclater)	Colubridae	DD	-
Ophisops leschenaultii leschenaultii (Milne-Edwards)	Lacertidae	LR-lc	-
Ophisops beddomei (Jerdon)	Lacertidae	LR-nt	-
Ophisops microlepis (Blanford)	Lacertidae	LR-lc	-
Ophisops minor nictans Arnold	Lacertidae	LR-nt	--
Oriocalotes paulus Smith	Agamidae	EN	(B1, 2c)
Otocryptis beddomeii Boulenger	Agamidae	VU	(B1, 2c; D2)
Phelsuma andamanense Blyth	Gekkonidae	LR-lc	-

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Phrynocephalus alticola Peters	Agamidae	VU	(D2)
Platyplectrurus madurensis madurensis Beddome	Uropeltidae	EN	(B1, 2c)
Platyplectrurus trilineatus (Beddome)	Uropeltidae	VU	(B1, 2c)
Plectrurus aureus Beddome	Uropeltidae	DD	-
Plectrurus canaricus (Beddome)	Uropeltidae	DD	-
Plectrurus guentheri Beddome	Uropeltidae	VU	(D2)
Plectrurus perroteti Dumeril, Bibron & Dumeril	Uropeltidae	LR-lc	-
Psammophilus dorsalis (Gray)	Agamidae	LR-nt	-
Psammophis longifrons Boulenger	Colubridae	LR-nt	-
Pyxidea mouhotii (Gray)	Bataguridae	LR-nt	-
Rhabdops olivaceus (Beddome)	Colubridae	CR	(B1, 2c)
Rhinophis fergusonianus Boulenger	Uropeltidae	DD	-
Rhinophis sanguineus Beddome	Uropeltidae	DD	-
Rhinophis travancoricus Boulenger	Uropeltidae	DD	-
Ristella beddomii Boulenger	Scincidae	VU	(B1, 2bc)
Ristella guentheri Boulenger	Scincidae	VU	(B1, 2ac)
Ristella rurkii Gray	Scincidae	VU	(B1, 2bc)
Ristella travancoricus (Beddome)	Scincidae	VU	(B1, 2b; D2)
Salea anamallayana (Beddome)	Agamidae	EN	(B1, 2ac)
Salea horsfieldii (Gray)	Agamidae	EN	(B1, 2ac)
Scincella bilineatum (Gray)	Scincidae	DD	-
Scincella macrotis (Fitzinger in: Steindachner)	Scincidae	VU	(D2)
Scincella tragbulense (Alcock)	Scincidae	VU	(D2)
Scincella travancoricum (Beddome)	Scincidae	VU	(B1, 2b)
Sepsophis punctatus Beddome	Scincidae	EN	(B1, 2bd)
Sibynophis subpunctatus subpunctatus (Dumeril, Bibron & Dumeril)	Colubridae	LR-nt	-
Sphenomorphus courcyanum (Annandale)	Scincidae	VU	(B1, 2c; D2)
Stoliczkaia khasiensis Jerdon	Colubridae	DD	-
Takydromus haughtonianus (Jerdon)	Lacertidae	VU	(D2)
Teratolepis albofasciatus (Grandison & Soman)	Gekkonidae	DD	-
Teretrurus sanguineus Beddome	Uropeltidae	DD	-
Trachischium laeve Peracca	Colubridae	DD	-
Trimeresurus cantori Blyth	Viperidae	VU	(D2)
Trimeresurus gramineus (Shaw)	Viperidae	LR-nt	-
Trimeresurus labialis Fitzinger in Steindachner	Viperidae	DD	-
Trimeresurus macrolepis Beddome	Viperidae	LR-nt	-
Trimeresurus malabaricus (Jerdon)	Viperidae	LR-nt	-
Trimeresurus purpureomaculatus andersoni Theobald	Viperidae	VU	(D2)
Trimeresurus strigatus Gray	Viperidae	LR-nt	-
Trimereurus huttoni Smith	Viperidae	CR	(B1, 2c)
Typhlops andamanensis Stoliczka	Typhlopidae	DD	-

Contd. . . .

Taxon	*Family*	*IUCN*	. *Criteria*
Typhlops beddomi Boulenger	Typhlopidae	VU	(B1, 2c; D2)
Typhlops bothriorhynchus Gunther	Typhlopidae	DD	-
Typhlops loveridgei Constable	Typhlopidae	DD	-
Typhlops oatesii Boulenger	Typhlopidae	VU	(D2)
Typhlops oligolepis Wall	Typhlopidae	EN	(B1, 2c)
Typhlops tennuicollis (Peters)	Typhlopidae	CR	(B1, 2c)
Typhlops thurstoni Boettger	Typhlopidae	DD	-
Typhlops tindalli Smith	Typhlopidae	DD	-
Uropeltis macrolepis (Peter)	Uropeltidae	VU	(B1, 2c)
Uropeltis arcticeps (Gunther)	Uropeltidae	LR-nt	-
Uropeltis beddomii (Gunther)	Uropeltidae	DD	-
Uropeltis broughami (Beddome)	Uropeltidae	DD	-
Uropeltis ceylanicus Cuvier	Uropeltidae	LR-lc	-
Uropeltis dindigalensis (Beddome)	Uropeltidae	CR	(B1, 2c)
Uropeltis ellioti (Gray)	Uropeltidae	LR-nt	-
Uropeltis liura (Gunther)	Uropeltidae	EN	(B1, 2c)
Uropeltis macrorhynchus (Beddome)	Uropeltidae	DD	--
Uropeltis maculatus (Beddome)	Uropeltidae	EN	(B1, 2c)
Uropeltis myhendrae Beddome	Uropeltidae	DD	-
Uropeltis nitidus (Beddome)	Uropeltidae	DD	-
Uropeltis ocellatus (Beddome)	Uropeltidae	LR-lc	--
Uropeltis petersi (Beddome)	Uropeltidae	DD	-
Uropeltis phipsonii (Mason)	Uropeltidae	LR-nt	-
Uropeltis pulneyensis (Beddome)	Uropeltidae	EN	(B1, 2c)
Uropeltis rubrolineatus (Gunther)	Uropeltidae	LR-nt	-
Uropeltis rubromaculatus (Beddome)	Uropeltidae	EN	(B1, 2c)
Uropeltis smithi Gans	Uropeltidae	DD	-
Uropeltis woodmasoni (Thebold)	Uropeltidae	EN	(B1, 2c)
Varanas salvator nicobariensis Deraiyagala	Varanidae	LR-nt	--
Varanus salvator andamanensis Deraniyagala	Varanidae	VU	(A1a, 1c)
Xylophis perroteti Dumeril, Bibron & Dumeril	Colubridae	VU	(B1, 2c; D2)
Xylophis stenorhynchus (Gunther)	Colubridae	EN	(B1, 2c)
NON-ENDEMICS			
Ablepharus grayanus (Stoliczka)	Scincidae	DD	-
Ablepharus pannonicus Fitzinger in: Lichtenstein in: Eversmann	Scincidae	DD	-
Acanthodactylus blanfordii Boulenger	Lacertidae	DD	-
Acanthodactylus cantoris Gunther	Lacertidae	LR-nt	-
Acrochordus granulatus (Schneider)	Acrochordidae	LR-nt	-
Agkistrodon himalayanus (Gunther)	Viperidae	DD	-
Ahaetulla fronticincta (Gunther)	Colubridae	DD	-
Ahaetulla nasutus (Andersson)	Colubridae	LR-nt	-

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Ahaetulla prasina prasina (Reinwardt in: Boie)	Colubridae	EN	(B1, 2c)
Ahaetulla pulverulenta (Dumeril, Bibron & Dumeril)	Colubridae	LR-nt	-
Amphiesma modesta (Gunther)	Colubridae	EN	(B1, 2c)
Amphiesma parallela (Boulenger)	Colubridae	EN	(B1, 2c)
Amphiesma platyceps (Blyth)	Colubridae	VU	(B1, 2c)
Amphiesma sieboldii (Gunther)	Colubridae	DD	-
Amphiesma stolata (Linnaeus)	Colubridae	LR-nt	-
Argyrogena fasciolatus (Shaw)	Colubridae	LR-nt	-
Aspideretes gangeticus (Cuvier)	Trionychidae	VU	(A1a,1c,1d)-
Aspideretes hurum (Gray)	Trionychidae	LR-nt	-
Astrotia stokesii (Gray)	Hydrophiidae	DD	-
Atretium schistosum (Daudin)	Colubridae	LR-nt	-
Batagur baska baska (Gray)	Bataguridae	CR	(C2a)
Blythia reticulata (Blyth)	Colubridae	LR-nt	-
Boiga beddomei (Wall)	Colubridae	DD	-
Boiga cyanea (Dumeril, Bibron & Dumeril)	Colubridae	LR-nt	--
Boiga forsteni (Dumeril, Bibron & Dumeril)	Colubridae	LR-nt	-
Boiga multifasciata (Blyth)	Colubridae	VU	(B1, 2c)
Boiga multomaculata (Reinwardt in: Boie)	Colubridae	VU	(B1, 2c; D2)
Boiga nuchalis (Gunther)	Colubridae	LR-nt	-
Boiga ocellata (Boie)	Colubridae	LR-nt	-
Boiga ochraceus ochraceus (Gunther)	Colubridae	VU	(B1, 2c; D2)
Boiga ochraceus stoliczkae (Wall)	Colubridae	DD	-
Boiga ochraceus Walli	Colubridae	DD	-
Boiga quincunciata (Wall)	Colubridae	DD	-
Boiga trigonatus trigonatus (Schneider)	Colubridae	LR-lc	-
Bungarus caeruleus (Schneider)	Elapidae	LR-nt	-
Bungarus fasciatus (Schneider)	Elapidae	LR-nt	-
Bungarus lividus Cantor	Elapidae	DD	-
Bungarus niger Wall	Elapidae	DD	-
Bungarus sindanus sindanus Boulenger	Elapidae	DD	-
Bungarus sindanus Walli	Elapidae	DD	-
Calamaria pavimentata (Dumeril, Bibron & Dumeril)	Colubridae	VU	(B1, 2c)
Calliophis macclellandi univirgatus (Gunther)	Elapidae	DD	-
Calliophis melanurus melanurus (Shaw)	Elapidae	LR-nt	-
Calotes calotes (Linnaeus)	Agamidae	LR-nt	-
Calotes jerdoni Gunther	Agamidae	DD	-
Calotes versicolor farooqi Auffenberg & Rehman	Agamidae	CR	(B1, 2c)
Calotes versicolor versicolor (Daudin)	Agamidae	LR-nt	-
Caretta caretta (Linnaeus)	Chelonidae	LR-nt	-
Cerberus rynchops rynchops (Schneider)	Colubridae	LR-nt	-
Chamaeleo zeylanicus Laurenti	Chamaeleonidae	VU	(A1ac)

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Chelonia mydas (Linnaeus)	Chelonidae	EN	(B1, 2c)
Chitra indica (Gray in : Griffith & Pidgeon)	Trionychidae	LR-nt	-
Chrysopelea ornata ornata (Shaw)	Colubridae	LR-nt	-
Chrysopelea paradisi H. paradisi H. Boie in: F. Boie	Colubridae	CR	(B1, 2c)
Cnemaspis kandianus (Kelaart)	Gekkonidae	LR-lc	-
Cnemaspis tropidogaster (Boulenger)	Gekkonidae	VU	(B1, 2c)
Coluber ventromaculatus Gray	Colubridae	LR-lc	-
Cosymbotus platyurus (Schneider)	Gekkonidae	LR-lc	-
Crocodylus palustris Lesson	Crocodylidae	VU	(B1, 2abcde)
Crocodylus porosus Schneider	Crocodylidae	EN	(B1, 2c; C2a)
Cuora amboinensis kamaroma Rummler & Fritz	Bataguridae	LR-nt	-
Cyclemys dentata (Gray)	Bataguridae	LR-nt	-
Cyrtodactylus stoliczkai (Steindachner)	Gekkonidae	DD	-
Cyrtodactylus walli Ingoldby	Gekkonidae	DD	-
Cyrtopodion kachhensis (Stoliczka)	Gekkonidae	DD	-
Cyrtopodion scaber (Heyden in: Ruppell)	Gekkonidae	DD	-
Daboia russelii russelii (Shaw & Nodder)	Viperidae	LR-nt	.-
Dasamia *rugifera* (Stoliczka)	Scincidae	VU	(D2)
Dasia *halianus* (Hally and Nevill in: Nevill)	Scincidae	CR	(B1, 2abc)
Dasia *oliveceae* Gray	Scincidae	EN	(B1, 2acd)
Dendrelaphis bifrenalis (Boulenger)	Colubridae	EN	(B1, 2c)
Dendrelaphis cyanochloris (Wall)	Colubridae	LR-lc	-
Dendrelaphis tristis (Daudin)	Colubridae	LR-lc	-
Dermochelys coriacea (Vandelli)	Dermochelyidae	EN	(A1cd)
Dinodon septentrionalis septentrionalis (Gunther)	Colubridae	EN	(B1, 2c)
Draco blanfordii norvilli (Alcock)	Agamidae	LR-lc	-
Dryocalamus gracilis (Gunther)	Colubridae	DD	-
Dryocalamus nympha (Daudin)	Colubridae	VU	(B1, 2c)
Echis carinatus sochureki Stemmier	Viperidae	LR-nt	-
Elachistodon westermanni Reinhardt	Colubridae	VU	(B1, 2c)
Elaphe cantoris (Boulenger)	Colubridae	LR-nt	--
Elaphe flavolineata (Schlegel)	Colubridae	VU	(D2)
Elaphe helena helena (Daudin)	Colubridae	LR-nt	-
Elaphe hodgsonii (Gunther)	Colubridae	LR-nt	-
Elaphe mandarina (Cantor)	Colubridae	VU	(D2)
Elaphe porphyracea porphyracea (Cantor)	Colubridae	DD	-
Elaphe radiata Schlegel	Colubridae	LR-lc	-
Enhydrina schistosus (Daudin)	Hydrophiidae	DD	-
Enhydris sieboldii (Schlegel)	Colubridae	LR-nt	-
Enhydris enhydris (Schneider)	Colubridae	LR-nt	-
Eremias guttulata watsonana (Stoliczka)	Lacertidae	DD	-
Eretmochelys imbricata (Linnaeus)	Chelonidae	EN	(A1c)

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Eristicophis macmahoni Alcock & Finn	Viperidae	DD	-
Eryx conica conica (Schneider)	Boidae	LR-nt	-
Eryx johnii johnii (Russel)	Boidae	LR-lc	-
Eryx johnii persicus (Nilkolsby)	Boidae	LR-lc	-
Eublepharis hardwickii Gray in: Hardwicke & Gray	Eublepharidae	DD	-
Eublepharis macularius (Blyth)	Eublepharidae	LR-lc	-
Eumeces blythianus (Anderson)	Scincidae	DD	-
Eumeces taeniolatus (Blyth)	Scincidae	DD	-
Fordonia leucobalia (Schlegel)	Colubridae	VU	(B1, 2c)
Gavialis gangeticus (Gmelin)	Gavialidae	EN	(B1, 2c; C2a)
Geckoella collegalensis (Beddome)	Gekkonidae	DD	-
Gekko gecko gecko (Linnaeus)	Gekkonidae	DD	-
Gekko smithii (Gray)	Gekkonidae	VU	D2
Geochelone elegans (Schoepff)	Testudinidae	VU	(A1acd)
Geoclemys hamiltonii (Gray)	Bataguridae	VU	(A1ac)
Gerardia prevostianus (Eydoux & Gervais)	Colubridae	LR-nt	-
Hardella thurjii thurjii (Gray)	Bataguridae	VU	(A1a)
Hemidactylus bowringii (Gray)	Gekkonidae	LR-lc	-
Hemidactylus brookii (Gray)	Gekkonidae	LR-lc	-
Hemidactylus flaviviridis Ruppell	Gekkonidae	LR-lc	-
Hemidactylus frenatus Dumeril & Bibron	Gekkonidae	LR-lc	-
Hemidactylus garnotii Dumeril & Bibron	Gekkonidae	LR-lc	-
Hemidactylus karenorum (Theobald)	Gekkonidae	VU	(D2)
Hemidactylus leschenaulti Dumeril & Bibron	Gekkonidae	LR-lc	-
Hemidactylus scabriceps (Annandale)	Gekkonidae	VU	(B1, 2c; D2)
Hemidactylus triedrus triedrus (Daudin)	Gekkonidae	LR-lc	-
Homalopsis buccata (Linnaeus)	Colubridae	CR	(B1, 2c)
Hydrophis caerulescens (Shaw)	Hydrophiidae	DD	-
Hydrophis lapemoides (Gray)	Hydrophiidae	DD	-
Hypnale hypnale (Merrem)	Viperidae	LR-nt	-
Indotestudo elongata (Blyth)	Testudinidae	LR-nt	-
Japalura andersoniana Annandale	Agamidae	DD	-
Japalura kumaonensis (Annandale)	Agamidae	CR	(B1, 2c)
Japalura planidorsata Jerdon	Agamidae	VU	(B1, 2c; D2)
Japalura tricarinatus (Blyth)	Agamidae	LR-lc	-
Japalura variegata Gray	Agamidae	LR-lc	-
Kachuga dhongoka (Gray in : Grayand Hardwicke)	Bataguridae	VU	(A1a, A2c)
Kachuga kachuga (Gray in: Gray and Hardwicke)	Bataguridae	VU	(A1a, A2c)
Kachuga smithii pallidipes Moll	Bataguridae	LR-lc	-
Kachuga smithii smithii (Gray)	Bataguridae	LR-lc	-
Kachuga sylhetensis (Jerdon)	Bataguridae	CR	(A1ac)
Kachuga tecta (Gray)	Bataguridae	LR-nt	-

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Kachuga tentoria flaviventer (Gunther)	Bataguridae	VU	(B1, 2c)
Kerilia jerdonii jerdonii (Gray)	Hydrophiidae	DD	-
Laticauda colubrina (Schneider)	Hydrophiidae	DD	-
Laticaudata laticaudata (Linnaeus)	Hydrophiidae	DD	-
Laudakia agrorensis (Stoliczka)	Agamidae	DD	-
Laudakia himalayanus himalayanus (Steindachner)	Agamidae	LR-lc	-
Laudakia melanura (Blyth)	Agamidae	LR-lc	-
Laudakia minor (Hardwicke & Gray)	Agamidae	LR-lc	-
Laudakia pakistanica (Baig)	Agamidae	VU	(D2)
Laudakia tuberculata (Hardwicke & Gray)	Agamidae	LR-lc	-
Leicocephalophis cyanocincta (Daudin)	Hydrophiidae	DD	-
Leiocephalus spiralis (Shaw)	Hydrophiidae	DD	-
Lepidochelys olivacea (Eschscholtz)	Chelonidae	EN	(A1c)
Leptotyphlops blanfordii blanfordii (Boulenger)	Leptotyphlopidae	VU	(B1, 2c; D2)
Liopeltis calamarius (Gunther)	Colubridae	LR-nt	-
Liopeltis frenatus (Gunther)	Colubridae	VU	(B1, 2c)
Liopeltis rappii (Gunther)	Colubridae	VU	(B1, 2c)
Liopeltis stoliczkae (Sclater)	Colubridae	VU	(B1, 2c; D2)
Lissemys punctata andersoni Webb	Trionychidae	LR-nt	-
Lissemys punctata punctata (Bonnaterre)	Trionychidae	LR-nt	-
Lycodon aulicus (Linnaeus)	Colubridae	LR-lc	-
Lycodon capucinus (Boie)	Colubridae	VU	(D2)
Lycodon fasciatus (Anderson)	Colubridae	VU	(B1, 2c)
Lycodon jara (Shaw)	Colubridae	DD	-
Lycodon striatus striatus (Shaw)	Colubridae	LR-nt	-
Lygosoma albopunctata Gray	Scincidae	LR-lc	-
Lygosoma bowringai (Gunther)	Scincidae	CR	(B1, 2c)
Lygosoma punctatus (Gmelin)	Scincidae	LR-lc	-
Lygosoma vosmaerii (Gray)	Scincidae	DD	-
Mabuya beddomei (Jerdon)	Scincidae	LR-lc	-
Mabuya bibronii (Gray)	Scincidae	LR-lc	-
Mabuya carinata carinata (Schneider)	Scincidae	LR-nt	-
Mabuya dissimilis (Hallowell)	Scincidae	DD	-
Mabuya macularius (Blyth)	Scincidae	LR-lc	-
Mabuya multifasciata (Kuhl)	Scincidae	LR-nt	-
Mabuya multicarianata	Scincidae	EN	(B1, 2c)
Mabuya rudis Boulenger	Scincidae	EN	(B1, 2c)
Macropisthodon plumbicolor plumbicolor (Cantor)	Colubridae	LR-nt	-
Manouria emys phayrei (Blyth)	Testudinidae	VU	(A1acd)
Melanochelys tricarinata (Blyth)	Bataguridae	LR-lc	-
Melanochelys trijuga indopeninsularis (Annandale)	Bataguridae	LR-nt	-
Melanochelys trijuga thermalis (Lesson)	Bataguridae	EN	(B1, 2c)

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Microcephalophis gracilis (Shaw)	Hydrophiidae	DD	-
Morenia petersi (Anderson)	Bataguridae	LR-nt	-
Naja naja (Linnaeus)	Elapidae	LR-nt	-
Naja oxiana (Eichwald)	Elapidae	CR	(B1, 2c)
Oligodon albocinctus (Cantor)	Colubridae	DD	-
Oligodon arnensis (Shaw)	Colubridae	LR-lc	-
Oligodon cinereus (Gunther)	Colubridae	EN	(B1, 2c)
Oligodon cyclurus cyclurus (Cantor)	Colubridae	EN	(B1, 2c)
Oligodon dorsalis (Gray in: Gray & Hardwickie)	Colubridae	VU	(B1, 2c)
Oligodon erythrogaster Boulenger	Colubridae	EN	(B1, 2c)
Oligodon taeniolatus fasciatus (Gunther)	Colubridae	LR-nt	-
Ophiodrys doriae (Boulenger)	Colubridae	CR	(B1, 2c)
Ophiomorus raithmai Anderson & Leviton	Scincidae	VU	(D2)
Ophiomorus tridactylus (Blyth)	Scincidae	DD	-
Ophiophagus hannah (Cantor)	Elapidae	LR-nt	-
Ophisaurus gracilis (Gray)	Anguidae	LR-nt	-
Ophisops jerdoni Blyth	Lacertidae	DD	-
Ovophis monticola monticola (Gunther)	Viperidae	DD	-
Pareas macularius (Blyth in: Theobald)	Colubridae	CR	(B1, 2c)
Pareas monticolus (Cantor)	Colubridae	VU	(B1, 2c)
Pelochelys cantorii Gray	Trionychidae	LR-nt	-
Phrynocephalus theobaldi Blyth	Agamidae	VU	(D2)
Protobothrops jerdonii jerdonii (Gunther)	Viperidae	VU	(B1, 2c; D2)
Protobothrops mucrosquamatus (Cantor)	Viperidae	DD	-
Psammodynastes pulverulentus (H. Boie in: F. Boie)	Colubridae	VU	(B1, 2c)
Psammophis condanarus condanarus (Merrem)	Colubridae	LR-nt	-
Psammophis leithii Gunther	Colubridae	LR-nt	-
Psammophis schokari (Forsskal)	Colubridae	LR-nt	-
Pseudoxenodon macrops macrops (Blyth)	Colubridae	VU	(B1, 2c)
Ptyas mucosus mucosus (Linnaeus)	Colubridae	LR-nt	-
Ptyas nigromarginatus (Blyth)	Colubridae	VU	(B1, 2c)
Ptychozoon kuhli Stejneger	Gekkonidae	CR	(B1, 2c)
Ptyctolaemus gularis (Peters)	Agamidae	EN	(B1, 2c)
Python molurus bivittatus (Kuhl)	Boidae	LR-nt	-
Python molurus molurus (Linnaeus)	Boidae	LR-nt	-
Python reticulatus (Schneider)	Boidae	LR-nt	-
Ramphotyphlops braminus (Daudin)	Typhlopidae	LR-nt	-
Rhabdophis himalayanus (Gunther)	Colubridae	LR-nt	-
Rhabdophis subminiatus (Schlegel)	Colubridae	VU	(B1, 2c)
Rhabdops bicolor (Blyth)	Colubridae	VU	(B1, 2c)
Rhinotyphlops acutus (Dumeril & Bibron)	Typhlopidae	LR-nt	-
Salea kakhienensis (Anderson)	Agamidae	CR	(B1, 2c)

Contd. . . .

Taxon	*Family*	*IUCN*	*Criteria*
Scincella himalayanus (Gunther)	Scincidae	DD	-
Scincella ladacensis (Gunther)	Scincidae	DD	-
Scincella sikimmensis (Blyth)	Scincidae	DD	-
Sibynophis collaris (Gray)	Colubridae	LR-nt	-
Sibynophis sagittaria (Cantor)	Colubridae	LR-nt	-
Sitana ponticeriana Cuvier	Agamidae	LR-lc	-
Spalerosophis arenarius (Boulenger)	Colubridae	VU	(B1, 2c)
Spalerosophis diadema Schlegel	Colubridae	LR-nt	-
Sphenomorphus dussumieri (Dumeril and Bibron)	Scincidae	LR-lc	-
Sphenomorphus indicus (Gray)	Scincidae	DD	-
Sphenomorphus maculatus (Blyth)	Scincidae	DD	-
Sphenomorphus reevesii reevesii (Gray)	Scincidae	DD	-
Takydromus sexlineatus khasiensis (Boulenger)	Lacertidae	EN	(B1, 2c)
Trachischium fuscum (Blyth)	Colubridae	VU	(B1,2c)
Trachischium guentheri Boulenger	Colubridae	CR	(B1, 2c)
Trachischium monticolum (Cantor)	Colubridae	CR	(B1, 2c)
Trachischium tenuiceps (Blyth)	Colubridae	CR	(B1, 2c)
Trapelus agilis (Oliver)	Agamidae	DD	-
Trimeresurus albolabris septentrionalis Kramer	Viperidae	LR-lc	-
Trimeresurus erythrurus (Cantor)	Viperidae	DD	-
Trimeresurus popeorum Smith	Viperidae	VU	(B1, 2c)
Trimeresurus stejnegeri yunnanensis Schmidt	Viperidae	LR-nt	-
Typhlops diardii diardii (Schlegel)	Typhlopidae	DD	-
Typhlops jerdoni (Boulenger)	Typhlopidae	LR-nt	-
Typhlops pammeces Gunther	Typhlopidae	DD	-
Typhlops porrectus Stoliczka	Typhlopidae	LR-nt	-
Uromastyx hardwickii Gray in : Hardwicke & Gray	Agamidae	VU	(A1ac)
Varanus bengalensis Daudin	Varanidae	VU	(A1acd)
Varanus flavescens (Hardwickie & Gray)	Varanidae	VU	(A1ac)
Varanus griseus konicznyi Mertens	Varanidae	VU	(A1acd)
Varanus salvator salvator (Laurenti)	Varanidae	VU	(B1, 2c)
Xenochrophis cerasogaster (Cantor)	Colubridae	LR-nt	-
Xenochrophis melanzostus (Gravenhorst)	Colubridae	VU	(D2)
Xenochrophis piscator piscator (Schneider)	Colubridae	LR-lc	-
Xenochrophis sanctijohannis (Boulenger)	Colubridae	LR-nt	-

Appendix 5. Alphabetical list of Mangroves assessed at the workshop

Taxon	*Family*	*IUCN*	*Subcriteria*
Algae			
Bostrychia tenella	Polysiphonaceae	EN	(B1, 2c)
Caloglossa leprieurii	Catnellaceae	EN	(B1, 2c)
Catnella impudica	Catnellaceae	EN	(B1, 2c)
Catnella repens	Catnellaceae	EN	(B1, 2c)
Chaetomorpha linum	Cladophoraceae	EN	(B1, 2abc)
Codium fragile	Codiaceae	EN	(B1, 2c)
Colpomenia sinuosa	Colpomeniaceae	LRnt	--
Dichotomosiphon salina *	Codiaceae	CR	(B1, 2bcd)
Dictyota indica	Dictyotaceae	EN	(B1, 2a)
Enteromorpha clathrata	Ulvaceae	LRlc	—
Enteromorpha intestinalis	Ulvaceae	LRnt	—
Gracilaria verrucosa	Gracilariaceae	EN	(B1, 2bc)
Hypnea musciformis	Hypneaceae	LRnt	—
Monostroma oxyspermum	Monostromataceae	EN	(B1, 2c)
Padina tetrastromatica	Dictyotaceae	LRnt	—
Rhizoclonium ciperium	Rhizocloniaceae	EN	(B1, 2c)
Rhizoclonium kerneri	Rhizocloniaceae	LRnt	—
Rhizoclonium kochianum	Rhizocloniaceae	LRnt	—
Sargassum ilicifolium	Sargassaceae	LRnt	–
Spatoglossum asperum	Dictyotaceae	LRnt	—
Ulva patengansis	Ulvaceae	CR	(B1, 2c)
Ulva reticulata	Ulvaceae	EN	(B1, 2c)
Vaucheria prescottii	Vaucheraiceae	EN	(B1, 2c)
Marine fishes			
Alecits indicus	Carangidae	LRnt	
Ambassis commersoni	Ambassidae	LRnt	
Anguilla bicolar	Anguillidae	LRnt	
Anodentestoma chacunda	Clupidae	LRnt	
Arius subrostratus	Ariidae	VU	(A1acd)
Boleophthalmus boddari	Gobiidae	VU	(A1ac, 2c)
Boleophthalmus dussumieri	Gobiidae	EN	(B1, 2c)
Carangoides ciliarius	Carangidae	LRnt	
Caranx ignobilis	Carangidae	LRnt	
Caranx sexfasciates	Carangidae	LRnt	
Chanos chanos	Chanidae	LRnt	
Dasyatis uarnak	Trygonidae	VU	(B1, 2e)
Elopes machnata	Elopidae	VU	(A1acd)
Epinephelus tauvina	Serranidae	LRnt	
Etroplus suratensis	Chichillidae	LRnt	
Glassogobius giurus	Gobiidae	LRnt	
Hilsa kelee	Clupeidae	LRnt	
Lates calcarifer	Centropomidae	LRnt	
Leiognathus splendens	Leiognathidae	VU	(A1b, 2b)
Lethrenus nebulosus	Lethrenidae	LRnt	

Contd. . . .

Taxon	*Family*	*IUCN*	*Subcriteria*
Liza dussumieri	Mugilidae	LRnt	
Liza macrolepis	Mugilidae	LRnt	
Liza parsia	Mugilidae	LRnt	
Lobotes surinamensis	Lobotidae	LRnt	
Lutjanus argentimaculatus	Lutjanidae	LRnt	
Lutjanus fulviflammus	Lutjanidae	LRnt	
Lutjanus johni	Lutjanidae	LRnt	
Lutjanus russelli	Lutjanidae	LRnt	
Lutjanus sebae	Lutjanidae	LRnt	
Megalops cyprinoides	Megalopidae	LRnt	
Mugil cephalus	Mugilidae	LRnt	
Muraena macrura	Muraenidae	LRnt	
Muraenesex cinereus	Muraenidae	LRnt	
Muraenichthys schultzei	Muraenidae	VU	(B1, 2c)
Nematalosa nasus	Clupidae	LRnt	
Osteomugil cunensius	Mugilidae	LRnt	
Otolithus ruber	Sciaenidae	LRnt	
Periophthalmus koelreuteri	Gobiidae	VU	(A1ac)
Plotosus canius	Plotosidae	LRnt	
Pomadasys hasta	Pomadasydae	LRnt	
Polynemus indicus	Polynemidae	LRnt	
Psammaperca waigaensis	Centropomidae	VU (A1acd)	(A1acd)
Scartelaos viridis	Gobiidae	EN	(A1ac; B1, 2c)
Secutor ruconius	Leiognathidae	VU	(A1a, 2b)
Siganus canaliculatus	Siganidae	LRnt	
Siganus javus	Siganidae	LRnt	
Sillago sihama	Sillaginidae	LRnt	
Sphyraena barracuda	Sphyraenidae	LRnt	
Tenualosa ilisha	Clupidae	LRnt	
Therapon jarbua	Teraponidae	LRnt	
Therapon puta	Teraponidae	LRnt	
Trypauchen vagina	Trypauchenidae	LRnt	
Mangrove Invertebrates			
Atacira flaviluna	Noctuidae	LRlc	
Attacus mcmulleni *	Saturniidae/ Lepiodoptera	LRlc	
Bactronophorus thoracites	Teredenidae	LRlc	
Balanus amphitrite	Balanidae	LRlc	
Bankia campanellata	Teredenidae	LRlc	
Bankia carinata	Teredenidae	LRlc	
Bankia rochi	Teredenidae	LRlc	
Cardisoma carnifex	Gecarcinidae	CR	(A1c)
Crassostrea gryphoides	Ostreidae	LRnt	
Dicyathifer manni	Teredinidae	LRlc	
Dotilla myctiroides	Ocypodidae	LRnt	
Geloina erosa	Geloindae	EN	(B1, 2c)
Gonodontis clelia	Geometridae	LRlc	

Contd. . . .

Taxon	*Family*	*IUCN*	*Subcriteria*
Lyrodus pedicellatus	Teredenidae	LRlc	
Macrophthalmus depressus	Ocypodidae	LRnt	
Macrophthalmus convexus	Ocypodidae	EN	(B1, 2c)
Martesia striata	Pholadidae	LRlc	
Meretrix casta *	Veneridae	VU	(A1cd)
Metapenaeus dobsoni	Unknown	LRnt	
Modiolus striatulus	Mytilidae	LRnt	
Nausitora dunlopei	Teredeinidae	LRlc	
Nausitora hedleyi	Teredenidae	LRlc	
Ocypode ceratophthalma	Ocypoidae	LRnt	
Penaeus cantliculatus	Palaemonidae	VU	(B1, 2c)
Penaeus indicus	Palaemonidae	LRnt	
Penaeus japonicus	Palaemonidae	VU	(B1, 2c)
Penaeus merguiensis	Palaemonidae	LRnt	
Penaeus monodom	Palaemonidae	LRnt	
Penaeus semisulcaetus	Palaemonidae	LRnt	
Perna viridis	Mytilidae	LRnt	
Pilodius nigrocrinitus	Xanthidae	EN	(B1, 2c)
Polyura schreiber *	Nymphalidae	NE	
Saccostrea cucullata	Ostreidae	LRnt	
Scylla serrata	Portunidae	LRnt	
Sesarma taeniolata	Grpsidae	VU	(B1, 2c)
Sphaeroma terebrans	Sphagomidae	LRlc	
Thalassina anomala	Thalassinidae	LRnt	
Uca dussumieri	Ocypodidae	LRnt	
Uca lactea	Ocypodidae	LRnt	
Uca tetragonon	Ocypodidae	EN	(B1, 2c)
Uca vocans	Ocypodidae	LRnt	
Mangrove - Plants			
Acanthus ebracteatus	Acanthaceae	CR	(B1, 2c)
Acanthus ilicifolius	Acanthaceae	EN	(B1, 2c)
Acanthus volubilis	Acanthaceae	CR	(B1, 2c)
Acrostichum aureum	Pteridaceae (Fern)	LRlc	
Aegialitis rotundifolia	Plumbaginaceae	EN	(B1, 2c)
Aegiceras corniculatum	Myrsinaceae	EN	(B1, 2c)
Aeluropus lagopoides	Poaceae	EN	(B1, 2b)
Aglaia cuculata	Meliaceae	EN	(B1, 2c)
Arthrocnemum indicum	Chenopodiaceae	VU	(A1ab)
Avicennia alba	Avicenniaceae	CR	(A1a, 1c)
Avicennia marina var. acutissima	Avicenniaceae	EN	(A1c, 1d)
Avicennia marina var. resinifera	Avicenniaceae	CR	(B1, 2bcd; D)
Avicennia officinalis	Avicenniaceae	EN	(B1, 2b)
Brownlowia tersa	Tiliaceae	EN	(B1, 2c)
Bruguiera cylindrica	Rhizophoraceae	EN	(A1cd, 2d; B1, 2c)
Bruguiera gymnorrhiza	Rhizophoraceae	CR	(A1cd)
Bruguiera parviflora	Rhizophoraceae	CR	(A1cd)

Contd. . . .

Taxon	*Family*	*IUCN*	*Subcriteria*
Bruguiera sexangula	Rhizophoraceae	VU	(B1, 2c, 2d)
Cenchrus ciliaris	Poaceae; panicoideae,Paniceae	EN	(B1, 2c)
Cerbera manghas	Apocynaceae	EN	(B1, 2c)
Ceriops decandra	Rhizophoraceae	EN	(A1cd, A2d; B1, 2c)
Ceriops tagal	Rhizophoraceae	EN	(B1, 2ac)
Clerodendrum inerme	Verbenaceae	EN	(B1, 2c)
Cynometra ramiflora	Fabaceae	EN	(B1, 2c)
Derris heterophylla	Fabaceae	EN	(B1, 2c)
Derris trifoliata	Fabaceae	EN	(B1, 2c)
Excoecaria agallocha	Euphorbiaceae	VU	(B1, 2c)
Finlaysonia obovata	Asclepiadaceae	CR	(B1, 2c)
Halophila beccarii	Hydrocharitaceae	EN	(B1, 2cd)
Heretiera fomes	Sterculiaceae	EN	(B1, 2bc)
Heretiera kanikensis	Sterculiaceae	CR	(B1, 2c; C2b; D)
Heretiera littoralis	Sterculiaceae	EN	(A2bcd; B1, 2c, 2d)
Kandelia candel	Rhizophoraceae	EN	(B1, 2c)
Lumnitzera littorea	Combretaceae	CR	(B1, 2c)
Lumnitzera racemosa	Combretaceae	EN	(B1, 2c)
Myriostachya wightiana	Poaceae	EN	(B1, 2c)
Nypa fruticans	Arecaceae	EN	(B1, 2abc)
Phoenix paludosa	Arecaceae	EN	(B1, 2c)
Porteresia coarctata	Poaceae	VU	(B1, 2c)
Rhizophora annamalayana	Rhizophoraceae	NE	
Rhizophora apiculata	Rhizophoraceae	EN	(A2bd)
Rhizophora lamarckii	Rhizophoraceae	CR	(B1, 2c; C2a)
Rhizophora mucronata	Rhizophoraceae	VU	(A2c, 2d; B1, 2c)
Rhizhophora stylosa	Rhizophoraceae	CR	(B1, 2c)
Salicornia brachiata	Chenopodiaceae	LRnt	(B1, 2c)
Scyphiphora hydrophyllacea	Rubiaceae	EN	(B1, 2c)
Sesuvium portulacastrum	Aizoaceae	EN	(B1, 2c)
Sonneratia alba	Sonneratiaceae	EN	(A2c, 2d)
Sonneratia apetala	Sonneratiaceae	EN	(A2bdc; B1, 2c)
Sonneratia caseolaris	Sonneratiaceae	EN	(A2bcd; B1, 2c)
Sonneratia griffithii	Sonneratiaceae	CR	(B1, 2c)
Sporobolus virginicus	Poaceae	EN	(B1, 2c)
Suaeda maritima	Chenopodiaceae	EN	(B1, 2bc)
Suaeda monoica	Chenopodiaceae	EN	(B1, 2abc)
Suaeda nudiflora	Chenopodiaceae	EN	(B1, 2ac)
Tamarix troupii	Tamaricaceae	EN	(B1, 2bcd)
Urochondra setulosa	Poaceae	EN	(B1, 2c)
Xylocarpus granatum	Meliaceae	EN	(A1acd; A2bcd; B2ac)
Xylocarpus mekongensis	Meliaceae	EN	(B1, 2c)
Xylocarpus moluccensis	Meliaceae	EN	(B1, 2c)

Appendix 6. Alphabetical list of Mammals assessed at the workshop

Species	*Family*	*IUCN*	*Criteria*
Endemic			
Anathana ellioti (Waterhouse)	Tupaiidae	LRnt	--
Atherurus macrourus assamensis (Linnaeus)	Hystricidae	EN	(B1, 2bcd)
Biswamoyopterus biswasi (Saha)	Sciuridae	CR	(B1, 2c)
Bubalus arnee Kerr	Bovidae	EN	B1, 2c
Cervus duvaucelli branderi	Cervidae	CR	C2b
Cervus elaphus hanglu Linnaeus	Cervidae	CR	(B1, 2cd; C2b)
Cervus eldi eldi M'Clelland	Cervidae	CR	(C2b; B1, 2c)
Cremnomys cutchicus Wroughton	Muridae	LRlc	--
Cremnomys elvira (Ellerman)	Muridae	VU	(D2)
Crocidura andamanensis Miller	Soricidae	DD	--
Crocidura hispida Thomas	Soricidae	EN	(B1, 2c)
Crocidura jenkinsi (Chakraborthy)	Soricidae	DD	--
Crocidura nicobarica Miller	Soricidae	DD	--
Cuon alpinus dekhanensis (Pallas)	Canidae	LRnt	--
Cuon alpinus laniger	Canidae	CR	(C2b)
Eptesicus nilssoni (Keyserling and Blasius)	Vespertilionidae	DD	--
Eptesicus tatei (Ellerman & Morrison Scott)	Vespertilionidae	DD	--
Funambulus tristriatus (Waterhouse)	Sciuridae	LRnt	--
Harpiocephalus harpia Hodgson	Vespertilionidae	DD	--
Hemitragus hylocrius (Ogilby)	Bovidae	EN	(B1, 2acd; C2a)
Herpestes fuscus fuscus Waterhouse	Herpestidae	VU	(B1, 2abc)
Herpestes palustris (Ghosh)	Herpestidae	EN	(B1, 2abcd)
Hipposideros schistaceus K. Anderson	Hipposideridae	DD	--
Latidens salimalii Thonglongya	Pteropodidae	EN	(B1, 2a; C2a)
Macaca radiata (E. Geoffroy)	Cercopithecidae	LRlc	--
Macaca silenus (Linnaeus)	Cercopithecidae	EN	(B1, 2c; C2a)
Martes gwatkinsi (Horsfield)	Mustelidae	VU	B1, 2bc
Millardia kondana Mishra and Dhanda	Muridae	VU	(D2)
Murina grisea Peters	Vespertilionidae	VU	(D2)
Mus famulus (Bonhote)	Muridae	EN	(B1, 2c)
Mus phillipsi (Wroughton)	Muridae	LRlc	--
Mus platythrix Bennett	Muridae	LRlc	--
Otomops wroughtoni (Thomas)	Molossidae	CR	(B1, 2c)
Ovis vignes vignes	Bovidae	EN	(C2a)
Panthera leo persica (Linnaeus)	Felidae	CR	(C2b)
Paradoxurus jerdoni Blanford	Viverridae	VU	(B1, 2bc)
Paraechinus micropus nudirentris (Horsfield)	Erinaceidae	VU	(D2)
Petinomys fuscocapillus fuscocapillus (Jerdon)	Sciuridae	VU	(B1, 2bc)
Plantacanthomys lasiurus Blyth	Muridae	LRlc	--
Pteropus faunulus Miller	Pteropodidae	VU	(B1, 2cd)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Rattus palmarum (Zelebor)	Muridae	DD	--
Rattus ranjiniae Agarwal & Ghosal	Muridae	VU	(D2)
Rattus stoicus (Miller)	Muridae	VU	(D2)
Ratufa indica centralis (Erxleben)	Sciuridae	VU	(A1c)
Ratufa indica dealbata (Erxleben)	Sciuridae	EX	(PR/PE/PX)
Ratufa indica indica (Erxleben)	Sciuridae	VU	(A1ac; C1)
Ratufa indica maxima (Erxleben)	Sciuridae	VU	(B1, 2c; C1)
Rhinolophus cognatus Anderson	Rhinolopidae	DD	--
Rhinolophus mitratus Blyth	Rhinolopidae	VU	(D2)
Suncus dayi (Dobson)	Soricidae	VU	(B1, 2b)
Trachypithecus johnii (Fischer)	Cercopithecidae	VU	(B1, B2; C1a)
Tupaia nicobarica (Zelebor)	Tupaiidae	EN	(B1, 2c)
Viverra civettina Blyth	Viverridae	CR	(A1bc)
Non Endemics			
Acinonyx jubatus venaticus (Pocock, Ellerman and Morrison-Scott)	Felidae	EX	--
Ailurus fulgens fulgens Cuvier	Ailuridae	VU	(B1, 2abc)
Alticola montosa (True)	Muridae	DD	--
Alticola roylei (Gray)	Muridae	DD	--
Alticola stoliczkanus (Blanford)	Muridae	DD	--
Anourosorex squamipes Milne-Edwards	Soricidae	VU	(B1, 2c)
Antilope cervicapra (Linnaeus)	Bovidae	LRlc	--
Apodemus draco (Berrett-Hamilton)	Muridae	VU	(D2)
Apodemus sylvaticus (Linnaeus)	Muridae	DD	--
Arctictis binturong albifrons (Raffles)	Viverridae	DD	--
Arctogalidia trivirgata millsi (Gray)	Viverridae	VU	(B1, 2c; D2)
Arctonyx collaris F.G. Cuvier	Mustelidae	DD	--
Axis axis (Erhleben)	Cervidae	LRlc	--
Axis porcinus (Zimmermann)	Cervidae	LRnt	
Balaenoptera acutorostrata Lace 'pe 'de	Balaenoptridae	LRnt	--
Balaenoptera borealis Lesson	Balaenoptridae	LRnt	--
Balaenoptera edeni Anderson	Balaenoptridae	LRnt	--
Balaenoptera musculus (Linnaeus)	Balaenoptridae	CR	(A1bd)
Balaenoptera physalus (Linnaeus)	Balaenoptridae	LRnt	--
Bandicota bengalensis (Gray & Hardwicke)	Muridae	LRlc	--
Bandicota indica (Bechstein)	Muridae	LRnt	--
Barbastella leucomelas (Cretzschmar)	Vespertilionidae	DD	--
Belomys pearsonii (Gray)	Sciuridae	LRnt	--
Berylmys bowersi (Anderson)	Muridae	EN	(B1, 2c)
Berylmys mackenziei (Thomas)	Muridae	LRlc	--
Berylmys manipulus (Thomas)	Muridae	DD	--
Bos gaurus Smith	Bovidae	VU	(C2a)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Bos grunniens (Przewalski)	Bovidae	CR	(C2a)
Boselaphus tragocamelus (Pallas)	Bovidae	LRlc	--
Callosciurus erythraeus (Pallas)	Sciuridae	LRnt	--
Callosciurus pygerythus (Geoffroy St. Hilaire)	Sciuridae	LRnt	--
Canis aureus Linnaeus	Canidae	LRlc	--
Canis lupus palipus Sykes	Canidae	LRnt	--
Cannomys badius (Hodgson)	Muridae	LRlc	--
Capra falconeri falconeri (Wagner)	Bovidae	CR	(C2b)
Capra falconeri kashmeriensis (Wagner)	Bovidae	CR	(C2b)
Capra ibex Linnaeus	Bovidae	VU	(B1, 2c)
Caracal caracal (Schreber)	Felidae	LRnt	--
Cervus duvaucelli duvaucelii G. Cuvier	Cervidae	EN	(C2a)
Cervus unicolor Kerr	Cervidae	LRlc	--
Chaerephon plicata (Buchanan)	Molossidae	DD	--
Chimarrogale himalayica (Gray)	Soricidae	LRnt	--
Chiropodomys gliroides (Blyth)	Muridae	VU	(D2)
Cöelops frithi Blyth	Hipposideridae	DD	--
Cremnomys blanfordi (Thomas)	Muridae	LRnt	--
Cricetulus alticola (Thomas)	Muridae	VU	(B1, 2c)
Cricetulus migratorius (Pallas)	Muridae	EN	(B1, 2c)
Crocidura attenuata Milne-Edwards	Soricidae	LRlc	--
Crocidura fuliginosa (Blyth)	Soricidae	DD	--
Crocidura horsfieldi (Thomas)	Soricidae	DD	--
Crocidura leucodaon (Hermann)	Soricidae	DD	--
Crocidura pergrisea Miller	Soricidae	EN	(B1, 2c)
Crocidura pullata Miller	Soricidae	DD	--
Cuon alpinus adjustes (Pallas)	Canidae	CR	(C2b)
Cuon alpinus primaevus	Canidae	VU	(D1)
Cynopterus brachyotis (Muller)	Pteropodidae	LRlc	--
Cynopterus sphinx Vahl	Pteropodidae	LRlc	--
Daenomys millardi (Thomas)	Muridae	VU	(D2)
Delphinus delphis Linnaeus	Delphinidae	LRnt	--
Dicerorhinus sumatrensis (G. Fischer)	Rhinocerotidae	CR	(D)
Diomys crumpi Thomas	Muridae	EN	(B1, 2c)
Dremomys lokriah Hodgson	Sciuridae	LRnt	--
Dugong dugon (Muller)	Dugongidae	CR	(A1acd; D)
Elephas maximus Linnaeus	Elephantidae	VU	(A1acd)
Eonycteris spelaea (Dobson)	Pteropodidae	VU	(D2)
Eothenomys melanogastor (Milne-Edwards)	Muridae	DD	--
Eptesicus pachyotis Dobson	Vespertilionidae	DD	--
Eptesicus serotinus (Scherber)	Vespertilionidae	DD	--
Equus kiang Moorcroft	Equidae	VU	(B1, 2c; D2)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Eubalaena glacialis (Muller)	Balaenidae	EN	(C1, C2b)
Eupetaurus cinereus Thomas	Sciuridae	LRnt	--
Felis chaus Schreber	Felidae	LRnt	--
Felis silvestris ornata Schreber	Felidae	LRnt	--
Feroculus feroculus (Kelaart)	Soricidae	VU	(B1, 2c; D2)
Funambulus layardi (Blyth)	Sciuridae	DD	--
Funambulus palmarum (Linnaeus)	Sciuridae	LRlc	--
Funambulus pennantii Wroughton	Sciuridae	LRlc	--
Funambulus sublineatus (Waterhouse)	Sciuridae	DD	--
Gazella bennettii (Sykes)	Bovidae	LRlc	--
Gerbillus gleadowi (Murray)	Muridae	LRlc	--
Gerbillus nanus Blanford	Muridae	LRnt	--
Globicephala macrorhynchus Gray	Delphinidae	LRnt	--
Gohunda ellioti Gray	Muridae	LRlc	--
Grampus griseus G. Cuvier	Delphinidae	LRnt	--
Hadromys humei (Thomas)	Muridae	DD	--
Helarctos malayanus (Raffles)	Ursidae	DD	--
Hemiechinus collaris (Gray)	Erinaceidae	LRlc	--
Hemitragus jemlahicus (H. Smith)	Bovidae	LR-nt	--
Herpestes endwardsii (Geoffroy Saint-Hilliare)	Herpestidae	LRlc	--
Herpestes javanicus (E. Geoffroy Saint-Hilliare)	Herpestidae	LRlc	--
Herpestes smithii smithii Gray	Herpestidae	LRlc	--
Herpestes urva (Hodgson)	Herpestidae	VU	(B1, 2ac)
Herpestes vitticollis Bennett	Herpestidae	LRnt	--
Hesperoptenus tickelli (Blyth)	Vespertilionidae	DD	--
Hipposideros armiger (Hodgson)	Hipposideridae	LRnt	--
Hipposideros ater (Temppleton)	Hipposideridae	LRnt	--
Hipposideros cineraceus Blyth	Hipposideridae	DD	--
Hipposideros fulvus Gray	Hipposideridae	LRnt	--
Hipposideros galeritus Cantor	Hipposideridae	DD	--
Hipposideros lankadiva Kelaart	Hipposideridae	VU	(B1, 2c)
Hipposideros larvatus Horsfield	Hipposideridae	DD	--
Hipposideros pomona K. Anderson	Hipposideridae	DD	--
Hipposideros speoris (Schnider)	Hipposideridae	LRnt	--
Hyaena hyaena (Linnaeus)	Hyaenidae	LRnt	--
Hylobates hoolock (Harlan)	Hylobatidae	EN	(C2a)
Hylopetes alboniger (Hodgson)	Sciuridae	VU	(B1, 2abc)
Hylopetes barberi (Blyth)	Sciuridae	DD	--
Hylopetes fimbriatus (Gray)	Sciuridae	LRnt	--
Hyperacrius fertilis (True)	Muridae	DD	--
Hyperacrius wynnei (Blanford)	Muridae	VU	(D2)
Hystrix brachyura Linnaeus	Hystricidae	VU	(B1, 2bd; D2)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Hystrix indica Kerr	Hystricidae	LRlc	--
Ia io Thomas	Vespertilionidae	EN	(B1, 2c)
Kerivoula papillosa (Temminck)	Vespertilionidae	DD	--
Kerivoula hardwickii (Horsfield)	Vespertilionidae	DD	—
Kerivoula picta Pallas	Vespertilionidae	LRnt	--
Kogia breviceps (Blainville)	Phocoenidae	LRnt	--
Kogia simus (Owen)	Phocoenidae	LRnt	--
Leopoldamys edwardsi (Thomas)	Muridae	DD	-
Lepus capensis Linnaeus	Leporidae	DD	--
Lepus nigricollis F. Cuvier	Leporidae	LRlc	--
Lepus oiostolus Hodgson	Leporidae	DD	--
Loris tradigradus (Linnaeus)	Loridae	LRnt	
Lynx lynx Blyth	Felidae	EN	(B1, 2bc)
Macaca arctodes I. Geoffroy	Cercopithecidae	LRnt	--
Macaca assamensis (M'Clelland)	Cercopithecidae	LRnt	--
Macaca fascicularis umbrosa (Raffles)	Cercopithecidae	CR	(C2a)
Macaca mulatta (Zimmermann)	Cercopithecidae	LRlc	—
Macaca nemestrina (Linnaeus)	Cercopithecidae	DD	--
Manis crassicaudata Gray	Manidae	LRnt	—
Manis pentadactyla Linnaeus	Manidae	LRnt	—
Marcoglossus sobrinus K. Anderson	Pteropodidae	DD	--
Marmota bobak	Sciuridae	EN	(B1, 2abc & 3ab)
Marmota caudata (Geoffroy)	Sciuridae	VU	(B1, 2abc)
Martes flavigula (Boddart)	Mustelidae	LRlc	-
Martes foina (Erxleben)	Mustelidae	DD	--
Megaderma lyra E. Geoffroy	Megadermatidae	LRlc	--
Megaderma spasma (Linnaeus)	Megadermatidae	DD	—
Megaptera novaeangliae (Borowski)	Balaenoptridae	LRnt	--
Megarops niphanae Yenbutra and Felton	Pteropodidae	DD	--
Mellivora capensis Schreber	Mustelidae	LRnt	--
Melogale moschata (Gray)	Mustelidae	EN	(B1, 2c)
Melogale personata (I. Geoffroy Saint Hilaire)	Mustelidae	VU	(B1, 2c)
Melursus ursinus (Shaw)	Ursidae	VU	(C2a)
Meriones hurriane Jerdon	Muridae	LRlc	--
Micromys minutus (Pallas)	Muridae	VU	(D2)
Microtus leusurus (Blyth)	Muridae	DD	-
Microtus sikimensis (Hodgson)	Muridae	LRlc	--
Millardia gleadowi (Murray)	Muridae	LRnt	--
Millardia meltada Gray	Muridae	LRlc	--
Miniopterus pusillus Dobson	Vespertilionidae	DD	—
Miniopterus schreibersii (Kuhl)	Vespertilionidae	LRlc	--
Moschola meminna (Erhleben)	Tragulidae	LRnt	--

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Moschus chrysogaster (Hodgson)	Moschidae	CR	(A1d)
Muntiacus muntjak (Zimmermann)	Cervidae	LRlc	--
Murina aurata Milne-Edwards	Vespertilionidae	DD	--
Murina cyclotis Dobson	Vespertilionidae	DD	--
Murina huttoni (Peters)	Vespertilionidae	DD	--
Murina leucogaster Milne-Edwards	Vespertilionidae	DD	--
Murina tubinaris (Scully)	Vespertilionidae	VU	(B1, 2c; D2)
Mus booduga (Gray)	Muridae	LRlc	--
Mus cervicolor Hodgson	Muridae	LRlc	--
Mus cookii (Ryley)	Muridae	LRnt	--
Mus musculus (Linnaeus)	Muridae	LRlc	--
Mus pahari Thomas	Muridae	DD	--
Mus saxicola (Elliot)	Muridae	LRlc	--
Mustela altaica (Pallas)	Mustelidae	DD	--
Mustela erminea ferghanae Linnaeus	Mustelidae	DD	--
Mustela kathiah Hodgson	Mustelidae	DD	--
Mustela putorius larvatus Linnaeus	Mustelidae	DD	--
Mustela sibirica (Pallas)	Mustelidae	LRnt	--
Mustela strigidorsa Gray	Mustelidae	DD	--
Myotis annectans (Dobson)	Vespertilionidae	DD	--
Myotis blythi (Tomes)	Vespertilionidae	DD	--
Myotis daubentoni (Kuhl)	Vespertilionidae	DD	--
Myotis formosus (Hodgson)	Vespertilionidae	LRnt	--
Myotis hasseltii (Temminck)	Vespertilionidae	DD	--
Myotis horsfieldii (Temminck)	Vespertilionidae	LRnt	--
Myotis longipes (Dobson)	Vespertilionidae	EN	(B1, 2c)
Myotis montivagus (Dobson)	Vespertilionidae	DD	--
Myotis muricola (Gray)	Vespertilionidae	DD	--
Myotis mystacinus Kuhl	Vespertilionidae	DD	--
Myotis sicarius Thomas	Vespertilionidae	VU	(D2)
Myotis siligorensis (Horsfield)	Vespertilionidae	DD	--
Naemorhedus sumatraensis (Bechstein)	Caprinae	VU	(D1)
Nectogale elegans Milne-Edwards	Soricidae	VU	(D2)
Neofelis nebulosa (Griffith)	Felidae	LRnt	--
Neophocaena phocaenoides (G. Cuvier)	Phocoenidae	LRnt	--
Nesokia indica (Gray and Hardwicke)	Muridae	LRlc	--
Niviventer brahma (Thomas)	Muridae	EN	(B1, 2c)
Niviventer eha (Wroughton)	Muridae	VU	(B1, 2c; D2)
Niviventer fulvercens (Gray)	Muridae	LRlc	--
Niviventer langbianis (Robinson and Kloss)	Muridae	DD	--
Niviventer niviventer (Hodgson)	Muridae	DD	--

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Niviventer tenaster (Thomas)	Muridae	DD	--
Nyctalus leisleri (Kuhl)	Vespertilionidae	DD	--
Nyctalus montanus (Barrett-Hamilton)	Vespertilionidae	DD	--
Nyctalus noctula (Schreber)	Vespertilionidae	DD	--
Nycticebus coucang (Boddaert)	Loridae	LRnt	--
Ochotona curzoniae (Hodgson)	Ochotonidae	EN	(B1, 2ab)
Ochotona forresti Thomas	Ochotonidae	LRnt	--
Ochotona ladacensis (Gunther)	Ochotonidae	DD	--
Ochotona macrotis (Gunther)	Ochotonidae	DD	--
Ochotona nubrica Thomas	Nk	DD	--
Ochotona roylei (Ogilby)	Ochotonidae	LRnt	--
Ochotona thibetana (Milne-Edwards)	Ochotonidae	LRnt	--
Orcaella brevirostris (Gray)	Delphinidae	EN	(B1, 2c)
Orcinus orca (Linnaeus)	Delphinidae	LRnt	--
Otonycteris hemprichii Peters	Vespertilionidae	VU	(D2)
Ovis ammon (Linnaeus)	Bovidae	CR	(C2a)
Ovis orientalis Gmelin	Bovidae	EN	(B1, 2c)
Paguma larvata (Hamilton-Smith)	Viverridae	LRlc	--
Panthera pardus (Linnaeus)	Felidae	VU	(C2a)
Panthera tigris (Linnaeus)	Felidae	EN	(C2a)
Pantholops hodgsoni	Bovidae	CR	(C2b)
Paradoxurus hermaphroditus (Pallas)	Viverridae	LRlc	--
Paraechinus micropus (Blyth)	Erinaceidae	LRlc	--
Pardofelis marmorata (Martin)	Felidae	LRnt	--
Peponocephala electra (Gray)	Delphinidae	LRnt	--
Petaurista philippensis (Elliot)	Sciuridae	LRnt	--
Physeter catodon Linnaeus	Phocoenidae	LRnt	--
Pipistrellus affinis (Dobson)	Vespertilionidae	DD	--
Pipistrellus cadornae Thomas	Vespertilionidae	DD	--
Pipistrellus ceylonicus (Kelaart)	Vespertilionidae	LRlc	--
Pipistrellus coromandra Gray	Vespertilionidae	LRnt	--
Pipistrellus dormeri (Dobson)	Vespertilionidae	LRnt	--
Pipistrellus kuhlii (Kuhl)	Vespertilionidae	DD	--
Pipistrellus paterculus Thomas	Vespertilionidae	LRnt	
Pipistrellus pipistrellus (Schreber)	Vespertilionidae	VU	(D2)
Pipistrellus savii (Bonaparte)	Vespertilionidae	DD	--
Pipistrellus tenuis (Temminck)	Vespertilionidae	LRlc	--
Platanista gangetica (Roxburgh)	Platanistidae	CR	(A1acd; C1, C2a)
Plecotus auritus Linnaeus	Vespertilionidae	DD	--
Plecotus austriacus (J. Fisher)	Vespertilionidae	DD	--
Prionailurus bengalensis (Kerr)	Felidae	LRnt	--
Prionailurus rubiginosus rubiginosus (Geoffroy Saint-Hilaire)	Felidae	LRnt	--

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Prionailurus viverrinus (Bennett)	Felidae	VU	(B1, 2abc)
Prionodon pardicolor Hodgson	Viverridae	VU	(B2, 2ac)
Procapra picticaudata picticaudata	Bovidae	CR	(D)
Pseudois nayaur (Hodgson)	Bovidae	LRlc	--
Psuedorca crassidens (Owen)	Delphinidae	LRnt	--
Pteropus giganteus giganteus Brunnich	Pteropodidae	LRnt	--
Pteropus melanotus Blyth	Pteropodidae	DD	--
Pteropus vampyrus (Linnaeus)	Pteropodidae	DD	--
Rattus nitidus (Hodgson)	Muridae	DD	--
Rattus norvegicus (Berkenhout)	Muridae	LRlc	--
Rattus rattus (Linnaeus)	Muridae	LRlc	--
Rattus sikkimensis Hinton	Muridae	DD	--
Rattus tiomanicus (Miller)	Muridae	VU	(D2)
Rattus turkestanicus (Satunin)	Muridae	DD	--
Ratufa bicolor gigantea (Sparrman)	Sciuridae	VU	(A1c)
Ratufa macroura dandolena (Pennant)	Sciuridae	EN	(B1, 2c; C1)
Rhinoceros sondaicus Desmarest	Rhinocerotidae	EX	--
Rhinocerous unicornis Linnaeus	Rhinocerotidae	EN	(B1, 2d)
Rhinolophus affinisHorsfield	Rhinolopidae	LRnt	--
Rhinolophus ferrumeuinum (Schreber)	Rhinolopidae	VU	(B1, 2c; D2)
Rhinolophus hipposideros (Bechstein)	Rhinolopidae	VU	(D2)
Rhinolophus lepidus Blyth	Rhinolopidae	LRnt	--
Rhinolophus pearsonii Horsfield	Rhinolopidae	LRnt	--
Rhinolophus pusillus Temminck	Rhinolopidae	LRnt	--
Rhinolophus rouxi Temminck	Rhinolopidae	LRnt	--
Rhinolophus subbadius Blyth	Rhinolopidae	CR	(B1, 2c)
Rhinolophus trifoliatus Temminck	Rhinolopidae	DD	--
Rhinolophus yunanensis Dobson	Rhinolopidae	DD	--
Rhinolopus luctus Temminck	Rhinolopidae	DD	--
Rhinopoma hardwickii Gray	Rhinopomatidae	LRnt	--
Rhinopoma microphyllum Brunnich	Rhinopomatidae	LRnt	--
Rhizomys pruinosus	Muridae	LRnt	--
Rousettus leschenaulti (Desmarest)	Pteropodidae	LRlc	--
Saccolaimus saccolaimus (Temminck)	Emballonuridae	DD	--
Scotoecus pallidus (Dobson)	Vespertilionidae	LRnt	--
Scotomanes ornatus (Blyth)	Vespertilionidae	DD	--
Scotophilus heathi (Horsfield)	Vespertilionidae	LRlc	--
Scotophilus kuhlii Leach	Vespertilionidae	LRnt	--
Semnopithecus entellus (Dufresne)	Cercopithecidae	LRlc	--
Sicista concolor (Buchner)	Muridae	DD	--
Sorex caudatus (Horsfield)	Soricidae	VU	(B1, 2c)
Sorex minutus Linnaeus	Soricidae	VU	(D2)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Soriculus leucops (Horsfield)	Soricidae	VU	(B1, 2c; D2)
Soriculus macrurus Blanford	Soricidae	VU	(B1, 2c; D2)
Soriculus nigrescens (Gray)	Soricidae	VU	(B1, 2c)
Sousa chinensis (Osbeck)	Delphinidae	EN	(A1acd, 2b)
Sphaerias blanfordi (Thomas)	Pteropodidae	DD	--
Stenella longirostris (Gray)	Delphinidae	LRnt	--
Suncus etruscus (Savi)	Soricidae	LRlc	--
Suncus montanus (Kelaart)	Soricidae	VU	(B1, 2b)
Suncus murinus (Linnaeus)	Soricidae	LRlc	--
Suncus stoliczkanus (Anderson)	Soricidae	LRlc	--
Sus salvanius (Hodgson)	Suidae	CR	(C2a)
Sus scrofa Linnaeus	Suidae	LRlc	--
Tadarida aegyptiaca (Geoffroy)	Molossidae	LRnt	--
Tadarida teniotis (Refinesque)	Molossidae	DD	--
Talpa leucura (Blyth)	Talpidae	VU	(B1, 2c)
Talpa micrura (Hodgson)	Talpidae	LRlc	--
Tamiops macclellandi (Horsfield)	Sciuridae	LRnt	--
Taphozous longimanus Hardwicke	Emballonuridae	LRlc	--
Taphozous melanopogan Temminck	Emballonuridae	LRnt	--
Taphozous nudiventris Cretzschmar	Emballonuridae	LRnt	--
Taphozous perforatus E. Geoffroy	Emballonuridae	LRnt	--
Taphozous theobaldi Dobson	Emballonuridae	DD	--
Tatera indica (Hardwicke)	Muridae	LRlc	--
Tetracerus quadricornis (Blainville)	Bovidae	LRnt	--
Trachypithecus geei Khajuria	Cercopithecidae	CR	(C2a)
Trachypithecus phayrei (Blyth)	Cercopithecidae	EN	(C1, 2a)
Trachypithecus piletaus (Blyth)	Cercopithecidae	LRnt	--
Tupaia belangeri (Wagner)	Tupaiidae	LRlc	--
Tupaia nicobarica (Zelebor)	Tupaiidae	EN	(B1, 2c)
Tursiops truncatus (Montagu)	Delphinidae	LRnt	--
Tylonycteri spachypus (Temminck)	Vespertilionidae	LRnt	--
Uncia uncia (Schreber)	Felidae	EN	(C2a)
Ursus arctos Linnaeus	Ursidae	LRnt	--
Ursus thibetanus (Baron)	Ursidae	LRlc	--
Vandeleuria oleracea (Bennett)	Muridae	LRlc	--
Viverra zibetha Linnaeus	Viverridae	VU	(A1c)
Viverricula indica (Desmarest)	Viverridae	LRnt	--
Vulpes bengalensis (Shaw)	Canidae	LRnt	--
Vulpes vulpes montanna Linnaeus	Canidae	LRnt	--
Vulpes vulpes pusilla (Linnaeus)	Canidae	LRnt	--
Ziphius cavirostris G. Cuvier	Ziphiidae	LRnt	--

Contd. . . .

Appendix 7. Alphabetical list of fish assessed at the workshop

Species	*Family*	*IUCN*	*Criteria*
Aborichthys elongatus Hora	Balitoridae	EN	(B1, 2c)
Aborichthys garoensis Hora	Balitoridae	CR	(B1, 2c)
Aborichthys kempi Chaudhuri	Balitoridae	VU	(B1, 2c)
Aborichthys tikaderi Barman	Balitoridae	EN	(B1, 2a, 2b, 2c)
Acanthocobitis zonalternans (Blyth)	Homalopteridae	DD	--
Ailia colia (Hamilton-Buchanan)	Schilbeidae	VU	(A1a, 1b, 1c, 1d, 2b, 2c, 2d)
Ailia punctata Day	Schilbeidae	VU	(A1a, 1c, 1d)
Amblyceps apangi Nath and Dey	Amblycipitidae	VU	(D2)
Amblyceps arunachalensis Nath and Dey	Amblycipitidae	VU	(D2)
Amblyceps mangois (Hamilton-Buchanan)	Amblycipitidae	LRnt	--
Amblypharyngodon chakaiensis (Babu Rao & Nair)	Cyprinidae	CR	(A1, 2c)
Amblypharyngodon mola (Hamilton)	Cyprinidae	LRlc	--
Anabas cobojius (Hamilton-Buchanan)	Anabantidae	VU	(A1a, 1c, 1d)
Anabas testudineus (Bloch)	Anabantidae	VU	(A1a, 1c, 1d)
Anguilla bengalensis Gray	Anguillidae	EN	(A1a, 1c, 1d; B1, 2c)
Aplocheilus rubroshigma (Val.)	Aplocheilidae	DD	--
Aplocheilus panchax (Hamilton)	Aplocheilidae	DD	--
Aspidoparia jaya (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c, 1d)
Aspidoparia morar (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Bagarius bagarius (Hamilton)	Sisoridae	VU	(A1a, 1c, 1d)
Balitora brucei (Gray)	Balitoridae	LRnt	--
Barbus carletoni (Hamilton-Buchanan)	Cyprinidae	EN	(B1, 2c)
Barilius bakeri Day	Cyprinidae	VU	(A1a, 1c, 1d)
Barilius barila (Hamilton-Buchanan)	Cyprinidae	VU	(B1, 2c)
Barilius barna (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Barilius bendelisis (Hamiltong-Buchanan)	Cyprinidae	LRnt	--
Barilius canarensis (Jerdon)	Cyprinidae	DD	--
Barilius corbetti Tilak & Husain	Cyprinidae	CR	(B1, 2c)
Barilius dimorphicus Tilak & Husain	Cyprinidae	CR	(B1, 2c)
Barilius dogarsinghi Hora	Cyprinidae	EN	(B1, 2a, 2b, 2d)
Barilius evezardi (Day)	Cyprinidae	LRnt	--
Barilius shacra (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Barilius tileo (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Barilius vagra (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c)
Batasio travancoria Hora & Law	Bagridae	EN	(A1b; B1, 2b)
Bhavania australis (Jerdon)	Balitoridae	EN	(B1, 2c)
Botia almorhae Gray	Cobitidae	EN	(B1, 2c)
Botia berdmorei (Blyth)	Cobitidae	EN	(A1a, 1c, 1d)
Botia birdi Chanduri	Cobitidae	LRnt	--
Botia geto (Hamilton-Buchanan)	Cobitidae	LRnt	--

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Botia histrionica Blyth	Cobitidae	VU	(B1, 2c)
Botia lohachata Chandhuri	Cobitidae	EN	(B1, 2c)
Botia striata Rao	Cobitidae	EN	(B1, 2c)
Brachydanio acuticophala (Hora)	Cyprinidae	VU	(A1c; B1, 2c)
Brachydanio rerio (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Catla catla (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c, 1d, 1e)
Channa baculis (Hamilton-Buchanan)	Channidae	LRlc	--
Channa marulius (Hamilton-Buchanan)	Channidae	LRnt	--
Channa micropeltes (Cuvier)	Channidae	CR	(A1a, 1b, 1c, 1d; B1, 2c)
*Channa orientalis*Bloch & Schneider	Channidae	VU	(A1a, 1c, 1d)
Channa punctatus (Bloch)	Channidae	LRnt	--
Channa striatus (Bloch)	Channidae	LRlc	--
Chaudhurai indica (Talwar, Yazdani & Kundu)	Chaudhuriidae	VU	(B1, 2c, 2d; D2)
Chaudhuria khajuriai (Yazdani)	Chaudhuriidae	EN	(B1, 2b, 2c)
Chela dadyburjori (Menon)	Cyprinidae	DD	--
Chela laubuca (Hamilton-Buchanan)	Cyprinidae	LRlc	--
Chelonodon fluviatilis (Hamilton-Buchanan)	Tetradontidae	LRnt	--
Cirrhinus cirrhosus (Bloch)	Cyprinidae	VU	(B1, 2c)
Cirrhinus fulungee (Sykes)	Cyprinidae	LRnt	--
Cirrhinus macrops Steindachner	Cyprinidae	DD	--
Cirrhinus mrigala Hamilton-Buchanan	Cyprinidae	LRnt	--
Cirrhinus reba (Hamilton-Buchanan)	Cyprinidae	VU	(A1, 1b, 1c, 1d, 2c, 2d)
Clarias batrachus (Linnaeus)	Claridae	VU	(A1a, 1c, 1d)
Clarias dayi Hora	Claridae	EN	(B1, 2c)
Clarias dussumieri (Valenciennes)	Claridae	VU	(A1a, 1b, 1c, 1d)
Clupisoma bastari Datta & Karmakar	Schilbeidae	EN	(B1, 2c)
Clupisoma garua (Hamilton)	Schilbeidae	VU	(A1a, 1c, 1d, 2c, 2d)
Colisa fasciatus (Bloch & Schneider)	Anabantidae	LRnt	--
Crossocheilus burmanicus Hora	Cyprinidae	VU	(B1, 2c)
Crossocheilus latius latius (Hamilton & Buchanan)	Cyprinidae	DD	--
Crossocheilus periyarensis Menon & Jacob	Cyprinidae	VU	(D2)
Danio aequipinnatus (McClelland)	Cyprinidae	LRnt	--
Danio devario (Hamilton)	Cyprinidae	LRnt	--
Danio naganensis Chaudhuri	Cyprinidae	VU	(A1a, 1c)
Dayella malabarica (Day)	Clupeidae	CR	(A1a, 1c, 1d, 2c, 2d)
Erethistoides montana pipri Hora	Sisoridae	CR	(B1, 2a, 2b, 2c, 2d)
Esomus danricus (Hamilton)	Cyprinidae	LRlc	--
Etroplus canarensis Day	Cichilidae	DD	--
Euchiloglanis hodgarti Hora	Sisoridae	VU	(A1c)
Euchiloglanis kamengensis (Hora)	Sisoridae	EN	(B1, 2c, 2d)
Eutropiichthys murius (Hamilton)	Schilbeidae	LRnt	--
Eutropiichthys vacha (Hamilton)	Schilbeidae	EN	(A1a, 1b, 1c, 1d, 2b, 2c,2d)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Gagata sexualis Tilak	Sisoridae	LRnt	--
Garra gotyla gotyla (Gray)	Cyprinidae	VU	(A1a, 1c)
Garra gotyla stenorhynchus Jerdon	Cyprinidae	EN	(B1, 2c)
Garra hughi Silas	Cyprinidae	EN	(A1a, 1c)
*Garra kempi*Hora	Cyprinidae	VU	(A1a, 1c; B1, 2c)
Garra lissorhynchus (McClelland)	Cyprinidae	VU	(A1a, 1c)
Garra litanensis Vishwanath	Cyprinidae	CR	(B1, 2c)
Garra manipurensis Vishwanath & Sarojnalini	Cyprinidae	CR	(B1, 2c)
Garra menoni Devi & Indra	Cyprinidae	VU	(D2)
Garra naganensis Hora	Cyprinidae	VU	(B1, 2c)
Garra rupecula (McClelland)	Cyprinidae	VU	(A1a; B1, 2b)
Garra surendranathanii (Shaji, Arun & Easa)	Cyprinidae	EN	(B1, 2c)
Glossgobius giuris (Hamilton)	Gobiidae	LRnt	--
Glyphis gangeticus (Muller & Henle)	Carcharhinidae	VU	(D2)
Glyptosternum reticulatum McClelland	Sisoridae	EN	(B1, 2c)
Glyptothorax alaknandi Tilak	Sisoridae	CR	(B1, 2c)
Glyptothorax anamalaiensis Silas	Sisoridae	CR	(B1, 2c)
Glyptothorax bervipinnis Hora	Sisoridae	VU	(A1a, 1c, 1d, 2c, 2d; B1, 2c)
Glyptothorax cavia Hamilton	Sisoridae	EN	(A1a, 1c, 1d)
Glyptothorax dakpathari Tilak & Husain	Sisoridae	CR	(B1, 2c)
Glyptothorax davissinghi Manimekalan & Das	Sisoridae	CR	(B1, 2c)
Glyptothorax garhwali Tilak	Sisoridae	CR	(B1, 2c)
Glyptothorax housei Herra	Sisoridae	DD	--
Glyptothorax indicus Talwar	Sisoridae	VU	(A1a, 1c, 1d)
Glyptothorax kashmirensis (Hora)	Sisoridae	EN	(B1, 2c)
Glyptothorax lonah (Sykes)	Sisoridae	LRnt	--
Glyptothorax madraspatanum (Day)	Sisoridae	VU	(D2)
Glyptothorax nelsoni Ganguly, Dutta & Sen	Sisoridae	EN	(B1, 2c)
Glyptothorax pectinopterus (McClelland)	Sisoridae	LRnt	--
Glyptothorax saisii (Jenkins)	Sisoridae	EN	(B1, 2c)
Glyptothorax stoliczkae (Steindachner)	Sisoridae	CR	(B1, 2c)
Glyptothorax striatus (McClelland; Hora)	Sisoridae	VU	(B1, 2c; D2)
Glyptothorax telchitta (Hamilton)	Sisoridae	LRnt	--
Gonialosa manmina Hamilton	Clupeidae	VU	(A1a, 1c, 1d)
Gudusia chapra (Hamilton)	Clupeidae	LRlc	--
Gymnocypris biswasi Talwar	Cyprinidae	EX	--
Hara horai Mishra	Sisoridae	EN	(A1a, 1c, 1d; B1, 2c)
Heteropneustes fossilis (Bloch)	Heteropneustidae	VU	(A1a, 1c, 1d)
Hilsa ilisha (Hamilton)	Clupeidae	VU	(A1a, 1c, 1d)
Homaloptera montana Herre	Baletoridae	CR	(B1, 2c)
Homaloptera pillaii Rema Devi & Indira	Baletoridae	VU	(D2)
Horabagrus brachysoma (Gunther)	Bagridae	EN	(A1a, 1c, 1d)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Horabagrus nigricollaris (Pethiyagoda & Kottelat)	Bagridae	CR	(B1, 2c)
Horadandia atukorali brittani Menon	Cyprinidae	EN	(B1, 2c)
Horaglanis krishnai Menon	Claridae	CR	(D2; B1, 2a, 2c)
Hyporhamphus xanthopterus (Valenciennes)	Hemiramphidae	CR	(A1a, 1b, 1c, 1d; B1, 2c)
Hypselobarbus curmuca (Day)	Cyprinidae	EN	(A1d, 1c, 1d, 1e)
Hypselobarbus dubius (Day)	Cyprinidae	EN	(B1, 2c, 2d)
Hypselobarbus jerdoni (Day)	Cyprinidae	EN	(B1, 2c)
Hypselobarbus kolus (Sykes)	Cyprinidae	EN	(A1a; B1, 2c)
Hypselobarbus lithopides (Day)	Cyprinidae	EN	(A1a, 1c, 1d; B1, 2c)
Hypselobarbus micropogon periyarensis Raj	Cyprinidae	EN	(B1, 2a, 2b, 2c)
Hypselobarbus thomassi (Day)	Cyprinidae	EN	(B1, 2c)
Hypselobarbus kurali Menon & Rema Devi	Cyprinidae	EN	(B1, 2c)
Johnius gangaticus Talwar	Sciaenidae	EN	(B1, 2c)
Kryptopterus indicus Datta, Barman & Jayaram	Siluridae	CR	(B1, 2c)
Labeo ariza (Hamilton)	Cyprinidae	CR	(B1, 2c)
Labeo angra (Hamilton)	Cyprinidae	LRnt	--
Labeo bata (Hamilton)	Cyprinidae	LRnt	--
Labeo boga (Hamilton)	Cyprinidae	LRnt	--
Labeo calbasu (Hamilton)	Cyprinidae	LRnt	--
Labeo dero (Hamilton)	Cyprinidae	VU	(A1a, 1c, 1d)
Labeo dussumieri (Valenciennes)	Cyprinidae	EN	(A1a, 1c, 1d, 1e, 2c, 2d,2e)
Labeo dyocheilus (McClelland)	Cyprinidae	VU	(A1a, 1c, 1d)
Labeo fimbriatus (Bloch)	Cyprinidae	LRnt	--
Labeo gonius (Hamilton)	Cyprinidae	LRnt	--
Labeo kontius (Jerdon)	Cyprinidae	EN	(B1, 2c)
Labeo pangusia (Hamilton)	Cyprinidae	LRnt	-
Labeo rajasthanicus (Datta & Majumdar)	Cyprinidae	CR	(B1, 2c)
Labeo rohita (Hamilton)	Cyprinidae	LRnt	-
Laguvia kapuri (Tilak & Hussain)	Sisoridae	CR	(B1, 2a, 2c, 2d)
Laguvia ribeiroi Hora	Sisoridae	LRnt	--
Laguvia shawi Hora	Sisoridae	EN	(B1, 2c)
Lepidocephalus annandalei (Chaudhuri)	Cobitidae	LRnt	--
Lepidocephalus berdmorei (Blyth)	Cobitidae	EN	(A1c; B1, 2c)
Lepidocephalus caudofurcatus Tilak & Hussain	Cobitidae	VU	(B1, 2c)
Lepidocephalus goalparensis (Pillai & Yazdani)	Cobitidae	CR	(B1, 2c)
Lepidocephalus irrorata (Hora)	Cobitidae	VU	(B1, 2c)
Lepidopygopsis typus Raj	Schizothoracinae	CR	(B1, 2c)
Macrognathus aral (Bloch & Schneider)	Mastacembelidae	LRnt	--
Macrognathus guentheri (Day)	Mastacembelidae	VU	(A1a, 1c, 2c, 2d; B1, 2c)
Macrognathus pancalus (Hamilton-Buchanan)	Mastacembelidae	LRnt	--
Mesonoemacheilus reticulofasciatus Singh, Sen & Banarescu	Homalopteridae	EN	(B1, 2c)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Mesonoemacheilus sijuensis (Menon)	Homalopteridae	VU	(D2)
Monopterus cuchia (Hamilton-Buchanan)	Symbranchidae	LRnt	--
Monopterus eapeni Talwar	Symbranchidae	CR	(B1, 2c)
Monopterus fossorius (Nair)	Symbranchidae	EN	(B1, 2c)
Moringua hodgarti Chaudhuri	Moringuidae	CR	(B1, 2b, 2c, 2d, 2e)
Mystus bleekeri (Day)	Bagridae	VU	(A1a, 1c, 1d)
Mystus cavasius (Hamilton-Buchanan)	Bagridae	LRnt	--
Mystus malabaricus (Jerdon)	Bagridae	EN	(A1a, 2b, 2c, 2d)
Mystus microphthalmus (Day)	Bagridae	EN	(B1, 2c; A1a, 1c)
Mystus montanus (Jerdon)	Bagridae	VU	(A1a, 1b, 1c, 1d, 2c, 2d)
Mystus punctatus (Jerdon)	Bagridae	EN	(B1, 2c)
Mystus vittatus (Bloch)	Bagridae	VU	(A1a, 1c, 1d)
Nandus nandus (Hamilton-Buchanan)	Nandidae	LRnt	--
Nangra nangra (Hamilton-Buchanan)	Sisoridae	VU	(A1a, 1c, 1d)
Nangra viridescens (Hamilton-Buchanan)	Sisoridae	LRnt	--
Nemacheilus botia (Hamilton-Buchanan)	Balitoridae	LRnt	--
Nemacheilus carletonii Fowler	Balitoridae	EN	(B1, 2c)
Nemacheilus chindwinicus Tilak & Hussain	Balitoridae	EN	(B1, 2c)
Nemacheilus corica (Hamilton-Buchanan)	Balitoridae	LRnt	--
Nemacheilus doonensis (Tilak & Hussain)	Balitoridae	EN	(B1, 2c)
Nemacheilus guentheri Day	Balitoridae	LRlc	--
Nemacheilus himachalensis (Menon)	Balitoridae	EN	(B1, 2c)
Nemacheilus horai Menon	Balitoridae	VU	(B1, 2c)
Nemacheilus kangrae (Menon)	Balitoridae	EN	(B1, 2c)
Nemacheilus keralensis Rita, Banarescu & Nalbant	Balitoridae	EN	(B1, 2c, 2d)
Nemacheilus labeosus (Kottelat)	Balitoridae	VU	(B1, 2c)
Nemacheilus monilis Hora	Balitoridae	EN	(B1, 2c)
Nemacheilus montanus (McClelland)	Balitoridae	EN	(B1, 2c)
Nemacheilus multifasciatus Day	Balitoridae	EN	(B1, 2c)
Nemacheilus nilgiriensis (Menon)	Balitoridae	EN	(B1, 2c)
Nemacheilus petrubanarescui (Menon)	Balitoridae	DD	--
Nemacheilus pulchellus Day	Balitoridae	DD	--
Nemacheilus rupecola (McClelland)	Balitoridae	LRnt	--
Nemacheilus scaturigina(McClelland)	Balitoridae	VU	(A1a, 1c, 1d)
Nemacheilus semiarmatus Day	Balitoridae	VU	(D2)
Nemacheilus striatus Day	Balitoridae	DD	--
Nemacheilus triangularis Day	Balitoridae	LRlc	--
Neoeucirrhichthys maydelli Banarescu & Nalbant	Cobitidae	VU	(B1, 2c)
Neolissochecilus spinulosus (McClelland)	Cyprinidae	EN	(B1, 2c)
Neolissochilus wynaadensis (Day)	Cyprinidae	CR	(B1, 2c)
Neotropius khavalchor Kulkarni	Schilbeidae	DD	--
Notopterus chilata (Hamilton)	Notopteridae	EN	(A1a, 1b, 1c, 1d, 2c, 2d)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Notopterus notopterus (Pallas)	Notopteridae	LRnt	--
Ompok bimaculatus (Bloch)	Siluridae	EN	(A1a, 1c, 1d, 2c, 2d)
Ompok malabaricus (Valenciennes)	Siluridae	CR	(B1, 2c)
Ompok pabda (Hamilton)	Siluridae	EN	(A1a, 1c, 1d, 2c, 2d
Ophiocephalus channa gachua Bloch & Schneider	Channidae	VU	(B1, 2c)
Osteobrama belangeri (Valenciennes)	Cyprinidae	EW	--
Osteobrama brevipectoralis (Tilak & Hussain)	Cyprinidae	EN	(B1, 2c)
Osteobrama cotio cotio (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Osteobrama cotio cunma Day	Cyprinidae	VU	(A1a, 1c, 2c)
Osteochilu brevidorsalis (Day)	Cyprinidae	EN	(B1, 2c)
*Osteochilichthys longidorsalis*Pethiyagoda & Kottelat	Cyprinidae	CR	(B1, 2c)
Osteochilus godavariensis (Babu Rao)	Cyprinidae	DD	--
Osteobrama bakeri (Day)	Cyprinidae	EN	(B1, 2c)
Pangasius pangasius (Hamilton)	Pangasiidae	CR	(A1a, 1b, 1c, 1d)
Pangio pangia (Hamilton-Buchanan)	Cobitidae	VU	(B1, 2c)
Parambassis dayi (Bleeker)	Chandidae	EN	(B1, 2c)
Parambassis thomassi (Day)	Chandidae	VU	(A1a, 1b, 1c, 1d, 2c, 2d)
Parluciosoma daniconius (Hamilton)	Cyprinidae	LRnt	--
Periophthalmus weberi Eggert	Gobiidae	CR	(B1, 2c)
Pinniwallago kanpurensis Gupta, Jayaram and Hajela	Siluridae	CR	(B1, 2c)
Pristolepis marginata Jerdon	Nandidae	VU	(A1a, 1b, 1c, 1d, 1e, 2c, 2d)
Proeutropiichthys taakree (Sykest)	Schilbeidae	CR	(A1a, 1d, 2d)
Proeutropiichthys taakree taakree (Sykes)	Schilbeidae	VU	(D2)
Pseudecheneis sulcatus (McClelland)	Sisoridae	VU	(B1, 2c)
Pseudeutropius atherinoides (Bloch)	Schilbeidae	EN	(A1a, 1c, 1d)
Pseudeutropius mitchelli Gunther	Schilbeidae	DD	--
Psilorhynchus homalophera Hora & Mukherji	Psilorhynchidae.	VU	(A1a, 1c, 2c)
Psilorhynchus micropthalmus Vishwanath & Manoj	Psilorhynchidae	CR	(B1, 2c)
Psilorhynchus sucatio nudithoracicus Tilak & Husain	Psilorhynchidae	EN	(A1a; B1, 2c)
Puntius arulius (Jerdon)	Cyprinidae	EN	(A1a, 1c, 1d, 2c, 2d; B1, 2c)
Puntius arulius tambraparniei (Silas)	Cyprinidae	CR	(B1, 2c)
Puntius bovanicus (Day)	Cyprinidae	CR	(B1, 2c)
Puntius carnaticus (Jerdon)	Cyprinidae	LRnt	--
Puntius cauveriensis(Hora)	Cyprinidae	DD	--
Puntius chilinoides (McClelland)	Cyprinidae	EN	(A1a, 1c, 1d)
Puntius chola (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c, 1d)
Puntius chrysopterus (McClelland)	Cyprinidae	LRlc	--
Puntius clavatus (McClelland)	Cyprinidae	EN	(B1, 2c)
Puntius clavatus clavatus (McClelland)	Cyprinidae	EN	(A1a, 1c; B1, 2c)
Puntius conchonius (Hamilton-Buchanan)	Cyprinidae	VU	(B1, 2c)
Puntius deccanensis Yazdani & Babu Rao	Cyprinidae	CR	(B1, 2c)
Puntius denisonii (Day)	Cyprinidae	EN	(B1, 2c)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Puntius dorsalis (Jerdon)	Cyprinidae	EN	(B1, 2c)
Puntius fasciatus (Jerdon)	Cyprinidae	EN	(B1, 2c)
Puntius guganio (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Puntius hexastichus (McClelland)	Cyprindae	VU	(B1, 2c)
Puntius jayarami Vishwanath & Tombi	Cyprinidae	EN	(A1a, 1c; B1, 2c)
Puntius melanampyx Day	Cyprinidae	LRlc	---
Puntius melanostigma (Day)	Cyprinidae	EN	(B1, 2c)
Puntius mudumalaiensis Menon	Cyprinidae	CR	(B1, 2b, 2c; D2)
Puntius narayani (Hora)	Cyprinidae	CR	(B1, 2c)
Puntius ophicephalus Raj	Cyprinidae	EN	(B1, 2c, 2d)
Puntius parrah (Day)	Cyprinidae	EN	(B1, 2c)
Puntius phutunio (Hamilton-Buchanan)	Cyprinidae	LRlc	--
Puntius sarana sarana (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c, 1d)
Puntius shalynius Yazdani & Talukdar	Cyprinidae	VU	(B1, 2c)
Puntius sophore (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Puntius terio (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Puntius ticto (Hamilton-Buchanan)	Cyprinidae	LRnt	--
Puntius ticto punctatus (Day)	Cyprinidae	CR	(B1, 2c)
Puntius vittatus (Day)	Cyprinidae	VU	(A1a, 1c, 1d)
Raiamas bola (Hamilton-Buchanan)	Cyprinidae	VU	(A1a, 1c)
Raiamas guttatus (Day)	Cyprinidae	EN	(B1, 2c)
Rhinomugil corsula (Hamilton-Buchanan)	Mugilidae	VU	(A1a, 1c, 1d)
Rita chrysea (Day)	Bagridae	EN	(B1, 2c)
Rita kuturnee (Sykes)	Bagridae	LRnt	--
Rita pavimentatus (Valenciens)	Bagridae	EN	(B1, 2c)
Rita rita (Hamilton-Buchanan)	Bagridae	LRnt	--
Rohtee ogilbii Sykes	Cyprinidae	LRnt	--
Salmostoma bacaila (Hamilton-Buchanan)	Cyprinidae	LRlc	--
Salmostoma clupeoides (Bloch)	Cyprinidae	LRlc	--
Salmostoma novacula (Valenciennes)	Cyprinidae	LRnt	--
Salmostoma orissaensis Banarescur	Cyprinidae	EN	(B1, 2c)
Schistura arunachalensis (Menon)	Homalopteridae	EN	(B1, 2c)
Schistura devdevi (Hora)	Homalopteridae	EN	(B1, 2c)
Schistura elongatus (Sen & Nalbant)	Homalopteridae	EN	(B1, 2c)
Schistura kangjupkhulensis (Hora)	Homalopteridae	VU	(A1c; B1, 2c)
Schistura manipurensis (Chaudhuri)	Homalopteridae	VU	(A1a, 1c)
Schistura multifasciatus (Day)	Homalopteridae	VU	(D2)
Schistura nagaensis (Menon)	Homalopteridae	EN	(B1, 2a, 2c)
Schistura pavonaceus (McClelland)	Homalopteridae	EN	(B1, 2c)
Schistura peguensis (Hora)	Homalopteridae	EN	(B1, 2a, 2b)
Schistura prashari (Hora)	Homalopteridae	VU	(A1a, 1c, 1d)
Schistura sikmaiensis Hora	Homalopteridae	EN	(B1, 2c)

Contd. . . .

Species	*Family*	*IUCN*	*Criteria*
Schistura singhi (Menon)	Homalopteridae	CR	(B1, 2a, 2c)
Schistura vinciguerrae (Hora)	Homalopteridae	EN	(B1, 2c)
Schizothorax nasus (Heckell)	Cyprinidae	LRnt	--
Schizothoraichthys hugelii (Heckel)	Cyprinidae	LRnt	--
Schizothorax curvifrons Heckel	Cyprinidae	VU	(B1, 2c)
Schizothorax esocinus (Heckel)	Cyprinidae	LRnt	--
Schizothorax kumanosis (Menon)	Cyprinidae	LRnt	--
Schizothorax labiatus (McClelland)	Cyprinidae	EN	(B1, 2c)
Schizothorax niger (Heckel)	Cyprinidae	VU	(B1, 2c)
Schizothorax progastus (McClelland)	Cyprinidae	LRnt	--
Schizothorax richardsonii (Gray)	Cyprinidae	VU	(A1c, 2c, 2d)
Schizothorax sinuatus Heckel	Cyprinidae	LRnt	--
Semiplotus modestus Day	Cyprinidae	EN	(B1, 2b, 2c, 2d)
Semiplotus semiplotus (McClelland)	Cyprinidae	VU	(A1c; B1, 2a, 2b)
Sicamugil cascasia (Hamilton-Buchanan)	Mugilidae	VU	(A1a, 1c, 1d)
Silonia childreni (Sykes)	Silinidae	EN	(B1, 2c)
Silonia silondia (Hamilton-Buchanan)	Silinidae	LRnt	--
Silurus afghana Gunther	Siluridae	EN	(B1, 2c)
Silurus wynaadensis Day	Siluridae	CR	(B1, 2c)
Sisor rhabdophorus Hamilton-Buchanan	Sisoridae	EN	(B1, 2c)
Somileptes gongota Hamilton-Buchanan	Cobitidae	LRnt	--
Stenogobius malabaricus (Day)	Gobiidae	CR	(B1, 2c)
Tetraodon cutcutia Hamilton-Buchanan	Tetrodontidae	LRnt	--
Tetraodon travancoricus Hora and Nair	Tetrodontidae	EN	(B1, 2a, 2b)
Tor khudree (Sykes)	Cyprinidae	VU	(A1a, 1b, 1c, 1d)
Tor khudree malabaricus (Jerdon)	Cyprinidae	CR	(A1a, 1c;B1, 2c)
Tor kulkarni Menon	Cyprinidae	DD	--
Tor mosal (Hamilton-Buchanan)	Cyprinidae	EN	(A1a, 1c, 1d; B1, 2c)
Tor mussullah (Sykes)	Cyprinidae	CR	(A1a, 1c, 1d)
Tor progeneius (McClelland)	Cyprinidae	DD	--
Tor putitora (Hamilton-Buchanan)	Cyprinidae	EN	(A1a, 1c, 1d)
Tor tor (Hamilton-Buchanan)	Cyprinidae	EN	(A1a, 1c, 1d)
Travancoria elongata Pethiyagoda and Kottelat	Balitoridae	CR	(B1, 2c)
Travancoria jonesi Hora	Balitoridae	EN	(B1, 2c)
Wallago attu (Schneider)	Siluridae	LRnt	--
Xenentodon cancila (Hamilton-Buchanan)	Belonidae	LRnt	--

What to Conserve? An Objective and Participatory Method

Pramod Padmanabhan and Madhav Gadgil

Introduction

This is an era of unprecedented decline in natural habitats and thereby of erosion of biological diversity. Since 1600, 113 species of birds and 83 species of mammals are known to have completely disappeared (Dobson, 1996). It is feared that at least 10 % of the remaining species will become extinct over the next few decades (IUCN, 1994). We have to take quick decisions regarding the conservation of wild species that are really threatened. The prioritization of species for conservation is the first task towards this end.

At present, the species prioritization exercises in India are being conducted based on the IUCN criteria by various agencies like the Botanical Survey of India (BSI) and the Zoological Survey of India (ZSI). They have come up with various Red Data lists for plants and animals. Recently, the Conservation Assessment and Management Plan (CAMP) workshops of the Biodiversity Conservation Prioritization Project also attempted a species prioritization in many taxa, using the revised IUCN criteria.

IUCN has established conservation categories as extinct, critically endangered, endangered, vulnerable, low risk and insufficiently known. Of these, critically endangered, endangered and vulnerable are considered to be threatened with extinction. These categories and the Red Data Books, which are based on this categorization, are a very good first step in the conservation effort. However, it's inadequacies and difficulties are also well known. As per the IUCN criteria, to make an assessment each species must be studied to determine its population size and the trend of its change in numbers. Moreover it has to be studied over its whole range. To make any reasonable assessment, using this method, on abundance and the trend of population change of all species, that too in a tropical megabiodiversity country like India, may require hundreds of years.

Categorizing the species without proper rigorous studies may create greater problems, especially because it may place the organisms in unrealistic categories. Such a prioritization may also be biased against species with poor and inadequate information. It has become a practice to do conservation prioritization with subjective knowledge of some experts in the fields or the abundance of the plants or animals in the herbarium and other collections of BSI and ZSI. There are considerable disagreements among the experts about population estimates, trends and the status assigned to many species. As the herbarium and other collections do not really reflect the actual abundance of the species in the field, species prioritization based on them becomes unreliable. In the other case, collecting information from experts in a consultation meeting always ends up in the conclusions biased towards the opinion of the most dominant and talkative person/persons of the group. The information collected through such meetings remains subjective and cannot be subjected to quantification and validation without the input of the particular expert. Therefore, a great deal of ambiguity remains. Despite this ambiguity among experts and inadequacy of information in herbarium and other collections, nobody has tried to develop any quantifiable and repeatable method, which can objectively get validated. Another problem is, these categories are considered not suitable for all the taxonomically and biologically poorly known groups of organisms, like tropical insect communities.

The Process of Species Prioritization

To prioritize species for conservation, we need good information related to its potential for survival or possible extinction. The information is available in many places: in published scientific and popular literature and also in the minds of field taxonomists. A great amount of information is also available in scientific journals, natural history write-ups, in newspapers and magazines, and in books, but it remains scattered. If we have to use this information, the first task is to organize this information into a database. Once it is organized, we can put it in the public domain through the internet, so that all those who are interested can verify it and help to update it. The next task would be to digest and analyse the information in the database, in a well-defined and objective way, so as to make decisions on the relative priority of species. Such a method would make the process of species prioritization more transparent and participatory.

Database Organization

We attempted to organize a preliminary database for all known mammals and birds of India from available literature. This was then utilized for the species prioritization process. It must, however, be remembered that the information so far collected is not perfect. A lot of scope still remains for the improvement of the database. Improvement of database by adding new conservation criteria and by updating already existing information can facilitate the process leading to a more robust and correct prioritization of species.

To make a reliable judgement about the conservation value of any species, we need to know:

1. The geographical range of its occurrence.
2. The density of its populations in different regions where it is present.
3. The range of habitats it occupies.
4. Any form of threat it faces (say by the destruction of its preferred habitat or by economic exploitation)
5. Its evolutionary and taxonomic importance in terms of its uniqueness in the evolutionary lineage.

Of these five types of information, the second one, region wise density of populations, is very difficult, expensive and time-consuming to collect. Therefore, it is not practicable to collect this in the near future. On the other hand, partial information only confuses the general picture, as it creates a bias for or against a well-studied species.

Nevertheless, for the purpose of this exercise, data regarding birds and mammals found in India was collected and computerised. The data collected included, for each species:

1. Its geographic distribution over the entire world (divided into six biogeographic zones).
2. Its geographic distribution over the oriental region (divided into six subregions).
3. Its geographical distribution over the Indian subregion (divided into ten provinces, as per Rodgers and Panwar 1988).
4. The kinds of habitats the species is generally observed in.
5. The number of species described in its family and genus.

A list of the literature surveyed for the purpose is at appendix III.

Assigning Conservation Value

It is possible to assign any particular species a conservation value on the basis of its attributes such as rarity, on the extent of threat of extinction, and on its utility. However, for the purpose of this study, the utility and economic exploitation of the birds and mammals have not been taken into consideration. The basic methodology for the calculation of conservation value was developed by Daniels et_al in 1991 for the birds of the Western Ghats. We have used the same approach and method, with some significant modifications. Each species is assigned a quantitative value ranging between 0 and 1 with respect to 6 attributes. Three of these values are related to the geographical range; G1 over the entire world; G2 over the oriental region; and G3 over the Indian subregion. The conservation value for a taxon by geographic range (G) is given as:

$$G = (N-a)/(N-1)$$

where N is the number of subdivisions at a given level and a is the number of subdivisions from which the taxon is known. This ensures that the more restricted the range of any of these scales, the greater would be its conservation value. The conservation value of each taxon by habitat preference is computed as

$$H = (N-a)/(N-1)$$

Where N is the total number of habitats and a is the number of habitats favored by a given species. This ensures that the more limited the habitat range of a species the greater its value.

The threat to the habitat of a species is calculated by averaging the threat rank value (r) of all the habitat it prefers and normalising it by dividing it by the maximum rank assigned to the habitats ($rmax$).

$$HT = \frac{(\sum ri)/a}{r\max}$$

where ri is the threat rank of the ith habitat, a is the number of habitats the species prefers. The threat rank value assigned to the habitat is on the basis of some crude assessment of the reduction in the area under different habitat types and 'r' increases as the threat increases.

The threat rank assigned to the Indian habitats are at present subjective impressions of the author. The montane wet evergreen forests are given the highest value of 7, while manmade orchards and urban and rural human habitations are given the least value of 1. Indian desert ecosystem has been assigned 2; secondary scrub lands 3, forestry plantations 4, montane grasslands 5 and threatened wet lands 5. Admittedly this is a crude estimation and as and when more reliable information is available, that can be used.

The conservation value of a species reflecting taxonomic distinctiveness was calculated as

$$T = 1/(a \times b)$$

Where a is the number of species known from the family to which the species belongs and b is the number of species in the genera.

Composite Conservation Value

Thus, the conservation importance of a species is sought to be determined in terms of the narrowness of its geographical range, the narrowness of its habitat preference and the number of related taxa. The Composite Conservation Value (CCV) is then computed as the sum of four conservation values, namely the mean of the three geographical distribution values and the three values related to habitat preference, habitat threat and and taxonomic uniqueness. Species can be prioritized for conservation on the basis of decreasing order of the CCV. The species can be sorted and separated on the basis of its geographical occurrence or habitat preferences and ranked to prioritise most valuable species for a specific region and specific habitat. Habitat patches or specific localities can be prioritized for conservation on the basis of the overall ranking of the conservation importance of all the species (mean CCV) present in that area.

At present, environment impact assessments are being conducted for developmental projects without any objective criteria. Computed CCVs of different groups of organisms can work as an index of the overall ecological importance of any area. If this value and data are made available in public, anybody who is interested can evaluate the relative ecological importance of any area by using simple arithmetic. People will show a more positive attitude to such a scientifically robust and transparent exercise.

Conservation Prioritisation of Birds and Mammals

By this preliminary exercise we would like to suggest an objective method for future species prioritization exercise. 1227 species of birds and 393 species of wild mammals have been evaluated and ranked. The forest birds such as Frogmouth, which are evolutionarily unique and very rare in the field, do come up with well-known waterbirds such as Ibisbill and Masked Finfoot. Many birds and mammals, which are rare but not prominent either because of their secretive mode of life or because of their small size (eg. Dayi's shrew and Salimali's Fruitbat) do come up in the ranks of the threatened ones.

The Bangalore CAMP workshop for prioritization of mammals also brings out similar results. Many lesser mammals otherwise not considered as endangered (Mollur et.al, 1999) do come up in conservation importance both in our results as well as in the CAMP results. In mammals, one of the most endangered animals, Dugong, acquires rank one. Animals like Slender Loris and Brown mongoose come up with the other well-known endangered animals. In the mammalian orders, Cetacea (Whales and allies), Carnivora (cat family and allies) and Primates show a significantly higher conservation value than the rest.

The result obtained in this computation of CCV of all these species only shows the rank according to these four criteria under consideration. We would like to highlight one of the prominent weaknesses of this method, which is evident by the low ranking of some of the charismatic animals like Leopard (rank 298) and Musk deer (rank 128). Many significant criteria like economic exploitation are not considered in this preliminary exercise because of the non-availability of comparable good information. This may be the reason for low ranking of species like leopard and Musk deer. As most of these species are well studied, a significant amount of information other than the few criteria, which are used here, is available for them. Therefore for practical purposes we need to make subjective corrections in the prioritized list, regarding these kinds of species.

We would like to suggest a practical method to deal with this problem. After the preparation of CCV and ranking of all species, the whole list should be put to review by an expert group. The first 20 percent of the total species can be arbitrarily designated as the high priority species. On the basis of actual data available on the anthropogenic pressures affecting the species, the correction to the list should be made with the help of experts. Some of the species endangered by anthropogenic pressures, which are not considered here, may not be among these 20 percent of the species. In such cases, giving due consideration to other aspects for conservation, we should include those species in the list separately, on the basis of validated information. Appendix I and II give the high priority list of birds and mammals for conservation prepared in this way. The 13 species of birds which are prioritized by Red data list of ZSI (ZSI,1994) and 26 species of mammals which are prioritized by the CAMP workshop in Bangalore (Mollur et.al,1998) have not come in the 20% of the total birds and mammals prioritized in this preliminary exercise.

This could be because of any of the following reasons.

1. These species might be considered endangered because of some anthropogenic threat, which is not considered in the CCV analysis.
2. Inadequacy of the preliminary data synthesized by us (experts must be having better information about some specific species).
3. Special bias of the experts towards their study organisms also could have given atleast some of them a special status.

The mean CCV of the all mammal species prioritized under six different criteria by CAMP workshop is given in

Table 1. The first three categories show clearly a higher mean value than the rest. Table 2 gives the results of the 't' test for statistical significance of the differences of means between the six categories. The first three categories are seperately shown and have statistically significant differences with the low risk categories. But differences are not so significant within the threatened group, i.e., the first three categories of Table 1. This suggests that it is possible to classify these categories into two groups, the threatened and the low risk. This evaluation process does not see any particular reason to divide the threatened group further into different categories.

Table 1

Mean and Standard deviation of CCV for the mammalian spcies prioritized under different IUCN Workshop Redlist criteria (by CAMP workshop Banggalore)

Category No.	*Category*	*Mean*	*Std. Deviation*
1.	Critically Endangered	2.468728	0.325486
2.	Endangered	2.538763	0.302236
3.	Vulnerable	2.425151	0.272659
4.	Low risk near threatened	2.125513	0.371161
5.	Low risk least concerned	2.174773	0.375184
6.	Data deficient & not evaluated	2.309453	0.357975

Table 2

Result of 't' test for difference of means between six categories

Cat. No.	*t value*	*p value*	*DF*	*Significance*
1-2	0.4862	0.63	39	NS
1-3	0.6271	0.53	59	NS
1-4	3.5598	0.00	49	***
1-5	3.2516	0.00	76	**
1-6	1.9645	0.05	215	NS
2-3	1.5107	0.14	74	NS
2-4	5.2476	0.00	64	***
2-5	5.0921	0.00	91	***
2-6	3.5979	0.00	230	***
3-4	4.3647	0.00	84	***
3-5	4.1608	0.00	111	***
3-6	2.2807	0.02	250	*
4-5	0.7634	0.45	101	NS
4-6	3.2931	0.00	240	**
5-6	2.9906	0.00	267	**

Existing Problems and the Path Ahead

We have tried this exercise with birds and mammals because of the immediate availability of good information in published literature. But for most of the other tax a, particularly invertebrates, the information is scattered and, in many cases, not available at all. To make a realistic assessment of conservation prioritization we have to take this challenge of consolidating all the existing information, finding out the existing lacunae in the available literature and integrating the programme with the existing biodiversity inventorying and monitoring programmes, to get more information. This proposed system requires only presence or absence of data of the respective taxa from the different geographical regions and habitats. Even though it is a gigantic task, it is not impossible. A properly planned and co ordinated effort is required. 'Project Lifescape' of the Indian Academy of Sciences, Bangalore and Ministry of Environment and Forest's, on the Monitoring of Biodiversity of Eastern and Western Ghats, is an example of such an initiative. Thus, this species prioritization exercise can give a clear direction for our field investigations in the near future, so that we can collect more meaningful data with the minimum of effort.

Conservation Orientation and Public Participation

Prioritization is a prerequisite for any conservation effort. But actual conservation, to a great extent, is impossible without the active participation of the public. When data from which, and the method by which, the species get prioritized become transparent and available for the scrutiny and validation of all those who are interested, it may win the support and participation of the public. If this happens, then prioritization and conservation will not remain just subjects of some intellectual elite and nature lovers. For better success in our conservation programme, we need to convert the programme into a mass movement and everybody's concern. For that purposes, this kind of participatory method is the best way.

Concluding Remark

There are many limitations to the present method of CCV calculation, like the crudeness of the calculation of the geographic and habitat conservation value, the subjectivity of the habitat threat value and the sharp variation among the values of taxonomic uniqueness. The intention here is only to propose a method, which uses a robust and more objective way to derive conclusions from available and validated data.

Acknowledgement

We are happy to thank Mr. Deepak Jain and Mr. Rikikrishnan for their help in the consolidation and computerization of literature based data. We gratefully acknowledge the support of Prof. Shekhar Singh and the steering committee of Biodiversity Conservation Prioritization Project (BCPP).

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Appendix I. High priority species of Birds

Scientific Name	*Common English Name*	*CCV*	*Rank*
Ibidorhyncha struthersii	Ibisbill	3.577733	1
Dromas ardeola	Crab Plover	3.466666	2
Heliopais personata	Masked Finfoot	3.2	3
Batrachostomus moniliger	Ceylon Frogmouth	3.007692	4
Macropygia rufipennis	Nicobar Cuckoo-Dove	3.000333	5
Garrulax cinereifrons	Ashyheaded Laughing Thrush	3.000082	6
Ptiloaemus tickelli	Whitethroated Brown Hornbill	2.987533	7
Spelaeornis badeigularis	Mishmi Wren-Babbler	2.967354	8
Dicaeum vincens	Legge's Flowerpecker	2.967179	9
Columba torringtoni	Ceylon Wood Pigeon	2.966765	10
Phoeniconaias minor	Lesser Flamingo	2.966633	11
Anthracoceros coronatus	Lesser Pied Hornbill	2.9431	12
Phaenicophaeus pyrrhocephalus	Redfaced Malkoha	2.940494	13
Cissa ornata	Ceylon Blue Magpie	2.93625	14
Dendrocitta bayleyi	Andaman Tree Pie	2.934775	15
Rhinomyias brunneata	Olive Flycatcher	2.934259	16
Heterophasia capistrata	Blackcapped Sibia	2.933987	17
Sturnus erythropygius	Andaman Whiteheaded Myna	2.933879	18
Psittacula caniceps	Blyth's Nicobar Parakeet	2.933587	19
Turdus iliacus	Redwing	2.933383	20
Columba palumboides	Andaman Wood Pigeon	2.933365	21
Aegithalos niveogularis	Whitethroated Tit	2.930533	22
Spelaeornis longicaudatus	Longtailed Wren-Babbler	2.917321	23
Batrachostomus hodgsoni	Hodgson's Frogmouth	2.913259	24
Chaetura sylvatica	Whiterumped Spinetail Swift	2.912341	25
Pyrrhula aurantiaca	Orange Bullfinch	2.906877	26
Tockus griseus	Malabar Grey Hornbill	2.906835	27
Chaetura gigantea	Large Brownthroated Spinetail Swift	2.906775	28
Pyrrhula nipalensis	Brown Bullfinch	2.901377	29

Contd....

Scientific Name	*Common English Name*	*CCV*	*Rank*
Cinclidium frontale	Bluefronted Robin	2.901062	30
Picoides tridactylus	Threetoed Woodpecker	2.900152	31
Harpactes fasciatus	Trogon	2.885698	32
Sitta formosa	Beatiful Nuthatch	2.874172	33
Prinia cinereocapilla	Hodgson's Wren-Warbler	2.872372	34
Rhyticeros undulatus	Wreathed Hornbill	2.869271	35
Aegolius funereus	Tengmalm's Owl	2.868196	36
Muscicapa concreta	Whitetailed Blue Flycatcher	2.86701	37
Myiophonus horsfieldii	Malabar Whistling Thrush	2.856041	38
Rostratula benghalensis	Painted Snipe	2.8444	39
Microhierax caeulescens	Himalayan Redbreasted Falconet	2.842146	40
Aceros nipalensis	Rufousnecked Hornbill	2.841504	41
Eurostopodus macrotis	Great Eared Nightjar	2.840621	42
Yuhina flavicollis	Western Yellownaped Yuhina	2.83939	43
Yuhina nigrimenta	Blackchinned Yuhina	2.83939	44
Dicaeum trignostigma	Orangebellied Flowerpecker	2.839379	45
Macropygia unchall	Barrailed Cuckoo-dove	2.839233	46
Picus flavinucha	Yellownaped Woodpecker	2.838935	47
Chlidonias niger	Black Tern	2.836996	48
Rhyticeros plicatus	Narcondom Hornbill	2.835937	49
Upupa epops	Hoopoe	2.834943	50
Tragopan temminckii	Temminck's Trogopan	2.834315	51
Pteruthius aenobarbus	Chestnutfronted Shrike-Babbler	2.834151	52
Polyplectron bicalcaratum	Bhutan Peacock Pheasent	2.834124	53
Parus ater	Himalayan Coal Tit	2.833784	54
Anas gibberifrons	Grey Andaman Teal	2.833521	55
Columba elphinstonii	Nilgiri Woodpigeon	2.833398	56
Megalaima flavifrons	Yellowfronted barbet	2.822726	57
Myiophonus blighi	Ceylon Whistling Thrush	2.817108	58
Daption capensis	Cape Petrel	2.813922	59

Contd....

Scientific Name	*Common English Name*	*CCV*	*Rank*
Bombycilla garrulus	Waxwing	2.8139	60
Pavo muticus	Burmease Peafowl	2.813447	61
Muscicapa poliogenys	Brooks's Flycatcher	2.81141	62
Saroglossa spiloptera	Spottedwinged Stare	2.81023	63
Mulleripicus pulverulentus	Great slaty Woodpecker	2.807267	64
Pteruthius xanthochlorus	Green Shrike-Babbler	2.806384	65
Megalaima rubricapilla	Crimsonthroated Barbet	2.806103	66
Muscicapa strophiata	Orange Gorgeted Flycatcher	2.805943	67
Treron apicauda	Pintailed Green Pigeon	2.805745	68
Garrulax moniligerus	Necklaced Laughing Thrush	2.805682	69
Mino coronatus	Gold crested Myna	2.804663	70
Galloperdix bicalcarata	Ceylon spurfowl	2.801613	71
Turdus obscurus	Dark Thrush	2.800049	72
Pyrrhula erythrocephala	Redheaded Bullfinch	2.779155	73
Gavia arctica	Blackthroated Diver	2.778866	74
Otis tarda	Great Bustard	2.778821	75
Galerida deva	Sykes crested Lark	2.775207	76
Criniger flaveolus	Whitethroated Bulbul	2.773026	77
Heterophasia picaoides	Longtailed Sibia	2.772887	78
Charadrius melanops	Blackfronted Plover	2.772762	79
Megalaima australis	Blue eared Barbet	2.772737	80
Yuhina bakeri	Whitenaped Yuhina	2.77269	81
Columba pulchricollis	Ashy Wood pigeon	2.772298	82
Spizixos canifrons	Finchbilled Bulbul	2.770799	83
Laxia curvirostra	Crossbill	2.768716	84
Actinodura waldeni	NEFA Barwing	2.767354	85
Psittacula columboides	Blue winged Parakeet	2.76692	86
Turdus viscivorus	Missel Thrush	2.766716	87
Rynchops albicollis	Indian Skimmer	2.766677	88
Dryocopus martius	Black Woodpecker	2.761955	89

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Scientific Name	*Common English Name*	*CCV*	*Rank*
Melanochlora sultanea	Sultan Tit	2.758933	90
Galerida malabarica	Malabar crested Lark	2.752908	91
Sturnus senex	Ceylon Whiteheaded Myna	2.750579	92
Napothera brevicaudata	Streaked Wren Babbler	2.75047	93
Psittacula derbyana	Lord Derbys Parakket	2.750321	94
Dicrurus andamanensis	Large Andaman Drongo	2.746643	95
Pitta brachyura	Indian Pitta	2.745656	96
Aviceda jerdoni	Blyth's baza	2.745293	97
Ducula badia	Jerdon's Imperial Pigeon	2.744493	98
Gygis alba	Fairy Tern	2.744355	99
Cutia nipalensis	Nepal cutia	2.742855	100
Grus monacha	Hooded Crane	2.741058	101
Sitta himalayensis	Whitetailed Nuthatch	2.740838	102
Fregata ariel	Least Figate Bird	2.740567	103
Rhodonessa caryophyllacea	Pink headed duck	2.74031	104
Pyrrhula nipalensis	Brown Bullfinch	2.740277	105
Anser erythropus	Lesser whitefronted Goose	2.739594	106
Anser fabalis	Forest Bean Goose	2.739594	107
Dicaeum melanoxanthum	Yellowbellied Flowerpecker	2.739412	108
Seicercus castaniceps	Chestnut-headed Tit-Babbler	2.739324	109
Alcippe castaneceps	Chestnut headed Tit-Babbler	2.739178	110
Picoides cathpharius	Crimsonbreasted Pied Woodpecker	2.739085	111
Treron sphenura	Wedgetailed Green Pigeon	2.739078	112
Lophophorus sclateri	Redbreasted Hill Patridge	[illegible]	113
Arborophila mandellii	Redbreasted Hill Patridge	2.733682	114
Larus minutus	Little Gull	2.733648	115
Muscicapa vivida	Rufousbellied Flue Flycatcher	2.733643	116
Phylloscopus tenellipes	Pale legged Leaf Warbler	2.733393	117
Certhia nipalensis	Nepal Tree Creeper	2.729343	118
Muscicapa ruficauda	Rufoustailed Flyactcher	2.728132	119

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Scientific Name	*Common English Name*	*CCV*	*Rank*
Sturnus sturninus	Daurian Myna	2.722846	120
Muscicapa nigrorufa	Black-and-Orange Flycatcher	2.722565	121
Muscicapa pallipes	Whitebellied Blue Flycatcher	2.722565	122
Anthracoceros malabaricus	Indian Pied Hornbill	2.720834	123
Buceros bicornis	Great Pied Hornbill	2.718077	124
Strix leptogrammica	Himalayan Brown Wood Owl	2.717114	125
Garrulax austeni	Browncapped Laughing Thrush	2.716782	126
Hieraaetus kienerii	Rufousbellied Hawk Eagle	2.711625	127
Hypsipetes viridescens	Olive Bulbul	2.711524	128
Columba hodgsoni	Speckled Wood Pigeon	2.711199	129
Oceanodroma leucorhoa	Forktailed Storm Petrel	2.710145	130
Ardea goliath	Giant Heron	2.707267	131
Dinopium javanense	Goldenbacked Threetoed Woodpecker	2.70685	132
Pericrocotus brevirostris	Shortbilled Minivet	2.706815	133
Cygnus cygnus	Whooper Swan	2.706757	134
Alcedo hercules	Blyth's Kingfisher	2.706506	135
Heterophasia annectens	Chestnutbacked Sibia	2.706187	136
Heterophasia pulchella	Beautiful Sibia	2.706187	137
Yuhina xantholeuca	Whitebellied Yuhina	2.706057	138
Yuhina occipitalis	Rufousvented Yuhina	2.706023	139
Muscicapa muttui	Brownbreasted Flycatcher	2.705943	140
Pelargopsis amauroptera	Brownwinged Kingfisher	2.705886	141
Glaucidium brodiei	Collared Pygmy Owlet	2.70588	142
Strix butleri	Hume's Wood Owl	2.700447	143
Streptopelia turtur	Persian Turtle-Dove	2.700207	144
Cissa erythrorhyncha	Redbilled Blue Magpie	2.697439	145
Heterophasia gracilis	Grey Sibia	2.695143	146
Picoides auriceps	Brownheaded Pied Woodpecker	2.694641	147
Megapodius freycinet	North Nicobar Megapode	2.693685	148
Symaticus humiae	Mrs Hume's Barredback Pheasant	2.692615	149

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Scientific Name	*Common English Name*	*CCV*	*Rank*
Dendrocitta leucogastra	Whitebellied Tree Pie	2.690397	150
Prunella immaculata	Maroonbacked Accentor	2.690311	151
Cochoa viridis	Green Cochoa	2.689639	152
Enicurus immaculatus	Blackbacked Forktail	2.68933	153
Enicurus schistaceus	Slatybacked Forktail	2.689308	154
Ducula aenea	Northern Green Imperial Pigeon	2.689026	155
Podiceps nigricollis	Blacknecked Grebe	2.687629	156
Porzana fusca	Northern Ruddy Crake	2.684644	157
Napothera epilepidota	Austen's Small Wren-Babbler	2.683803	158
Seicercus burkii	Blackbrowed Flycatcher-Warbler	2.683758	159
Oenanthe pleschanka	Pleschanka's Chat	2.683495	160
Pycnonotus priocephalus	Greyheaded Bulbul	2.683476	161
Bucephala clangula	Goldeneye Duck	2.680115	162
Athene blewitti	Forest Spotted owlet	2.679341	163
Branta ruficollis	Redbreasted Goose	2.679189	164
Sterna repressa	Whitenecked Tern	2.678173	165
Cairina scutulata	Whitewinged Wood Duck	2.675705	166
Psittacula longicauda	Andaman Redcheeked Parakeet	2.67532	167
Grus leucogeranus	Siberian or Great White Crane	2.674358	168
Pterithius flaviscapis	Redwinged Shrike-Babbler	2.673017	169
Phylloscopus maculipennis	Western Greyfaced Leaf Warbler	2.672293	170
Salpornis spilonotus	Spotted Grey Creeper	2.670624	171
Aix galericulata	Mandarin Duck	2.670172	172
Collocalia maxima	Indomalayan or 'Black-nest' Swift	2.669417	173
Egretta gularis	Indian Reef Heron	2.667948	174
Cygnus olor	Mute Swan	2.667857	175
Porzana parva	Little Crake	2.667148	176
Falco concolor	Sooty Falcon	2.667131	177
Parus melanolophus	Crested Black Tit	2.667117	178
Pycnonotus penicillatus	Yellow-eared Bulbul	2.666843	179

Contd. . . .

Scientific Name	*Common English Name*	*CCV*	*Rank*
Zoothera sibirica	Whitebrowed Ground Thrush	2.666733	180
Muscicapa sibirica	Kashmir Sooty Flycatcher	2.661465	181
Collocalia fuciphaga	Andaman White-nest swiftlet	2.658239	182
Pteruthius melanotis	Chestnut-throated Shrike-Babbler	2.656384	183
Brachypteryx major	Rufousbellied Shortwing	2.656139	184
Muscicapa subrubra	Kashmir redbreasted Flycatcher	2.655876	185
Ducula bicolor	Pied Imperial Pigeon	2.655682	186
Zoothera marginata	Lesser Brown Thrush	2.655667	187
Tetraophasis szechenyii	Pheasant-Grouse	2.652404	188
Harpactes wardi	Ward's Trogon	2.652364	189
Pitta sordida	Hooded or Greenbreasted Pitta	2.651156	190
Vanellus gregarius	Sociable Lapwing	2.650702	191
Bubo nipalensis	Forest Eagle-Owl	2.65038	192
Garrulax galbanus	Yellowthroated Laughing Thrush	2.650115	193
Garrulax jerdoni	Kerala Laughing Thrush	2.650082	194
Cursorius bitorquatus	Jerdon's or Doublebanded Courser	2.648073	195
Haematospiza sipahi	Corn Crake	2.646998	196
Haematospiza sipahi	Scarlet Finch	2.646998	197
Ardea insignis	Great Whitebellied Heron	2.6461	198
Certhia discolor	Sikkim Tree Creeper	2.646065	199
Coccothraustes melanozanthos	Spottedwinged Grosbeak	2.645329	200
Garrulus lanceolatus	Blackthroated Jay	2.641883	201
Merops superciliosus	Bluecheeked Bee-eater	2.641107	202
Pnoepyga albiventer	Scalybreasted Wren-Babbler	2.640894	203
Pericrocotus divaricatus	Ashy Miniver	2.640149	204
Gavia stellata	Redthroated Diver	2.640033	205
Yuhina gularis	Western Stripethroated Yuhina	2.639423	206
Parus hypermelas	Blackbibbed Tit	2.63935	207
Muscicapa sapphira	Sapphireheaded Flycatcher	2.639276	208
Larus hemprichii	Sooty Gull	2.639215	209

Contd....

Scientific Name	*Common English Name*	*CCV*	*Rank*
Muscicapa ferruginea	Ferruginous Flycatcher	2.63921	210
Cettia major	Himalayan Large Bush Warbler	2.639144	211
Rhipidura hypoxantha	Yellowbellied Fantail Flycatcher	2.639126	212
Garrulax variegatus	Variegated Laughing Thrush	2.638982	213
Ophrysia superciliosa	Mountain Quail	2.638106	214
Anous stolidus	Noddy Tern	2.636996	215
Cissa flavirostris	Yellowbilled Blue Magpie	2.636283	216
Callacanthis burtoni	Redbrowed Finch	2.635854	217
Phalacrocorax pygmaeus	Pygmy Cormorant	2.634247	218
Rallina canningi	Andaman Banded Crake	2.634173	219
Charadrius hiaticula	Eastern Ringed Plover	2.633795	220
Picoides atratus	Stripebreasted Pied Woodpecker	2.633452	221
Grus antigone	Indian Sarus Crane	2.629958	222
Coccothraustes icterioides	Black-Yellow Grosbeak	2.628685	223
Pluvialis apricaria	Golden Plover	2.625322	224
Fregetta tropica	Duskyvented Storm Petrel	2.625033	225
Pericrocotus roseus	Rosy Minivet	2.623548	226
Oxyura leucocephala	Whiteheaded Stifftailed Duck	2.623423	227
Cinclidium leucurum	Whitetailed Blue Robin	2.623229	228
Tragopan melanocephalus	Western Horned Pheasant	2.623181	229
Muscicapa grandis	Large Niltava	2.622543	230
Psittacula alexandri	Indian Redbreasted Parakeet	2.622531	231
Marmaronetta angustirostris	Marbled Teal	2.622455	232
Acrocephalus scirpaceus	Asian Reed Warbler	[illegible]	233
Columba palumbus	Eastern Wood Pigeon	2.622332	234
Phylloscopus tytleri	Tytler's Leaf Warbler	2.622326	235
Acrocephalus stentoreus	Largebilled Reed Warbler	2.62232	236
Accipiter trivirgatus	North Indian Crested Goshawk	2.622293	237
Perdicula erythorhyncha	Painted Bush Quail	2.620651	238
Limnodromus semipalmatus	Snipe,billed Godwit or Asian Dowi	2.620542	239

Contd....

Scientific Name	*Common English Name*	*CCV*	*Rank*
Sitta tephronota	Eastern Rock Nuthatch	2.618572	240
Lophophorus impejanus	Himalayan Monal Pheasat	2.618258	241
Clangula hyemalis	Longtail Duck or old Squaw	2.618077	242
Otis tetrax	Eastern Little Bustard	2.617689	243
Ceyx erithacus	Threetoed Kingfisher	2.617655	244
Spelaeornis caudatus	Tailed Wren-Babbler	2.617287	245
Sterna sandvicensis	Sandwich Tern	2.617106	246
Birds that are selectively added to the high priority list			
Grus nigricollis	Blacknecked Crane	2.613225	254
Ciconia nigra	Black Stork	2.590885	284
Leptoptilos dubius	Adjutant Stork	2.53421	380
Catreus wallichii	Chir Pheasant	2.443673	543
Fregata andrewsi	Christmas Island Frigate Bird	2.44	548
Choriotis nigriceps	Great Indian Bustard	2.43386	561
Crossoptilon crossoptilon	Elwes's Eared Pheasant	2.418247	585
Tetraogallus tibetanus	Tibetan Snowcock	2.389881	652
Platalea leucorodia	Spoonbill	2.385799	661
Chlamydotis undulata	Houbara Bustard	2.323222	758
Coturnix coromandelica	Blackbreasted or Rain Quail	2.311659	779
Eupodotis bengalensis	Bengal Florican	2.193918	980
Ninox affinis	Andaman Brown Hawk-Owl	1.867029	1211

Appendix II. High Priority Species of Mammals

Genus Name	Species	Common name	CCV	Rank
Dugong	dugon	Dugong	3.5	1
Elephas	maximus	Asian elephant	3.015744	2
Suncus	dayi	Dayi's shrew	3.00029	3
Loris	tardigradus	Slender loris	2.957867	4
Ratufa	indica	Malabar gaint squirrel	2.904315	5
Ailurus	fulgens	Red bear	2.891666	6
Trachypithecus	phayrei	Phayre leaf monkey	2.873333	7
Macaca	silenus	Lion-tailed Macaque	2.86313	8
Latidens	salimali	Salimali fruit bat	2.839215	9
Bos	grunniens	Yak	2.834896	10
Vespertilio	murinus	Murinus evening bat	2.834362	11
Herpestes	brachyurus	Brown mongoose	2.834353	12
Mustela	altaica	Pale weasel	2.83431	13
Platacanthomys	laslurus	Spiny dormouse	2.834274	14
Sorex	minutus	Minutus shrew	2.83341	15
Sorex	planiceps	Planiceps shrew	2.83341	16
Physeteridae	catodon	Sperm whale	2.833333	17
Funambulus	sublineatus	Dusky striped squirrel	2.826963	18
Rhinoceros	unicornis	Greater-One horned rhinoceros	2.825712	19
Cervus	duvauceli	Swamp deer	2.799224	20
Soriculus	nigrescens	Sikkim large clawed shrew	2.796719	21
Parascaptor	leucura	The Assam mole	2.79405	22
Euroscaptor	micrura	The Himalayan mole	2.79405	23
Neofelis	nebulosa	Clouded leopard	2.790745	24
Helarctos	malayanus	Malayan sun bear	2.787499	25
Mellivora	capensis	Ratel, Honey badger	2.778592	26
Feroculus	Feroculus	Feroculus shrew	2.778307	27
Hylobates	hoolock	White-browed Gibbon	2.777777	28
Dacnomys	millardi	Millard rat	2.775474	29

Contd....

Genus Name	*Species*	*Common name*	*CCV*	*Rank*
Panthera	uncia	Snow leopard	2.772223	30
Macaca	arctoides	Stump-tailed Macaque	2.77193	31
Scotomanes	emarginatus	Harelequin bat	2.768209	32
Mustela	putorius	Tibetan polecat	2.767643	33
Soriculus	leucops	Leucops shrew	2.767085	34
Alticola	stoliczkanus	Stoloczkanus vole	2.766901	35
Alticola	stracheyi	Stracheyi vole	2.766901	36
Alticola	albicauda	Albicauda vole	2.766901	37
Alticola	montosa	Montosa vole	2.766901	38
Alticola	roylei	Royle vole	2.766901	39
Tamiops	macclellandi	Himalayan striped squirrel	2.766814	40
Dremonys	pernyi	Perny long-nosed squirrel	2.766785	41
Cricetinae	alticola	Alticola hamster	2.766784	42
Ratufa	macroura	Grizzled gaint squirrel	2.759414	43
Nycticebus	coucang	Slow loris	2.757867	44
Melursus	ursinus	Sloth bear	2.750466	45
Chimarrogale	himalaytica	The Himalayan water shrew	2.733407	46
Mustela	kathiah	Yellow-bellied weasel	2.73061	47
Gazella	bennettii	Indian gazelle	2.730284	48
Nyctalus	montanus	Montanus evening bat	2.73025	49
Arctictis	binturong	Binturong	2.714286	50
Panthera	tigris	Tiger	2.709256	51
Cervus	elaphus	Kashmir stag	2.702924	52
Mustela	erminea	Ermine, Stoat	2.700977	53
Soriculus	macrurus	Macrurus shrew	2.700418	54
Cricetinae	migratorius	Grey hamster	2.700118	55
Marmota	himalayana	Himalayan marmot	2.700053	56
Berylmys	mackenziel	Mackenziel LTG rat	2.700001	57
Berylmys	bowersi	Bowersi LTG rat	2.700001	58
Berylmys	manipulus	Manipulus LTG rat	2.700001	59

Contd....

Genus Name	Species	Common name	CCV	Rank
Trachypithecus	pileatus	Capped leaf monkey	2.697867	60
Hyperacius	wynnei	Wynnei vole	2.69167	61
Mains	crassicaudata	Indian pangolin	2.684057	62
Prinodon	pardicplor	Spotted Linsang	2.670109	63
Sphaerias	blanfordi	Blanfordi fruit bat	2.668848	64
Anourosorex	squamipes	Mole shrew	2.66674	65
Eubalaena	glaciallis	Black right whale	2.666667	66
Bos	gaurus	Gaur	2.664529	67
Ovis	ammon	Shapu	2.663943	68
Pardofelis	marmorata	Marbled cat	2.663892	69
Nyctalus	leisleri	Leisleri bat	2.663583	70
Trachypithecus	johnii	Niligiri langur	2.6635	71
Soriculus	caudatus	Caudatus shrew	2.663385	72
Capra	falconeri	Markor	2.638933	73
Ia	io	Great evening bat	2.636419	74
Cannomys	badius	Lesser bamboo rat	2.634274	75
Rhizomys	pruinosus	Hoary bamboo rat	2.633647	76
Leopoldamys	edwardsi	Edwardsi long tailed giant r	2.633396	77
Hyperacius	fertilis	True vole	2.630104	78
Nectogale	elegans	Elegans shrew	2.628307	79
The Mammals that are selectively added to the high priority list				
Herpestes	palustris	Asian mongoose	2.53482	109
Hemitragus	hylocrius	Niligiri tahr	2.502604	122
Trachypithecus	geei	Golden leaf monkey	2.500178	124
Moschus	chrysogaster	Musk deer	2.483305	128
Ochotona	curzoniae	Curzoniae pikas	2.477304	130
Dicerorhinus	sumatrensis	Sumatran rhinoceros	2.466691	138
Biswamoyopterus	biswassi	Namdapha flying squirrel	2.449093	149
Diomys	crumpi	Crump mouse	2.438441	157
Macaca	fascicularis	Crab-eating Macaque	2.41313	164

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Genus Name	*Species*	*Common name*	*CCV*	*Rank*
Cuon	alpinus	Indian wild dog	2.398612	180
Tupaia	nicobarica	Nicobar tree shrew	2.388082	186
Sousa	chinensis	Indo-pacific hump-back dolphin	2.379167	190
Cervus	eldi	Brow-antlered deer	2.377457	191
Melogale	moschata	Small-toothed Ferret badger	2.371875	194
Panthera	leo	Asiatic lion	2.343056	206
Atherurus	macrourus	Brush tailed porcupine	2.338966	208
Balaenoptera	musculus	Blue whale	2.333333	210
Bubalus	arnee	Wild water buffalo	2.331586	212
Orcaella	brevirostris	Irrawadydolphin	2.325	214
Crocidura	hispida	Andaman shrew	2.271315	234
Rhinolophus	subbadius	Subbadius horse-shoe bat	2.213527	252
Crocidura	pergrisea	Pale Grey shrew	2.204648	258
Sus	salvanius	Pygmy hog	2.1912	264
Otomops	wroughtoni	Wroughtons free tailed bat	2.160795	274
Myotis	longipes	Longipes evening bat	2.16021	277
Niviventer	brahma	Brahma white bellied rat	2.08374	305

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Prioritisation of Endangered Plants of India

M. Ahmedullah

Introduction

India is endowed with a rich and diverse flora with about 45000 species of plants. Of which 15000-17000 belong to the higher groups. About 10 percent of these higher plants are considered to be threatened. Since prioritisation is prerequisite for conservation of species that need immediate remedial measures to safeguard them from the threat of extinction, this study assumes considerable significance. Further, many of the endangered species are important in that they are in medicine and food, or some other socio-economic value. Hence, prioritisation of such threatened species based on their conservation status, biological value and socio-economic value is of prime importance from the point of view of biodiversity conservation.

Endangered species are those that are under imminent threat of extinction if certain causative factors continue operating. Included under this category are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. The survival of these species, which have already reached critically low levels of population numbers, is dependent on certain critical factors of ecology, population dynamics, or extrinsic factors such as exploitation and habitat loss or degradation.

Documentation of such species is imperative to initiate plant conservation action. The present work aims at prioritising the endangered species of higher plants of India based on conservation status, biological values and socio-economic values.

Project Objectives

The main objectives of the project are:

- Provide a profile of selected endangered species taking into consideration such parameters as:

  1. Natural range/location, including occurrence, if any, in Protected Areas;
  2. Threats/causes of rarity and decline;
  3. Biological values, i.e., endemicity, taxonomic uniqueness, and functioning such as keystone/ flagship/indicator species;
  4. Socio-economic values, including utilisation, use or potential use in medicine/ethnobotany, commercial use in trade etc.

  Prioritise the endangered plant species by scoring values of Conservation, socio-economic and biological for each species.

Methodology

The exercise of prioritising the endangered plant species was initiated through the screening of Red Data Books for Indian Plants (M.P. Nayar & A.R.K. Sastry, Vols. 1-3, 1987-1990, Botanical Survey of India) and other publications on the threatened plants of the country, especially of the publications of the Botanical Survey of India. This comprised screening of about 620 plant taxa listed therein (Level-I). The screening was done on the basis of the 'endangered' category ascribed to the species in the RDBs. This preliminary list is appended (as annex) at the end of the report.

Taking the 'endangered' status (as evaluated in the RDBs) as the primary criterion for selection about 80 plant taxa were short-listed (Level-II) from the total of 620 species figuring in the Red Data Books.

Extensive survey of regional/local floras, forest working plans, taxonomic and general literature was also taken up to glean additional information on the short-listed species. Detailed floristic/vegetation accounts of areas where the endangered species are located were also studied. Further consultation and research at central and regional herbaria of the Botanical Survey of India supplemented the information base.

The study took into account parameters such as extent of geographic range, general ecology and records of observations on phenology, existing threats, anticipated threats, socio-economic uses/potential uses, keystone functions, if any, etc.

The endangered species were prioritised on basis of the added values for the criteria of conservation status (i.e., evaluated as 'endangered'), biological values and socio-economic values. Data profiles of these short-listed endangered species (with full details of location/range, habitat conditions, threats, values, and distribution maps) are provided in Part II of this report. (A sample of the species data profile is given as an Appendix).

The distribution range/location of the prioritised endangered species was mapped using GIS. Species distribution is plotted on the maps of Indian states, with district administrative boundaries.

The biogeographic area code given in the Data Profiles of the endangered species follows the biogeographic classification of Rodgers & Panwar (1988).

For deriving a list of Prioritised Endangered Plants (Level - III) of the country, the species were given scores for specific criteria/sub-criteria as below:

While each criterion is given equal weightage (totaling to 10 points), each sub-criterion is given weightage with score values ranging from 1-6, arbitrarily ascribing values on subjective evaluation in the order of importance. Species having a greater scoring (total score value) through a combination of the values ascribed to the different subcriteria are prioritised.

NOTE: Values for 'threat' category are not ascribed separately as all the endangered species are subject to a similar degree of threat and, as such, this 'threat value' would not make any difference to the total weightage/score value. Also, the subcriterion, 'endemicity' (C1) has been treated as a biological value, separate or distinguishable from the criterion 'narrow range of distribution' (A1) as the later phenomenon could also relate to non-endemic species having wider distribution, even outside the country and could thus be included as non-endemic threatened plants.

The level-II species have been subject to the prioritisation methodology described above.

A. Conservation Value	*subcriteria*:	**A1**	Narrow range of distribution (i.e., within a single biogeographic zone)	Score value - 5
		A2	Medium range of geographic distribution (i.e., within 2 biogeographic zones)	Score value - 3
		A3	Large range of geographic distribution (i.e., within 3 or more biogeographic zones)	Score value - 2
B. Socio-economic Value	*subcriteria*:	**B1**	Medicinal value	Score value - 3
		B2	Food value	Score value - 3
		B3	Fodder value	Score value - 1
		B4	Horticultural value	Score value - 1
		B5	Timber value or any other economic value	Score value - 1
		B6	Potential value in any of the above	Score value - 1
C. Biological value	*subcriteria*:	**C1**	Endemicity	Score value - 5
		C2	Taxonomic uniqueness	Score value - 3
		C3	Keystone/Flagship function/arborescent (tree) form	Score value - 2

Table 1A: Prioritisation of Endangered Species Based on Biological Value

Scientific Name	Family Name	Biological Value			Total Score
		C1	C2	C3	
Dicliptera abuensis Blatter	**Acanthaceae**	+			5
Phlebophyllum jeyporense (Bedd.) Bremekamp		+			
Santapaua madurensis Balakr. & Subram.		+	+		8
Strobilanthes hallbergii Blatter		+			5
Acer osmastonii Gamble	**Aceraceae**	+		+	7
Acer hookeri Miquel var. ***majus*** Pax		+		+	7
Acer oblongum Wall. var. ***microcarpum*** Hiern		+		+	7
Acer oblongum Wall. ex DC. var ***membranaceum*** Bannerji		+		+	7
Acer sikkimense Miquel var. ***serrulatum*** Pax		+		+	7
Buchanania barberi Gamble	**Anacardiaceae**	+		+	7
Nothopegia aureo - fulva Bedd. ex Hook.f.		+		+	7
Desmos viridiflorus (Bedd.) Stapf	**Annonaceae**	+		+	7
Pimpinella tirupatiensis Balakr. & Subram	**Apiaceae**	+			5
Pimpinella wallichii Clarke	**Apiaceae**	+			5
Cryptocoryne tortuosa Blatter & McCann	**Araceae**	+			5
Calamus inermis T. Anders.	**Arecaceae**	+			5
Livistona jenkinsiana Griff.		+			5
Ceropegia beddomei Hook.f.	**Asclepiadaceae**	+			5
Ceropegia lawii Hook.f.		+			5
Ceropegia mahabalei Hemadri & Ansari		+			5
Ceropegia odorata Nimmo ex Hook.f.		+			5
Ceropegia omissa Huber		+			5
Ceropegia panchganiensis Blatter & McCann		+			5
Ceropegia barnesii Bruce & Chatterjee		+			5
Frerea indica Dalz.		+	+		8
Anaphalis barnesii C.E.C. Fischer	**Asteraceae**	+			5
Lactuca benthamii Clarke		+			5
Lactuca cooperi Anthony		+			5
Lactuca filicina Duthie ex Stebbins		+			5
Lactuca undulata Ledeb		+			5
Saussurea costus (Falc.) Lipschitz.		+			5
Senecio kundaicus Fischer		+			5
Vernonia multibracteata Gamble		+			5
Vernonia pulneyensis Gamble		+			5
Youngia nilgiriensis Babcook			+		3
Impatiens anaimudica C.E.C. Fischer	**Balsaminaceae**	+			5
Impatiens johnii Barnes	**Balsaminaceae**	+			5
Impatiens munnarensis E. Barnes		+			5
Impatiens neo-barnesii C.E.C. Fischer		+			5
Impatiens nilagirica C.E.C Fischer		+			5
Begonia aliciae C.E.C. Fischer	**Begoniaceae**	+			5
Begonia anamalayana Bedd.		+			5
Berberis lambertii R. Parker	**Berberidaceae**	+			5

Contd....

Scientific Name	Family Name	Biological Value			Total Score
		C1	C2	C3	
Arenaria curvifolia Majumdar	**Caryophyllaceae**	+			5
Arenaria ferruginea Duthie ex Williams		+			5
Euonymus angulata Wight	**Celastraceae**	+		+	7
Euonymus assamicus Blakelock		+		+	7
Salacia jenkinsii Kurz		+			5
Salacia malabarica Gamble		+			5
Belosynapsis kewensis Hassk.ex Kurz	**Commelinaceae**	+			5
Kalanchoe roseus C.B. Clarke	**Crassulaceae**	+			5
Elaegnus conferta Roxb. ssp. ***dendroidea*** Servetaz	**Elaeagnaceae**	+		+	7
Crotalaria fysonii Dunn var. ***glabra*** Gamble	**Fabaceae**	+			5
Crotalaria kodaiensis Debberm. & Biswas		+			5
Crotalaria sandoorensis Bedd. ex Gamble		+			5
Humboldtia bourdilloni Prain		+		+	7
Humboldtia laurifolia Vahl				+	2
Humboldtia unijuga var. ***unijuga*** Beddome		+		+	7
Nogra filicaulis (Kurz) Merr.					0
Hydnocarpus macrocarpa (Bedd.) Warb. ssp. ***Macrocarpa***	**Flacourtiaceae**	+		+	7
Leucas mukerjiana Rao & Kumari	**Lamiaceae**	+			5
Pogostemon nilagiricus Gamble	**Lamiaceae**	+			5
Pogostemon paludosus Benth.		+			5
Actinodaphne lanata Meisner	**Lauraceae**	+		+	7
Actinodophne bourneae Gamble		+		+	7
Iphigenia sahyadrica Ansari & Rolla Rao	**Liliaceae**	+			5
Lilium macklineae Sealy		+			5
Scilla viridis Blatt. & Halb.		+			5
Decaschistia rufa Craib	**Malvaceae**	+			5
Memecylon flavescens Gamble	**Melastomataceae**	+		+	7
Kendrickia walkeri (Wight) Hook. f.					
Eugenia discifera Gamble		+		+	7
Meteoromyrtus wynaadensis (Bedd.) Gamble		+	+	+	**10**
Syzigium travancoricum Gamble		+		+	7
Syzygium courtallense (Gamble) Alston		+		+	7
Syzygium gambleanum Rathakr & Chitra		+		+	7
Ipsea malabarica (Reichb.f.) Hook.f.	**Orchidaceae**	+			5
Anoectochilus nicobaricus Balakr. & P. Chakra.	**Orchidaceae**	+			5
Anoectochilus tetrapterus Hook. f.		+			5
Aphyllorchis gollani Duthie		+			5
Calanthe pachystalix Reichb.f. ex Hook.f.					0
Cymbidium whiteae King & Pantling		+			5
Dendrobium tenuicaule Hook. f.		+			5
Flickengeria hesperis Seidenf.		+			5
Malleola andamanica Balakr. & Bhargava		+			5
Paphiopedilum druryi (Bedd.) Stein		+			5
Paphiopedilum fairrieanum (Lindl.) Stein		+			5
Paphiopedilum wardii Summerh.		+			5

Table 1B: Prioritisation of Endangered Species
(Based on Conservation value, socio-economic value and biological value)

Scientific Name	*Family Name*	*Conservation Value*			*Socio-Economic Value*						*Biological Value*			*Total Score value*
		A1	*A2*	*A3*	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*C1*	*C2*	*C3*	
Dicliptera abuensis Blatter	**Acanthaceae**	+								+	+			11
Phlebophyllum jeyporense (Bedd.) Bremekamp			+							+	+			9
Santapaua madurensis Balakr. & Subram.		+									+	+		13
Strobilanthes hallbergii Blatter		+								+	+			11
Acer osmastonii Gamble	**Aceraceae**		+							+	+		+	11
Acer hookeri Miquel var. ***majus*** Pax		+							+		+		+	13
Acer oblongum Wall. var. ***microcarpum*** Hiern		+								+	+		+	13
Acer oblongum Wall. ex DC. var ***membranaceum*** Bannerji		+								+	+		+	13
Acer sikkimense Miquel var. ***serrulatum*** Pax		+								+	+		+	13
Buchanania barberi Gamble	**Anacardiaceae**	+								+	+		+	13
Nothopegia aureo-fulva Bedd. ex Hook.f.		+								+	+		+	13
Desmos viridiflorus (Bedd.) Stapf	**Annonaceae**	+									+		+	12
Pimpinella tirupatiensis Balakr. & Subram	**Apiaceae**	+								+	+			11
Pimpinella wallichii Clarke	**Apiáceae**	+								+	+			11
Cryptocoryne tortuosa Blatter & McCann	**Araceae**	+								+	+			11
Calamus inermis T. Anders.	**Arecaceae**	+								+	+			11
Livistona jenkinsiana Griff.			+			+		+	+		+			13
Ceropegia beddomei Hook.f.	**Asclepiadaceae**	+								+	+			11
Ceropegia lawii Hook.f.		+				+					+			13
Ceropegia mahabalei Hemadri & Ansari		+				+				+	+			14
Ceropegia odorata Nimmo ex Hook.f.			+							+	+			9
Ceropegia omissa Huber		+								+	+			11
Ceropegia panchganiensis Blatter & McCann		+				+					+			13
Ceropegia barnesii Bruce & Chatterjee		+								+	+			11
Frerea indica Dalz.		+								+	+	+		14
Anaphalis barnesii C.E.C. Fischer	**Asteraceae**	+									+			10
Lactuca benthamii Clarke		+								+	+			11
Lactuca cooperi Anthony		+								+	+			11

Contd....

Scientific Name	Family Name	Conservation Value			Socio-Economic Value						Biological Value			Total Score value
		A1	A2	A3	B1	B2	B3	B4	B5	B6	C1	C2	C3	
Lactuca filicina Duthie ex Stebbins		+								+	+			11
Lactuca undulata Ledeb		+								+	+			11
Saussurea costus (Falc.) Lipschitz.			+		+				+		+			12
Senecio kundaicus Fischer		+								+	+			11
Vernonia multibracteata Gamble		+								+	+			11
Vernonia pulneyensis Gamble		+								+	+			11
Youngia nilgiriensis Babcock		+										+		8
Impatiens anaimudica C.E.C. Fischer	**Balsaminaceae**	+								+	+			11
Impatiens johnii Barnes	**Balsaminaceae**	+								+	+			11
Impatiens munnarensis E. Barnes		+								+	+			11
Impatiens neo-barnesii C.E.C. Fischer		+								+	+			11
Impatiens nilagirica C.E.C Fischer		+								+	+			11
Begonia aliciae C.E.C. Fischer	**Begoniaceae**	+								+	+			11
Begonia anamalayana Bedd.		+								+	+			11
Berberis lambertii R. Parker	**Berberidaceae**	+								+	+			11
Arenaria curvifolia Majumdar	**Caryophyllaceae**	+								+	+			11
Arenaria ferruginea Duthie ex Williams		+								+	+			11
Euonymus angulata Wight	**Celastraceae**	+								+	+		+	13
Euonymus assamicus Blakelock		+								+	+		+	13
Salacia jenkinsii Kurz				+						+	+			8
Salacia malabarica Gamble		+								+	+			11
Belosynapsis kewensis Hassk. ex Kurz	**Commelinaceae**	+								+	+			11
Kalanchoe roseus C.B. Clarke	**Crassulaceae**	+			+					+	+			14
Elaegnus conferta Roxb. ssp. *dendroidea* Servetaz	**Elaeagnaceae**	+								+	+		+	13
Crotalaria fysonii Dunn var. *glabra* Gamble	**Fabaceae**	+								+	+			11
Crotalaria kodaiensis Debberm & Biswas		+								+	+			11
Crotalaria sandoorensis Bedd. ex Gamble		+								+	+			11
Humboldtia bourdilloni Prain		+				+				+	+		+	16
Humboldtia laurifolia Vahl			+							+			+	6
Humboldtia unijuga var. *unijuga* Beddome		+							+	+	+		+	14
Nogra filicaulis (Kurz) Merr.				+										2

Contd....

Scientific Name	*Family Name*	*Conservation Value*			*Socio-Economic Value*						*Biological Value*			*Total Score value*
		A1	*A2*	*A3*	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*C1*	*C2*	*C3*	
Hydnocarpus macrocarpa (Bedd.) Warb. ssp. ***Macrocarpa***	**Flacourtiaceae**	+							+	+	+		+	**14**
Leucas mukerjiana Rao & Kumari	**Lamiaceae**	+								+	+			11
Pogostemon nilagiricus Gamble	**Lamiaceae**	+								+	+			11
Pogostemon paludosus Benth.		+								+	+			11
Actinodaphne lanata Meisner	**Lauraceae**	+								+	+		+	13
Actinodophne bourneae Gamble		+								+	+		+	13
Iphigenia sahyadrica Ansari & Rolla Rao	**Liliaceae**	+			+						+			13
Lilium macklineae Sealy		+						+			+			11
Scilla viridis Blatt. & Halb.		+								+	+			11
Decaschistia rufa Craib	**Malvaceae**	+							+		+			11
Memecylon flavescens Gamble	**Melastomataceae**	+								+	+		+	13
Kendrickia walkeri (Wight) Hook. f.														3
Eugenia discifera Gamble		+								+	+		+	13
Meteoromyrtus wynaadensis (Bedd.) Gamble		+								+	+	+	+	**16**
Syzigium travancoricum Gamble		+			+					+	+		+	**16**
Syzygium courtallense (Gamble) Alston		+						+		+	+		+	**14**
Syzygium gambleanum Rathakr & Chitra		+								+	+		+	13
Ipsea malabarica (Reichb.f.) Hook.f.	**Orchidaceae**	+						+			+			11
Anoectochilus nicobaricus Balakr. & P. Chakra.	**Orchidaceae**	+						+			+			11
Anoectochilus tetrapterus Hook. f.		+						+			+			11
Aphyllorchis gollani Duthie		+						+			+			11
Calanthe pachystalix Reichb.f. ex Hook.f.				+				+						3
Cymbidium whiteae King & Pantling		+						+			+			11
Dendrobium tenuicaule Hook. f.		+						+			+			11
Flickengeria hesperis Seidenf.		+						+			+			11
Malleola andamanica Balakr. & Bhargava		+						+			+			
Paphiopedilum druryi (Bedd.) Stein		+			+			+			+			**14**
Paphiopedilum fairrieanum (Lindl.) Stein		+						+			+			11
Paphiopedilum wardii Summerh.		+						+			+			11

Drawbacks of the Methodology

The conservation status in particular is based on secondary sources (screened at Level-I prioritisation step). In any case, periodic re-assessments of all threatened species is a cardinal need.

The methodology ascribes arbitrary values to the selected parameters used for prioritising endangered species. The scores ascribed to different sub-criteria like medicinal value, food value, timber value, endemicity, taxonomic uniqueness etc., are very subjective.

The potential medicinal value or food value of many plant species is yet to be investigated. With the existing knowledge, which could well be insufficient in many cases, the methodology for prioritisation could be suspect, but in absence of knowledge in the gap areas it might serve the purpose for the present.

Results and Observations

When the endangered species were prioritised on the basis of biological value, alone (Table 1a) it was found that only one species, *Meteoromyrtus wynaadensis*, scored maximum value of 10 points on basis of its narrow endemicity, taxonomic uniqueness (being the constituent species of a monotypic genus) and arborescent/ tree form. Next are two species, *Santapua madurensis* and *Frerea indica*, both of which have scored 8 points on the basis of their endemicity and taxonomic uniqueness; both represent monotypic endemic genera. The rest of the endangered species have total score values of 5 to 7 mostly on basis of endemicity and arborescent/ tree form. Therefore, from the biological point of view priority for conservation must be given to narrow endemic species that are taxonomically unique and have an arborescent life form.

Adding on conservation value and socio-economic value to the biological value (Table 1b) through the methodology described earlier about 31 species were found to secure maximum values ranging from 12 - 16 points (list appended). These prioritised species were found to have certain commonalties like endemicity and narrow / localised distribution range. They gain an edge over others by having socio-economic value or biological value over and above the conservation value, which is a common denominator.

The top 10 endangered species prioritised on basis of conservation value, socio-economic value and biological value (Table 1b) are: *Humboldtia bourdillonii*, *Meteoromyrtus wynaadensis*, *Syzigium travancoricum*, *S. courtallensis*, *Ceropegia mahabalei*, *Frerea indica*, *Kalanchoe roseus*, *Humboldtia unijuga*, var. *unijuga*, *Hydnocarpus macrocarpa* ssp. *macrocarpa*, and *Paphiopedilum druryi*.

The top three species had the maximum score values of 16 points. These are *Humboldtia bourdillonii*, *Meteoromyrtus wynaadensis*, and *Syzigium travancoricum*. Incidentally, all the three are arborescent (tree) species. *Humboldtia bourdillonii* is an endemic tree species confined to a very narrow distribution range in the southern W. Ghats; its attractive flowers lend it horticultural potential, while the edible pods lend it high food value. As such, its socio-economic importance add to the overall value of the species. *Syzigium travancoricum*, an endemic tree species that is surviving in a few sacred groves in Kerala, is also of socio-economic significance, being of medicinal value. *Meteoromyrtuus wynaadensis*, also a tree species endemic to a narrow geographic range, on the other hand scores well owing to its biological value; the species is taxonomically unique, being a representative of a monotypic endemic genus of peninsular India.

The rest of the species that figure in the top ten bracket, with total scored values of 14 points, are a similar mix of species with socio-economic and biological values. *Syzygium courtallense*, *Humboldtia unijuga* var. *unijuga*, and *Hydnocarpus macrocarpa* ssp. *macrocarpa* are narrow endemic species that of socio-economic and biological values. All three are narrow endemic species with arborescent life forms giving them a higher biological value. *Syzygium courtallense* has horticultural value, with economic/food potential. *Humboldtia unijuga* var. *unijuga* is of timber and horticultural value. *Hydnocarpus macrocarpa* var. *macrocarpa* is again of timber value and has medicinal potential. *Ceropegia mahabalei* has high food value with its edible tubers being a cherished food item for the local communities; the plant has attractive flowers of horticultural potential.

Frerea indica on the other hand figures in the top ten list purely on the merit of its biological value; it is taxonomically unique being a representative of a monotypic endemic genus of the family Asclepiadaceae. The species is biologically interesting in other ways too; the shiny stems attract the birds that probably mistake it for worms and help in its dispersal, and the bright flowers attract insects.

Kalanchoe roseus and *Paphiopedilum druryi*, besides being narrow endemic species, also have socio-economic value, being of use in medicine. The former is used as antidote for snakebites in the local ethnomedicine; its attractive flowers are also of horticultural value. The latter, which was once regarded as extinct (IUCN Red Data Book) until rediscovered again in the Kalakad forests, is of immense horticultural value (highly prized by the plant collectors) and also purported to be of medicinal value.

Among the rest of the High priority endangered species, only one species, *Santapaua madurensis*, is of very high biological value. The species is taxonomically unique, being a complement of the monotypic endemic genus, *Santapaua*, which is endemically restricted to Alagar hills in southern E. Ghats. (However, being taxonomically very closely allied to the Sri Lankan endemic genus *Plaesianthea*, the delimitation of this species merits further study).

Of the remaining species in the prioritised list of endangered plants (total score values ranging from 12 to 13) the bulk are of high biological value by virtue of being endemics with arborescent tree forms. These include *Euonymus angulata, E. assamicus, Acer hookeri var. majus, A. hookeri var. membranaceum, A. sikkimense, Buchanania barberi, Nothopegia aureo-fulva, Elaegnus conferta* ssp. *dendroidea, Actinodaphne lanata, A. bourneae, Eugenia discifera, Syzygium gambleanum* and *Desmos viridiflorus.*

Buchanania barberi is a narrow endemic tree species confined to southern W. Ghats. This species is not known to have any particular use, but other species are well known sources of edible fruits and oil, which are used in local medicine.

Euonymus angulata and *E. assamicus* are endemic tree species; the former being confined to the hotspot area of southern W. Ghats, while the latter is restricted only to Dalie Valley in the NE region. The socio-economic potential of the two species is not known owing to their rarity, but other species of the group are used in medicine, the wood used for turnery, and leaves as fodder.

The endangered acers are found only in the Himalayas. *Acer hookeri* var. *majus, A. oblongum* var. *microcarpum, A. sikkimense* var. *serrulatum* are confined to the Eastern Himalaya 'Hotspot' area. Only *A. oblongum var. membranaceum* is endemic to Mussoorie hills in W. Himalaya. The socio-economic profile of the species shows that *Acer hookeri* var. *majus* is used locally as fuel wood, while *A. oblongum* var. *membranaceum* is of horticultural value.

Elaegnus conferta ssp. *dendroidea* is an endemic tree species confined to Khasi hills in NE region; though this species is not known to have specific uses other species of the group have food value (the fruits are edible and relished by the local people).

Nothopegia aureo-fulva is an endemic tree confined to the Tirunelveli hills of southern W. Ghats; the wood has low quality timber value.

The endemic trees *Actinodaphne lanata* and *A. bourneae* are restricted to the Nilgiri hills and Palni hills respectively in the southern W. Ghats 'hotspot' area. Though no socio-economic value is recorded they have medicinal potential with some level of the alkaloid 'actinodaphnine' in their bark.

Similarly, *Eugenia discifera* is an endemic tree species confined to a narrow range in the southern W. Ghats; it has no known socio-economic value, but has potential value in food, medicine, and as low-quality timber. The same is the case with the endemic tree *Syzygium gambleanum* that is recorded so far only from the lower hills of Kothyar in southern W. Ghats.

Memecylon flavescens has no known uses, but other species of the genus are well known sources of food, medicine and low quality wood.

Among the rest of the endangered species that have shrubby or herbaceous life forms are *Ceropegia lawii, C. panchganiensis, Livistona jenkinsiana, Iphigenia sahyadrica* and *Saussurea costus.*

Ceropegia lawii and *C. panchganiensis* are endemic to Harischandragad hill and Panchgani respectively in northern W. Ghats at about 1000 m altitude. Apart from being narrow endemics these species have high food value, with their tubers being consumed by the local communities - a factor responsible for their endangerment.

The endangered palm *Livistona jenkinsiana* is spread over two biogeographic zones in NE region; it has high socio-economic value with its seeds (endosperm) being edible and of food value; the leaves used by local communities for thatching purposes, and the plant as a whole being of high horticultural value.

The liliaceaous species *Iphigenia sahyadrica*, which is endemic to the central W. Ghats, is a source of the alkaloid 'colchicine' used extensively as a drug in modern medicine.

The high altitude endemic species *Saussurea costus*, which is distributed in the Western Himalayas between 3200 to 3800 m altitude, is of very high economic value so much so that it has been listed in Appendix I of CITES, wherein the trade of the species is globally banned. The species is a source of 'kuth', an aromatic oil extensively used in perfumery. It also is the source the alkaloid 'saussurine' used in medicine.

As is seen the majority of the high priority endangered species have biological as well as socio-economic values. The urgent need for their conservation is obvious.

The endangered species, which have scored a total value of 11 points, are generally of no known socio-economic value at present, but are of high biological value and conservation value. Being biological entities, which are restricted to narrow geographic ranges, and by virtue of their endemicity found only in a specific area and nowhere else in the world, are globally significant from the scientific standpoint and, as such, these species are no less important. Besides, the potential of these species in medicine or food is yet to be discovered. Hence, these genepools are of significance to the future bio-security and need to be conserved for posterity.

Distribution Pattern of the Endangered Plants

Analysis of the distribution patterns of the prioritised species shows that the endangered plants are found mostly in the two globally recognised 'hotspot' areas: W. Ghats and E. Himalayas.

Out of the top ten prioritised plants nine plants are endemic in the southern W. Ghats, while only one (*Kalanchoe roseus*) is from the NE region. The nine plants that are endemic in the southern W. Ghats are: *Humboldtia bourdillonii*, *Merteoromyrtus wynaadensis*, *Syzigium travancoricum*, *S. courtallense*, *Ceropegia mahabalei*, *Frerea indica*, *Humboldtia unijuga* var. *unijuga*, *Hydnocarpus macrocarpa*, ssp. *macrocarpa*, and *Paphiopedilum druryi*.

Out of the 31 High Priority Endangered Plants 2 species viz., *Acer oblongum* var. *membranaceum* and *Saussurea costus* are from the Western Himalaya, 3 species (*Kalanchoe roseus*, *Euonymus assamicus*, *Elaegnus conferta ssp. dendoidea*) are from the NE region, while the rest are all endemic to the W. Ghats. The prioritised endangered species of the W. Ghats are mostly found in the southern portion of the 'hotspot' area; the only species found in the northern sector are *Ceropegia lawii*, *C. panchganiensis* and *Iphigenia sahyadrica*.

An almost similar pattern of distribution is observed for the other 47 endangered species.

Acknowledgments

This project was sponsored by the Biodiversity Support Program, Washington, USA, and executed as part of the Biodiversity Conservation Prioritisation Project of WWF-India. Thanks are due to Prof. Shekhar Singh, Chairman, BCPP, Shri. A.R.K. Sastry, Member Secretary, and Shri. S.K. Puri, formerly Director, IGCMC, for their support. The help and co-operation provided by the Director and scientists of the Botanical Survey of India, Ministry of Environment & Forests, is gratefully acknowledged. The technical support provided by my colleagues, Mudit Mehrish, Vinodini Deshmukh, Lalit Rai and Alka Awasthi in the preparation of this project report is thankfully acknowledged.

APPENDIX

Prioritised Endangered Species

I. High Priority Endangered Species

Scientific Name	*Family Name*	*Total Score value*
Humboldtia bourdilloni Prain	**Fabaceae**	16
Meteoromyrtus wynaadensis (Bedd.) Gamble	**Myrtaceae**	16
Syzigium travancoricum Gamble	**Myrtaceae**	16
Syzygium courtallense (Gamble) Alston	"	14
Ceropegia mahabalei Hemadri & Ansari	**Asclepiadaceae**	14
Frerea indica Dalz.	**Asclepiadaceae**	14
Kalanchoe roseus C.B. Clarke	**Crassulaceae**	14
Humboldtia unijuga var. ***unijuga*** Beddome	**Fabaceae**	14
Hydnocarpus macrocarpa (Bedd.) Warb. ssp. ***Macrocarpa***	**Flacourtiaceae**	14
Paphiopedilum druryi (Bedd.) Stein	**Orchidaceae**	14
Santapaua madurensis Balakr. & Subram.	**Acanthaceae**	13
Ceropegia lawii Hook.f.	**Asclepiadaceae**	13
Ceropegia panchganiensis Blatter & McCann	"	13
Euonymus angulata Wight	**Celastraceae**	13
Euonymus assamicus Blakelock	"	13
Acer hookeri Miquel var. ***majus*** Pax	**Aceraceae**	13
Acer oblongum Wall. var. ***microcarpum*** Hiern	"	13
Acer oblongum Wall. ex DC. var ***membranaceum*** Bannerji	"	13
Acer sikkimense Miquel var. ***serrulatum*** Pax	"	13
Buchanania barberi Gamble	**Anacardiaceae**	13
Nothopegia aureo - fulva Bedd. ex Hook.f.	"	13
Livistona jenkinsiana Griff.	**Arecaceae**	13
Elaegnus conferta Roxb. ssp. ***dendroidea*** Servetaz	**Elaeagnaceae**	13
Actinodaphne lanata Meisner	**Lauraceae**	13
Actinodophne bourneae Gamble	"	13
Iphigenia sahyadrica Ansari & Rolla Rao	**Liliaceae**	13
Memecylon flavescens Gamble	**Melastomataceae**	13
Eugenia discifera Gamble	**Myrtaceae**	13
Syzygium gambleanum Rathakr & Chitra	"	13
Desmos viridiflorus (Bedd.) Stapf	**Annonaceae**	12
Saussurea costus (Falc.) Lipschitz.	**Asteraceae**	12

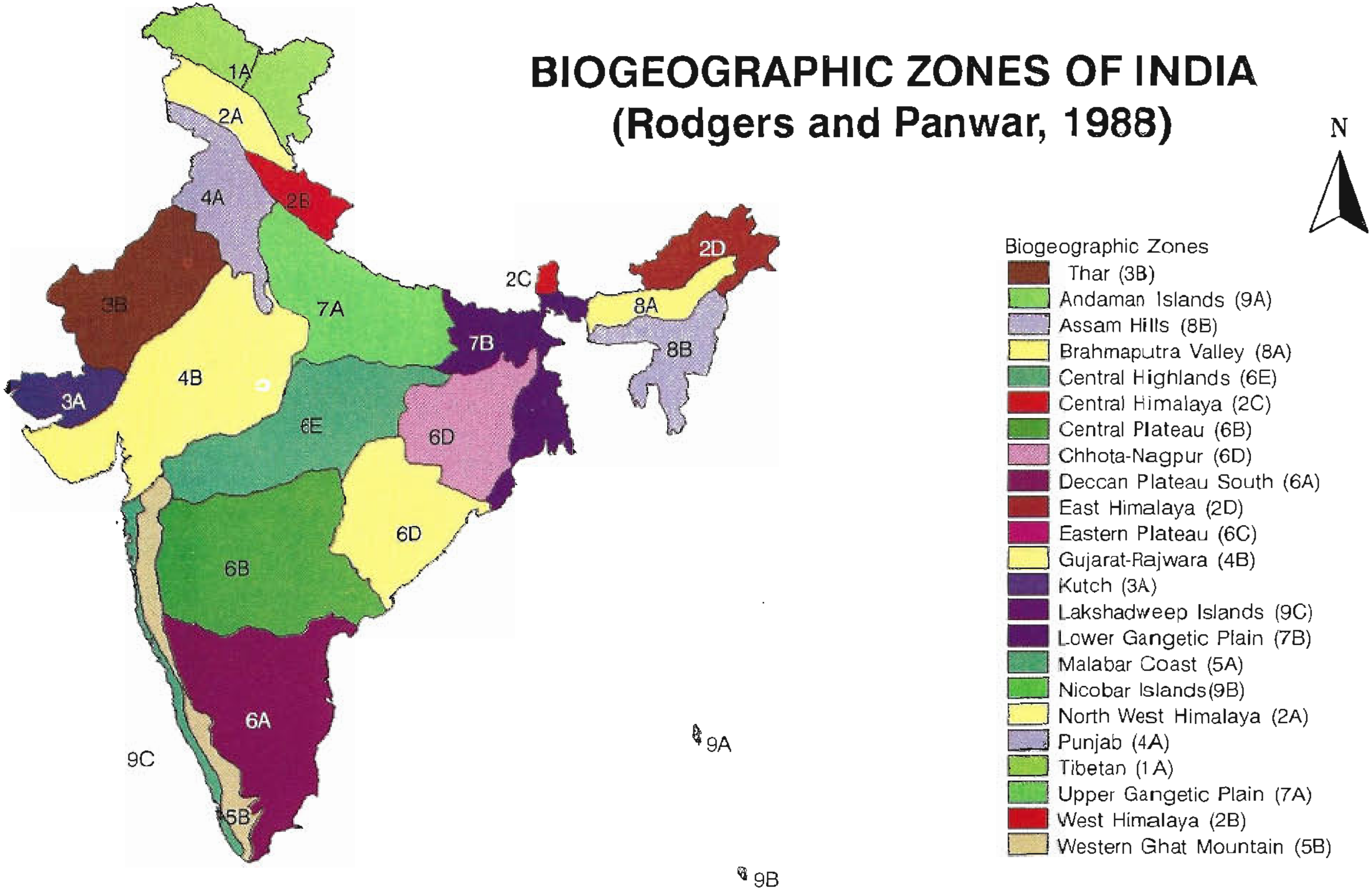
II. Other Endangered Species

Scientific Name	*Family Name*	*Total Score value*
Dicliptera abuensis Blatter	**Acanthaceae**	11
Strobilanthes hallbergii Blatter	**Acanthaceae**	11
Acer osmastonii Gamble	**Aceraceae**	11
Pimpinella tirupatiensis Balakr. & Subram	**Apiaceae**	11
Pimpinella wallichii Clarke	"	11
Cryptocoryne tortuosa Blatter & McCann	**Araceae**	11
Calamus inermis T. Anders.	**Arecaceae**	11
Ceropegia beddomei Hook.f.	**Asclepiadaceae**	11
Ceropegia omissa Huber	"	11
Ceropegia barnesii Bruce & Chatterjee	"	11
Lactuca benthamii Clarke	**Asteraceae**	11

Contd....

Scientific Name	*Family Name*	*Total Score value*
Lactuca cooperi Anthony	,,	11
Lactuca filicina Duthie ex Stebbins	,,	11
Lactuca undulata Ledeb	,,	11
Senecio kundaicus Fischer	,,	11
Vernonia multibracteata Gamble	,,	11
Vernonia pulneyensis Gamble	,,	11
Impatiens anaimudica C.E.C. Fischer	**Balsaminaceae**	11
Impatiens johnii Barnes	,,	11
Impatiens munnarensis E. Barnes	,,	11
Impatiens neo-barnesii C.E.C. Fischer	,,	11
Impatiens nilagirica C.E.C Fischer	,,	11
Begonia aliciae C.E.C. Fischer	**Begoniaceae**	11
Begonia anamalayana Bedd.	,,	11
Berberis lambertii R. Parker	**Berberidaceae**	11
Arenaria curvifolia Majumdar	**Caryophyllaceae**	11
Arenaria ferruginea Duthie ex Williams	,,	11
Salacia malabarica Gamble	**Celastraceae**	11
Belosynapsis kewensis Hassk.ex Kurz	**Commelinaceae**	11
Crotalaria fysonii Dunn var. ***glabra*** Gamble	**Fabaceae**	11
Crotalaria kodaiensis Debberm & Biswas	,,	11
Crotalaria sandoorensis Bedd. ex Gamble	,,	11
Leucas mukerjiana Rao & Kumari	**Lamiaceae**	11
Pogostemon nilagiricus Gamble	,,	11
Pogostemon paludosus Benth.	,,	11
Lilium macklineae Sealy	**Liliaceae**	11
Scilla viridis Blatt. & Halb.	,,	11
Decaschistia rufa Craib	**Malvaceae**	11
Ipsea malabarica (Reichb.f.) Hook.f.	**Orchidaceae**	11
Anoectochilus nicobaricus Balakr. & P. Chakra.	,,	11
Anoectochilus tetrapterus Hook. f.	**Orchidaceae**	11
Aphyllorchis gollani Duthie	,,	11
Cymbidium whiteae King & Pantling	,,	11
Dendrobium tenuicaule Hook. f.	,,	11
Flickengeria hesperis Seidenf.	,,	11
Malleola andamanica Balakr. & Bhargava	,,	11
Paphiopedilum fairrieanum (Lindl.) Stein	,,	11
Paphiopedilum wardii Summerh.	,,	11

BIOGEOGRAPHIC ZONES OF INDIA
(Rodgers and Panwar, 1988)



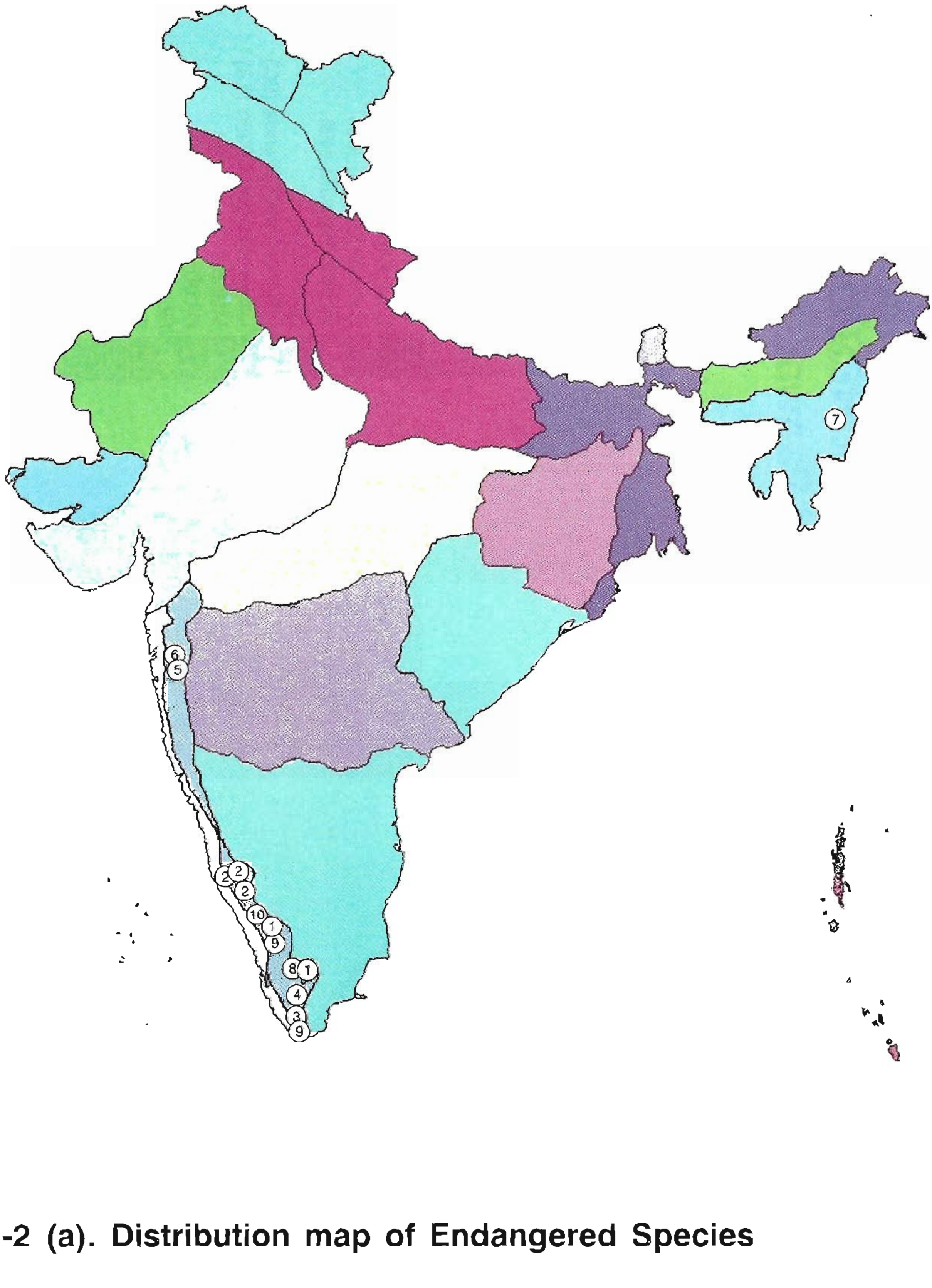


Fig -2 (a). Distribution map of Endangered Species

1. Humboldtia bourdilloni
2. Meteoromyrtus wynaadensis
3. Syzigium travancoricum
4. Syzygium courtallense
5. Ceropegia mahabalei
6. Frerea indica
7. Kalanchoe roseus
8. Humboldtia unijuga
9. Hydnocarpus macropcarpa
10. Paphiopedilum druryi

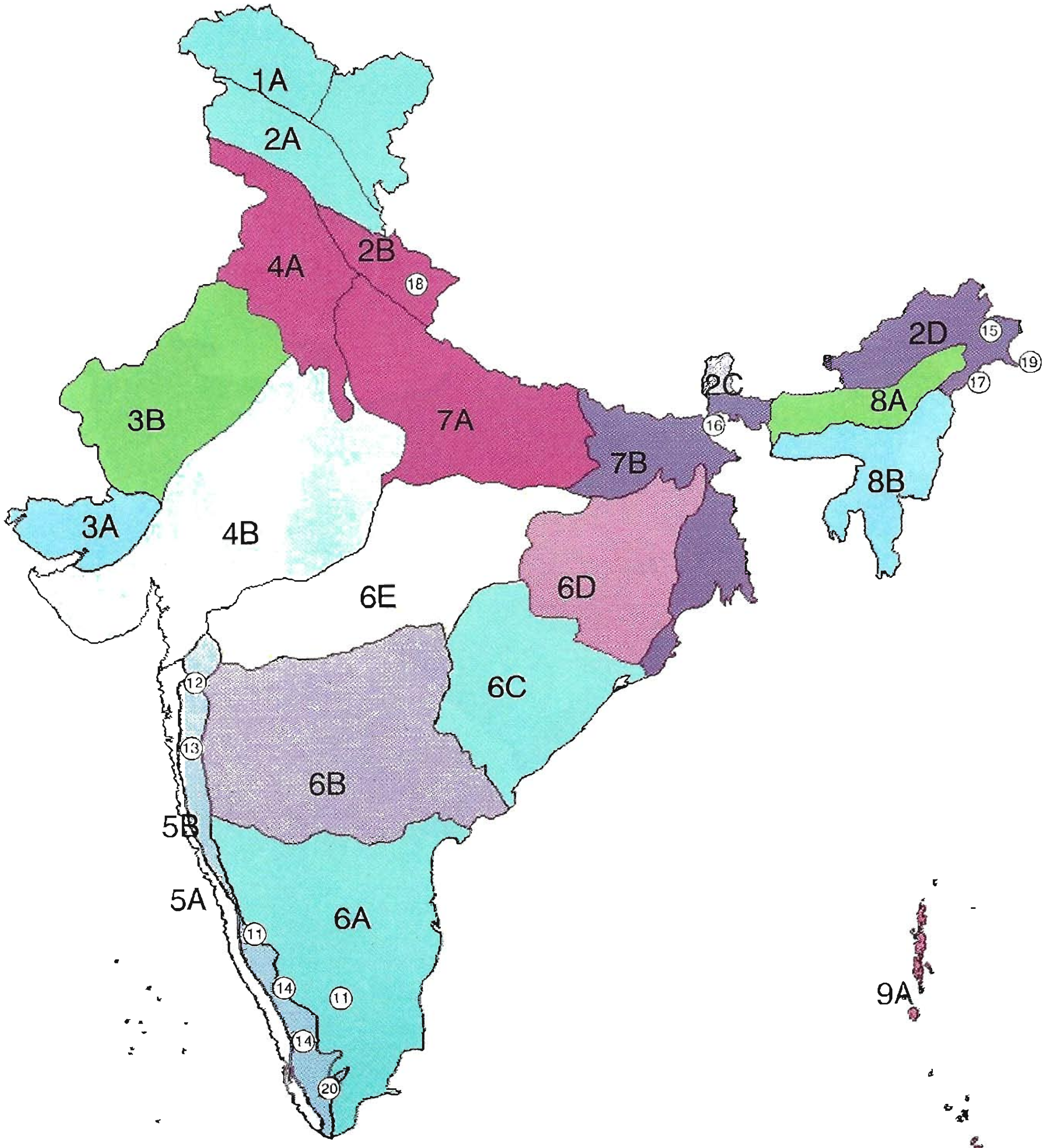


Fig -2 (a). Distribution map of Endangered Species

11. Santapaua madurensis
12. Ceropegia lawii
13. Ceropegia panchganiensis
14. Euonymus angulata
15. Euonymus assamicus
16. Acer hookeri
17. Acer oblongum
18. Acer oblongum var. membranaceum
19. Acer sikkimense var. serrulatum
20. Buchanania barberi

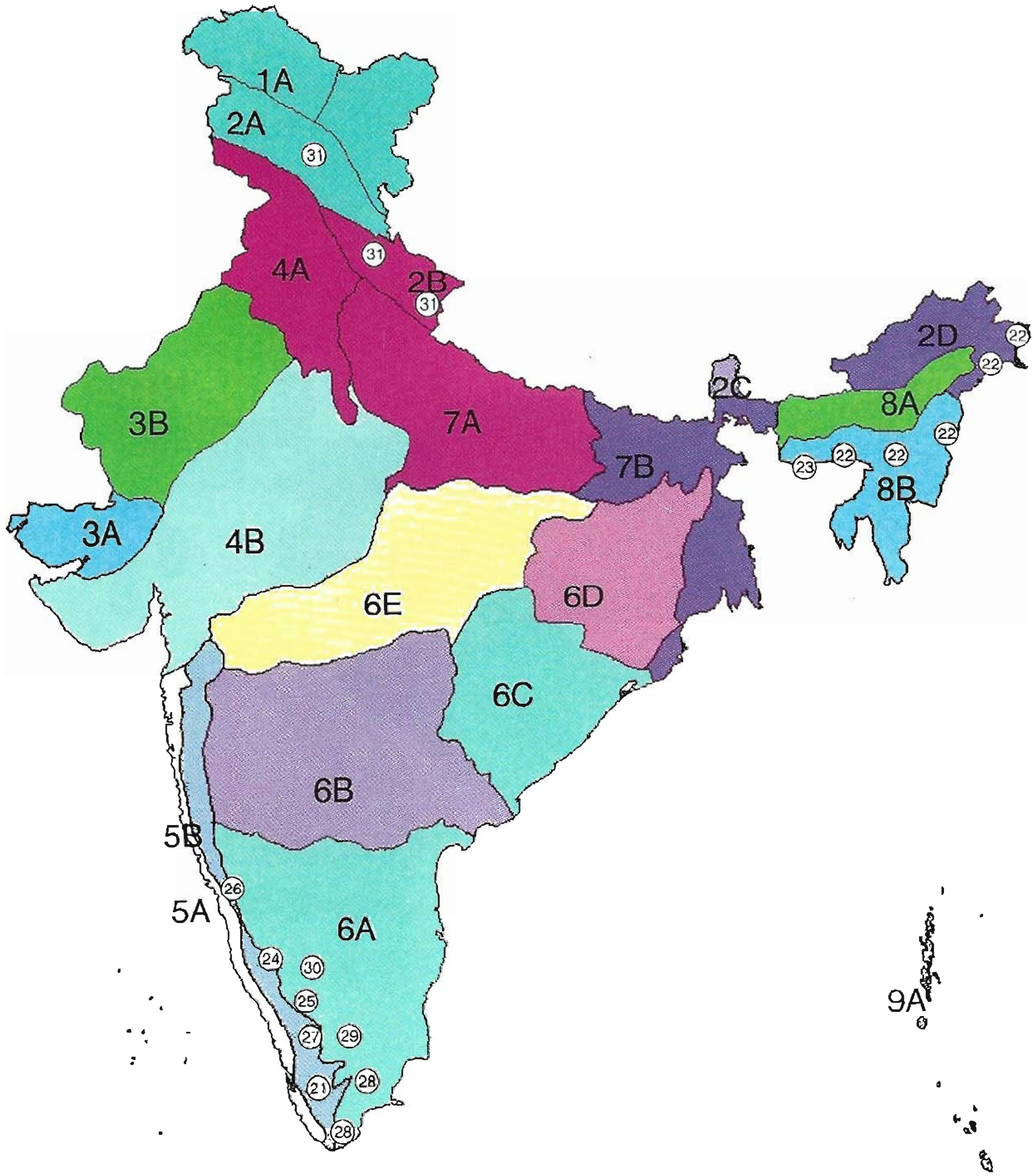


Fig -2 (a). Distribution map of Endangered Species

21. Nothopegia aureo - fulva
22. Livistona jenkinsiana
23. Elagnus conferta
24. Actinodaphne lanata
25. Actinodophne boumeae
26. Iphigenia sahyadrica
27. Memecylon flavescens
28. Eugenia discifera
29. Syzygium gambleanum
30. Desmos viridiflorus
31. Saussurea costus

Known Species Diversity in Indian Trees: A Summary

Suman Sahai

Objectives

To document the range of genetic variability found amongst the tree species of Indian forests.

Methodology

The study recorded the known genera, the species and phenotypic variability known within the genera in all the sixteen forest types as mentioned in Champion and Seth (1968).

This study was conducted in order to compile in one place all the information published in various places about species diversity of Indian trees. Over 300 publications have been scanned to cull information about the characterististics of various species. These publications include books, journals, monographs, reports, occasional papers, dissertations and conference papers. The publications were accessed from several libraries of Forest Research Institutes and departments of Forestry at universities.

Indian trees, indeed trees the world over, have traditionally been seen as sources of timber so the publications concentrate on these characteristics, often exclusively so, more than on other genetic traits. It has been the task of this study to ferret out information about non-timber qualities in order to comprehensively assess the germplasm of Indian trees for the range of their qualities and characteristics.

General

India with a land mass of over 329 million hectares, 2.4% of the global area, is home to a staggering array of species. Seven per cent of the world's flora is represented in India. Of the recorded 45,000 species of plants, 15,000 are flowering. Such a high diversity of flora has arisen as a result of high climatic variability. Based on rainfall, India can be divided into 4 climatic regions:

* Heavy rainfall area (1100 cm annually): Northeast and the west coast.
* Moderately high rainfall area (150 cm annually): Eastern peninsular plateau extending into Indo-Gangetic plains and eastwards to the coast.
* Low rainfall area (75 cm annually): Punjab plains, Central India up to western Deccan, East Karnataka and Western Andhra Pradesh.
* Nominal rainfall area (10 cm annually): Rajasthan, Gujrat and Ladhak plateau.

Such a pattern of rainfall and associated climatic variability has resulted in forests with various kinds of species and species associations, which are often unique as is exemplified by the fact that 30% of the total India flora of flowering species is endemic.

The rich Indian climate supports high biodiversity which is largely found in the forests of India. The forests vary from tropical rain and sub-tropical broad leaved on one hand to thorny scrub and dry alpine scrub on the other. Based on the associations and the dominant or emerging dominants, 16 major forest types have been identified in India (Champion and Seth 1968). It may be noted here that the forest types classified are irrespective of physiographic, edaphic or biotic factors and the emphasis is on main tree layers or on the most emergent vegetation. The major types are further subdivided into sub-types on a geographic basis.

According to the forest cover assessments of 1997 (State of Forest Report 1997), the total forest cover, which includes dense forest, open forest and mangrove, is estimated to be 633,397 sq.km. This constitutes 19.27% of the country's geographic area.

Change in Forest Cover

A comparison of the forest cover of the country as per 1997 assessment and 1995 assessment reveals that the total forest cover of the country has decreased from 638,879 sq.km., thus showing a net loss of 5,482 sq.km.

The changes in forest cover shows that the states of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Orissa and the Union Territory of Andaman & Nicobar Islands have lost forest cover.

The states which recorded gains in forest cover included Goa, Gujarat, Haryana, Himachal Pradesh, Jammu &

Kashmir, Karnataka, Maharashtra, Mizoram, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

In Delhi, Chandigarh, Dadra & Nagra Haveli and Daman & Diu, there was no change in forest cover during the period of the last two assessments.

The major losses of 3,822 and 3,969 sq.km., have been recorded in Andhra Pradesh and Madhya Pradesh respectively.

As we see, India is far behind the 1988 National Forest Policy Goal of achieving 33% forest cover of the total land area. Also the current status of the forest cover include 5.89 million hectares of scrub areas which are highly degraded and barren (crown density is much less than 10%).

The rapid increase in the human population has further intensified the dependence on the forest resources for fuel, food, fibre and timber. It has been observed that many states have recorded reduction in the forest cover.

The rapid deforestation has increased the urgency for documenting the genetic variability of the forest tree species of India. It is expected that such a documentation will help in the planning of afforestation programmes and in wise and sustainable use of forest resources.

Tropical forests constitute nearly 80% of the Indian forests. Of the different kinds of tropical forests, the commonest are the moist deciduous and dry deciduous forests. These constitute about 37 and 29 per cent of forest cover of the country respectively. The former type is characterized by mainly deciduous trees, which often exceed 25 m in height and the latter by smaller deciduous trees usually 8 to 20 m high. These two types of tropical forest are widely distributed in many Indian states. Subtropical pine forests are an important sub type of montane subtropical forests that constitute almost 7% of India's forest cover and range from Kashmir to Arunachal Pradesh. As has been mentioned earlier in this report, the country's forest cover has witnessed a sharp decline over the past few decades. The area officially recorded as forests, including 'protected forests' (with or without tree cover) is about 77 million hectares or 22.8 per cent of the total land area of India.

Forest cover greatly varies in different states. In Andaman and Nicobar Islands, 90 per cent of the land is under forest cover. States such as Arunachal Pradesh, Mizoram, and Nagaland have forest cover that ranges from 80 to 90 per cent of their land area. The cover declines in states such as Sikkim, where the forest cover is about 44 per cent. The cover further reduces in States like Goa, Madhya Pradesh and Orissa where it is only about 30 per cent. A much dismal picture of the forest cover is painted in States such as Bihar, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh where the forest cover is only between 11 to 17 per cent.

Indian forests have, however, managed to make it so far. But if the reduction in the forest cover continues at the current rate, soon we will loose this magnificent, life-giving, natural resources. With the forests gone, many other species that they support will also be wiped out. Species extinction is a one way process. Therefore, it becomes pertinent to appreciate the forest wealth and, to achieve this, the first requirement is to assess the diversity in the forests and the species that compose them. As early as 1968, Champion and Seth classified Indian forests into 16 major and many more sub types. These different forest types and the different dominant vegetation types and their associative vegetation adequately highlight the vast diversity of the Indian forests.

Such diverse types of forests harbour diverse plant species. With the rapid rate of decline of forests, there is an urgent need to document the nature and range of genetic variability found amongst the trees of the Indian forests. The inventorying of biodiversity provided fundamental and essential biological information used by many basic scientific disciplines, such as systematics, population biology, ecology and other fields of comparative biology and also helps various disciplines of applied sciences, such as biotechnology. Further, with the signing of the Convention on Biological Diversity and Agenda 21, the need of inventorying and monitoring biodiversity has been highlighted. For effective monitoring it is essential to document the diversity. Data from inventorying and monitoring are essential for identifying key issues for policy and management goals. The biodiversity inventory can be used for prioritising conservation, planning land use, conducting environmental impact assessments and in assessing the state of biodiversity itself. It also provides a basis for scientific research and defines the current and future options available for meeting human needs and for sustainable utilisation of the resources.

To have available a large diversity to ensure genetic variability and to avoid monoculture in afforestation programmes, the first requirement is to document the known diversity of the trees of Indian forests. An inventory of the diversity of trees of Indian forests may also be helpful in assessing the range of special characteristics like medicinal use, timber extraction, etc. that can also be used for the sustainable utilisation of natural resources.

In the present report on the assessment of tree germplasm in the forests of India, information about the genera and, to the extent possible, the species variability within the genera, has been recorded. An attempt has also been made to identify the conservation and research status of that species. Wherever possible, the human use a particular species is out to has also been identified. Based on the importance of the tree resources, separate lists of trees that are sources of fruits, medicine, timber etc are provided. These lists also contains names of those species that are not yet commercially exploited.

Summary

The entire species diversity of Indian trees can be ordered under 503 genera. These are listed in the main table. The table lists only those species of these genera that are trees, excluding those that are vines, shrubs and herbs. In addition, the list gives the physical characteristics of the particular genus and its geographical distribution.

The 503 genera are derived from several botanical families. The most commonly occurring family is the Euphorbiacea. Amongst Indian trees there are 36 genera from the Euphorbiacea. Almost as frequently found is the Leguminosae with 26 genera. These two families are well represented in tropical Asia. Other families like the Pinacea are not well represented in India, with only 6 genera. Pinacea and other conifers are found in temperate and sub-temperate regions and therefore restricted in their distribution here.

Species Distribution and Frequency

While there are some genera in which the number of species is as low as one, there are other genera like Eugenia with as many as 700 species and Ficus and Euphorbia where the number of species is 600.

Fifty four genera, mentioned below are represented by just one species

S.No.	*Genus*	*Species Name*
1.	Acrocarpus	fraxinifolius
2.	Adansonia	digitata
3.	Amherstia	nobilis
4.	Anona	cadamba
5.	Aulacodiscus	premnoides
6.	Balanostreblus	ilicifolia
7.	Bischofia	javanica
8.	Bixa	orellana
9.	Brachytome	wallichi
10.	Bucklandia	populnea
11.	Cedrus	deodara
12.	Chickrassia	tabularis
13.	Chloroxylon	swietenia
14.	Cullenia	excelsa
15.	Dittelasma	rarak
16.	Dobera	roxburghii
17.	Erinocarpus	nimmoanus
18.	Feronia	elephantum
19.	Filicium	decipiens
20.	Gamblea	ciliata
21.	Givotia	rottleriformis
22.	Gynocardia	odorata
23.	Gyrocarpus	jacquini
24.	Holoptelea	integrifolia
25.	Hovenia	dulcis
26.	Kandelia	rheedii
27.	Kleinhovia	hospita
28.	Lasiococca	symphilliaefolia
29.	Leucosceptrum	canum
30.	Mayodendron	igneum
31.	Millingtonia	hortensis
32.	Mischodon	zeylanicus
33.	Morindopsis	capillaris
34.	Nyctanthes	arbor-tristis
35.	Oroxylum	indicum
36.	Ougeinia	dalbergioides
37.	Panjanelia	rheedi
38.	Pemphis	acidula
39.	Platystigma	myristiceum
40.	Pongamia	glabra
41.	Ricinus	communis
42.	Rumphia	tiliaefolia
43.	Sarcochlamys	pulcherrima
44.	Scyphiphora	hydrophyllacea
45.	Splenocasrpus	indica
46.	Soymida	febrifuga
47.	Stelechocarpus	burahol
48.	Sycopsis	griffithiana
49.	Tamarindus	indica
50.	Telrameles	nudiflora
51.	Toricellia	tiliaefolia
52.	Utleria	salicifolia
53.	Xerospermum	noronhianum
54.	Xylia	dolabriformis

Another 148 genera are also quite sparsely represented, having only from 2 to 10 species each. These are given below.

S.No.	*Genus*	*No. of Species*
1.	Acanthopanax	6
2.	Actephila	10
3.	Adenanthera	4
4.	Adenochlaena	4-5
5.	Adina	6
6.	Adinandra	10
7.	Aegle	3
8.	Afzelia	10
9.	Ailanthus	4
10.	Alangium	2
11.	Aleurites	3

Contd. . . .

S.No.	Genus	No. of Species
12.	Allaeanthus	2-3
13.	Alphonsea	3
14.	Altingia	2
15.	Anacolosa	6
16.	Anaxagorea	6
17.	Anogeissus	5
18.	Antiaris	5-6
19.	Apodytes	9
20.	Apollonias	2
21.	Aquilaria	2-3
22.	Arthrophyllum	3
23.	Atlantia	10
24.	Averrhoa	4
25.	Balanites	2
26.	Balsamodendron	10
27.	Berchemia	10
28.	Bombax	10
29.	Boswellia	6
30.	Bouea	5
31.	Brassaia	2
32.	Brassaiopsis	10
33.	Broussonetia	2-3
34.	Brownlowia	3
35.	Brucea	6
36.	Brugiera	8
37.	Butea	4
38.	Byrsophyllum	2
39.	Carallia	7
40.	Carapa	2
41.	Careya	3
42.	Carpinus	9
43.	Cephalanthus	6
44.	Cephalotaxus	6
45.	Cerebra	4
46.	Ceriops	2-3
47.	Chaetocarpus	8
48.	Champereia	1-2
49.	Citrus	7
50.	Cleyera	6
51.	Coceoceras	3
52.	Colelodepas	3
53.	Corylus	7
54.	Crataeva	6
55.	Crypteronia	5
56.	Cudrania	3-4
57.	Cyathocalyx	3
58.	Debregesia	5
59.	Decaspermum	4
60.	Dehaasia	10
61.	Dicellostylus	2
62.	Dimorphocalyx	3-4
63.	Diplospora	6-8
64.	Distylium	2

S.No.	Genus	No. of Species
65.	Docynia	2
66.	Dracontomelum	5
67.	Drimycarpus	2-3
68.	Duabanga	2
69.	Echinocarpus	7
70.	Ellipantus	5
71.	Engelhardtia	4-5
72.	Enkianthus	5
73.	Eriobotrya	9
74.	Eriodendron	3
75.	Erioglossum	2
76.	Eriolaena	8
77.	Erthrospermum	6
78.	Eurycoma	2
79.	Flueggia	6
80.	Garuga	10
81.	Gironniera	8-10
82.	Gluta	8
83.	Glycosmis	5
84.	Glyptopetalum	3
85.	Gmelina	8
86.	Gomphandra	6
87.	Gordonia	10
88.	Guazuma	5
89.	Hardwickia	3
90.	Harpullia	6
91.	Hemicyclia	9
92.	Heritiera	5
93.	Hernandia	8
94.	Heteropanax	1-2
95.	Heterophragmma	5
96.	Heynea	3
97.	Hippophae	2
98.	Hourrhena	7-8
99.	Holigarna	7
100.	Humboldtia	5
101.	Hunteria	3
102.	Hydnocarpus	6
103.	Hymenocardia	5
104.	Hymenodictyon	4-5
105.	Illicium	5
106.	Isonandra	6
107.	Itea	5
108.	Ixonanthes	8
109.	Juglans	3-4
110.	Kayea	4
111.	Kokoona	3
112.	Kurrimia	-
113.	Kydia	2
114.	Larix	8
115.	Lepionurus	2
116.	Leptonicia	4
117.	Leucaena	8

Contd. . . .

S.No.	Genus	No. of Species
118.	Limonia	3
119.	Lophopetalum	8
120.	Lumnitzera	2
121.	Macropanax	2
122.	Maddenia	2
123.	Manglietia	5
124.	Mappia	8-10
125.	Marlea	8
126.	Mastixia	8
127.	Melanorrhoea	4
128.	Melia	5
129.	Mesua	3
130.	Micromelum	4
131.	Microtropis	9
132.	Miliusa	7
133.	Moringa	3
134.	Morus	-
135.	Murraya	4
136.	Niebutria	8
137.	Nothopegia	3
138.	Nyssa	5-6
139.	Opilia	2
140.	Osmanthus	8
141.	Ostodes	6-8
142.	Osyris	5-6
143.	Parishia	3
144.	Parkia	8
145.	Parkinsonia	3
146.	Pceciloneuron	2
147.	Peltophorum	6
148.	Pentapanax	5

As many as 31 genera have 100 or more species and represent the bulk of the genetic diversity in Indian trees.

S.No.	Genus	No. of Species
1.	Acacia	430
2.	Ardisia	200
3.	Bauhinia	130
4.	Capparis	120
5.	Cinnamomum	ca 130
6.	Cordia (Boraginaceae)	180
7.	Croton	ca 500
8.	Diospyros	153
9.	Eucalyptus	>130
10.	Eugenia	>700
11.	Euphorbia	600
13.	Ficus	ca 600
14.	Glochidon	120
15.	Hibiscus	150
16.	Ilex	145
17.	Inga	140
18.	Ixora	100
19.	Litsaea	140
20.	Melaleuca	>100
21.	Memecylon (Melastomaceae)	100
22.	Mimosa	230
23.	Pithecolobium	100
24.	Psidium	100
25.	Psychotria	500
26.	Quercus	300
27.	Rhododendron	130
28.	Rhus	120
29.	Salix (Salicaceae)	160
30.	Symplocos	160
31.	Tabernaemontana	110

Uses and Range of Utility

Almost 40 % of trees are used for non timber wood, a lot of it is for construction and furniture. A surprising 10 % of trees provide food in some form. Timber accounts for another 10%. The demand for fuel affecting just 7.8% of the genera appears to be an underassessment. With the growing rural population and corresponding demand for fuel wood, this figure would have to be revised upwards.

	Uses	Genera	% of Total
1.	Wood, other than Timber	309	38.38
2.	Edible (Fruit, Leaves etc.)	82	10.18
3.	Timber	77	9.56
4.	Fuel	63	7.82
5.	Medicinal	63	7.82
6.	Horticultural, ornamental, Avenue	62	7.70
7.	Dye, Colour, Tanning	35	4.34
8.	Fodder	30	3.72
9.	Oil	29	3.60
10.	Gum-Resin	23	2.85
11.	Aromatic, Fragrant	19	2.36
12.	Religious Purposes	19	2.36
13.	Fibre	13	0.12
14.	Insecticide, Poison, repellent	08	0.99
15.	Fertilizer, Manure	03	0.37

Forest Trees having High Medicinal Value

In this era of herbal drugs and neutraceuticals, Indian trees reveal a great potential for income generation for local and tribal communities living around them. What is needed is a time bound plan for sustainable harvesting and market tie ups to exploit this potential.

A total of 53 species of Indian forest trees contain high medicinal value. Some of the most commonly used parts of these trees are leaves, bark, fruit, root, flowers, seed and stem. In some cases, gum, wood etc.are also known to be used. It has been found that these trees have application in a wide range of ailments. Some of the ailments which find common mention are diarrhoea, dysentery, cough, cold, fever, headache, nausea, vomiting , inflammation, colic, indigestion, flatulence, constipation, loss of appetite, snake bites, scorpion stings, astringent, asthma and various gastro-intestinal, skin & soft tissue and respiratory tract infections. Some trees are also reported to be used for the preparation of tonics and aphrodisiacs.

Dye yielding Trees of Indian Forests

India's forest trees are a good source of vegetable dyes. Altogether 53 species are reported to yield dyes. Black, brown, yellow and red are the most common colours that are derived from these. Bark, flowers, leaves and roots are the most commonly used parts of these trees. Some of the better known dye yielding trees are: Acacia nilotica, Anogeissus latifolia, Madhuca longifolia, Toona ciliata, Ficus religiosa, Terminalia tomentosa and Shorea robusta.

Oil Bearing Trees

Of the total Indian tree species, 136 are sources of oil. Out of these 136, seeds of 44 species contain more than 15% oil, according to an analysis carried out at the Forest Research Institute (FRI), Dehradun. Nearly one-third of these oil bearing trees have commercial potential, having an oil content in excess of 15%.

Status of Research

The research status of the 503 genera to which Indian trees belong ranges from a few (20) that are well researched to almost 450 that are almost unresearched or poorly researched.

Very good research	20
Good Research	49
Fair Research	86
Poor Research	149
Not Known	199

According to available information 248 genera are being exploited currently. 145 are not being exploited and there is no information about the others.

Number of Species with Unexploited Potential as Food and Fodder

Food	
Edible fruits	98
Edible stems/ tubers	16
Edible leaves	39
Edible seeds	46
Edible flowers	17
Fodder	164

Palm Trees

Palm trees are treated separately. Palm diversity in India, although not comparable to certain South East Asian regions and the Caribbean, is not insignificant. Indian palms are distributed over 13 genera and a total of 30 species are found. The genus Bentinckia appears to be endemic and is represented by two species, *coddapanna* and *nicobarica*. These are slender stemmed palms found in the Travancore area and Nicobar islands. The genera Areca, Arenga, Caryota, Cocos and Pinanga, commonly found in India are common to most regions in Tropical Asia. Many of these are found in Australia as well.

Many of the palms have edible parts, most notably the coconut and areca nut. Other uses include wood and timber as also ornamental and sometimes, religious uses.

	Uses	*Genera*
1.	Edible	7
2.	Fibre	4
3.	Horticultural Ornamental	4
4.	Wood	3
5.	Miscellaneous	3
6.	Timber	1
7.	Religious use	1
8.	Oil	1

According to available information, just 5 of the palm genera are exploited for commercial and non-commercial use. Little research has been done on palms found in India, indicating the somewhat peripheral role they play in Indian forestry and the economy. Except for Cocos, Pandanus and Phoenix palms, little or no research has been done on the other species.

Prioritisation of Medicinal Plants of India

A.R.K. Sastry and Sudipto Chatterjee

Introduction

The project on Prioritisation of Medicinal plants is a part of the Biodiversity Conservation Prioritisation Project being implemented by WWF-India which seeks to prioritise biologically rich sites, species and draw strategies for conservation of biological diversity in India. The need to set priorities for conservation of medicinal plants was realised in view of an exponential growth in their demand in recent years subsequently leading to their over exploitation, depletion and in some cases almost extinction from their natural habitats. Efforts are on to reverse the trend and conserve them through *ex- situ* and *in-situ* methods. Substantive efforts in terms of research, financial support, education and awareness are being promoted by the government and non-government agencies. Medicinal plants that would require immediate conservation being rather known, are receiving attention of scientists and the general public. Cultivation of some of these through conventional methods and tissue culture techniques has met with a certain degree of success. Some of the species have been placed in the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) to regulate trade across the national borders and some have been provided protection through national legislations *viz.*, the Wildlife Protection Act of 1972 and Negative list of Exports. Extraction of some of the species like *Tecomella undulata* and *Taxus wallichiana* which have become vulnerable, have been banned by the State Governments. Species like *Rauvolfia serpentiana* which is less frequently sighted now in the wild has been demonstrated to propagate successfully in different research institutes and medicinal plant gardens. Efforts to rope in support for encouraging the industry to invest in conservation studies on medicinal plants rather than exploiting the medicinal plants from the wild habitats and their further depletion, have been made. Plants of ethnobiological significance in different parts of the country are being systematically documented as well by many institutes and organisations in this country.

Despite all these interventions, the present status of many of the medicinal plants in the country is a cause of concern. Unofficial trade is on the rise. The quantum of extraction of plants from the wild and in trade is not adequately surveyed. Population densities of most of the species assessed as 'critically endangered' and 'endangered' are not known. The problem of medicinal plants conservation is further accelerated by habitat loss, unscientific methods of extraction and adulteration with species with similar morphological features. This all the more necessitates a fresh look at the issue hitherto mentioned and set newer priorities. The project aims to bring to fore medicinal plant species which are exploited and require greater focus in the present scenario. This project prioritises species from amongst thirteen hundred medicinal plant species on the basis of their distributional range, conservation status and trade, based on analyses of available secondary information.

Objectives

1. To prepare an inventory of some important medicinal plants with data on their habitats distributional range and conservation status through literature study, data available in the major herbaria and random field surveys of limited extent for selected species.
2. To prioritise a list of medicinal plant species on the basis of the identified criteria.
3. Mapping of distribution of prioritised medicinal plant species and assess their conservation status.
4. To suggest strategies for conservation of the prioritised plants, identify related agencies and individuals who may contribute towards conservation of these plants.

The Approach

It is often said that almost all plant species possess therapeutic values. However, of the 7500 plant species recorded in Indian literature to be of medicinal value, about 3500 are widely acclaimed to be medicinal. Considering the magnitude of work involved in prioritising species from the known 3500 medicinal plant species, and due to time constraint under this project, scrutiny has been restricted to approximately 1300 plant species for prioritisation. Literature available through BSI & CSIR Publications, WWF-India sponsored projects, Proceedings of the Ethnobiological Congress held at National Botanical Research Institute, Lucknow, Taxon data sheets available from CAMP (Conservation Assessment Management Plan) workshops organised by Foundation for Revitalization of Local Health Traditions (FRLHT) and Zoo Outreach Organisation (ZOO) etc. have provided basic inputs to include plants from different biogeographical zones of the country. The species initially considered for prioritisation (Level 1) are enlisted Annexure 1 of the report. Of these, any species reported with a narrow distributional range, in trade and overexploited were shortlisted to Level 2. Some species which did not qualify under the aforesaid categories but needed further scrutiny and assessment were also elevated to Level 2 thus shortlisting 1300 species of Level 1 to (approximately) 700 species.

Further prioritisation of these shortlisted 700 species in Level 2 was made through a score sheet designed on the basis of the following six criteria, *viz.*,

1. Distribution
2. Conservation status
3. Trade
4. Cultivation
5. Use of plant part / method of harvest and
6. Data deficiency

Each criterion was given equal weightage with score values ranging from 0 - 10 and was further subcategorised. The scores obtained under each category were summed up for all the 700 species individually. No score was given in case of non-existence/non-availability of information under any of the category but appropriately highlighted as shown in the sample score sheet. A deliberate attempt has been made to lower the priority of a species receiving attention through research, conservation practices and to species receiving protection through National (WPA, 1972) and Negative List of Exports) and International (CITES) legislations, through negative scoring. The species under Schedule I of CITES were assumed to receive greatest amount of protection through the International Legislation and were therefore deleted from the list in favour of other species. Likewise, negative scores have been accorded to species in schedule II of CITES and schedules of WPA, 1972, and also to those species whose extraction has been banned by the Union or the State Governments. Species which are in and with known propagation techniques which ensure their survival and of those species imported to meet partly the country's demand were also negatively scored.

Species for which adequate data either is not available or could not be collected during the project period have been segregated. Higher priorities were credited to species which have been assessed as *critically endangered, endangered* and *vulnerable* for which cultivation techniques are presently not reported. For this purpose Annual Reports/Publications of the premier institutes from all parts of the country were referred. The information from brochures / publications of State Forest Research Institute, Itanagar representing the North East; National Bureau of Plant Genetic Resources, New Delhi, National Botanical Research Institute, Lucknow, G.B. Pant Institute for Himalayan Ecology and Development, Almora for the North; Agarkhar Research Institute, information from Academy of Development Science, Raigad to represent the West; Annual Reports of M.S. Swaminathan Research Foundation, Madras, Tropical Botanical Garden and Research Institute, Trivandrum, the Newsletter 'Amruth' published by FRLHT to represent the South; and publications by scientists of the Botanical Survey of India, (BSI) placed at Andaman & Nicobar Islands to represent the Islands, were referred. The score sheet is presented in Table 1. The first 59 highest scoring species were elevated from Level 3 to Level 4 for a closer examination and for final prioritisation to 30 species through a consultation shortly to be organised. The 59 shortlisted species are given in Table 2.

Fig. 1 is a flow chart of the methodology followed in this exercise.

- A biogeographic region wise priority list of medicinal plants prepared during this study has been placed in the Annexure of the project report.

Merits and Shortfalls of this Methodology

The methodology designed for this prioritisation exercise readily permits future reprioritisation of plant species with the availability of more authentic information on species whose medicinal value hitherto not known. The method of elimination and negative scoring facilitates setting of newer priorites in tune with the policy and legislative changes and new scientific data. The categorisation of the parameters for prioritisation helps to remove the possible bias of the investigators in assigning score values to a species under consideration.

This methodology is found to have certain shortfalls as well. The methodology of assigning score values and using them for prioritising the species is developed by the project team and has not evolved through a participatory exercise. Availability of more information under each of the criteria for a particular species could have influenced prioritisation of the species in other manner. However, data deficient species have been segregated as a separate group to make a conscious effort to garner further information on such species wherever possible for prioritisation.

This exercise also lacks information on the conservation efforts of the industrial sector, which is now increasingly being pressurised to cultivate species which are faced with extinction in their natural habitats due to over exploitation in the past.

METHODOLOGY
HAS A BEGINNING BUT NO END

1300 Plants of Medicinal Value of India

Literature Survey

← Plants in trade
← Use in indigenous /pharmaceutical industries
← Report of over-exploitation
← Medicinal plants identified as rare and endangered
← Plants of interest to the project

267 Species

SCORE

→ Eliminate CITES schedule I species
→ Lower priority to CITES schedule II
→ Wildlife Protection Act, 1972
→ Negative list of Exports
→ Extraction banned by Government of India
← Great weightage to species reported to be destructively harvested
← Species for which regeneration capacity not known
← Cultivation techniques not developed

DATA DEFICIENT

SHORTLISTED SPECIES (65)

NEW INFORMATION

CONSULTATION REGIONAL EXPERTS

PRIORITY LIST

Table 1: Methodology for Prioritisation of Medicinal Plants from Second Higher Priority list to Third Higher Priority List

A	**Distribution**	
A.1	Species **endemic** to few localities in any biogeographic zone	10
A.2	Species restricted to **only one biogeographic zone** (BGZ) in the country	8
A.3	Species restricted to **two to three BGZ**	6
A.4	Any plant whose distribution is reported to be not exactly known (DD)	9
A.0	Species distributed in three or more BGZ zones	0
B	**Conservation Status**	
B.1	Species **Critically Endangered/Endangered** assessed by Conservation action Management Planning Workshops (CAMP) /Conservation status assessed by Scientists of reputed organisations and institutes.	10
B.2	Species **Threatened/Rare/ Vulnerable** assessed by Conservation action Management Planning Workshops/Conservation status assessed by Scientists of reputed organisations and institutes.	8
B.0	Species not at Risk	0
C	**Trade**	
C.1	Species under heavy trade and categorised as **CE/E** in any BZ zone by the CAMP processes and relevant institutes/organisations and also not represented in schedules of CITES/negative list of exports.	8
C.2	Species under heavy trade but identified as **V/Th** by the CAMP processes and relevant institutes/ organisations in any BZ zone and also not represented in schedules of CITES/negative list of exports	8
C.3	Species under heavy trade but not assessed by CAMP processes/relevant institutes/organisations but information available through *mimeos.*	6
C.4	Species reported to be under moderate trade/used for indigenous/pharmaceutical purposes; information available through *mimeos*	4
C.5	Inclusion of the species in CITES Appendix 1	
C.6	Inclusion of the species in CITES Appendix II and inclusion of the species in negative list of exports	-6
C.7	Species imported from other countries to partly meet demands of the country	-
C.8	Species whose extraction from wild is banned by Govt. of India	-5
C.0	Species reported to be not threatened/not in trade	0
D	**Cultivation**	
D.1	Species belonging to cat A.1 and B.1 for which cultivation techniques have not been developed by premier institutes in the country viz., RRL Jammu, NBRI, Lucknow, SFRI Itanagar, MSSRF, BSI, etc.,	10
D.2	Species receiving attention by Research Institutes/Organisations or whose existing cultivation is known.	-4
D.0	Species that would not need consideration with respect to cultivation.	0
E	**Destructive Harvest of Plants /Plants with Poor Regeneration in Wild**	
E.1	Use of whole plant or roots/ species reported to be destructively harvested	8
E.2	Use of plants reported to be showing poor regeneration in the wild/seeds recalcitrant	8
E.0	Species that need not be considered under this category.	0
F	**Data deficient Species**	

Table 2: List of Medicinal Plants Prioritised for Consultation

S. No		Family	S. No		Family
1.	*Aconitum falconeri*	*Ranunculaceae*	31.	*Lavatera cashmirian*	*Malvaceae*
2.	*Ampelocissus arnottiana*	*Ampelidaceae*	32.	*Luvunga scandens*	*Rutaceae*
3.	*Angelica glauca*	*Apiaceae*	33.	*Madhuca longifolia*	*Sapotaceae*
4.	*Arnebia benthamii*	*Boraginaceae*	34.	*Madhuca insignis*	*Sapotaceae*
5.	*Cayratia pedata*	*Vitaceae*	35.	*Mappia foetida*	*Icacinaceae*
6.	*Cinnamomum malabaricum*	*Lauraceae*	36.	*Meconopsis aculeata*	*Papaveraceae*
7.	*Cinnamomum wightii*	*Lauraceae*	37.	*Microstylis wallichii*	*Orchidaceae*
8.	*Clerodendrum serratum*	*Verbenaceae*	38.	*Myristica dactyloides*	*Myristicaceae*
9.	*Coptis teeta*	*Rannunculaceae*	39.	*Myristica malabarica*	*Myristicaceae*
10.	*Curculigo orchiodes*	*Amagaryllidaceae*	40.	*Nothapodytes foetida*	*Icacinaceae*
11.	*Curcuma pseudonisntonum*	*Zingiberaceae*	41.	*Paeonia emodi*	*Paeoniaceae*
12.	*Decalepsis hamiltonii*	*Periplocaceae*	42.	*Panax pseudo ginseng*	*Araliaceae*
13.	*Dioxylum malabaricum*	*Mediaceae*	43.	*Piper barberi*	*Piperaceae*
14.	*Embelia tsjeriam-cottam*	*Myrsinaceae*	44.	*Pleatranthes nilgherricus*	*Lcmiaceae*
15.	*Fritillaria royleli*	*Aliaceae*	45.	*Pueraria tuberosa*	*Fabaceae*
16.	*Garcinia indica*	*Clusiaceae*	46.	*Rheum nobile*	*Polygonaceae*
17.	*Garcinia rubro echinata*	*Clusiaceae*	47.	*Salacia oblonga*	*Hippocrateaceae*
18.	*Garcinia travancoria*	*Clusiaceae*	48.	*Saussurea obvallata*	*Asteraceae*
19.	*Gastrochilus longiflora*	*Orchidaceae*	49.	*Saussurea simpsoniana*	*Asteraceae*
20.	*Gymnema khandalense*	*Asclepiadaceae*	50.	*Shorea tumbuggaia*	*Dipteocarpaceae*
21.	*Gymnema montanum*	*Asclepiadaceae*	51.	*Strychnos aenia*	*Loganiaceae*
22.	*Gymnema sylvestre*	*Asclepiadaceae*	52.	*Swerita angustifolia*	*Gentianaceae*
23.	*Heliostoma keralense*	*Asclepiadaceae*	53.	*Swerita corymbosa*	*Gentianaceae*
24.	*Heliotropium keralense*	*Boraginaceae*	54.	*Taxus wallichiana*	*Taxaceae*
25.	*Heracleum candecans*	*Apiaceae*	55.	*Tecomella undulata*	*Bignoniaceae*
26.	*Heracleum rigens*	*Apiaceae*	56.	*Tragia bicolor*	*Euphorbiaceae*
27.	*Humboltia vahliana*	*Caesalpiniaceae*	57.	*Utleria salicifolia*	*Asclepiadaceae*
28.	*Ilex khasiana*	*Aquifoliaceae*	58.	*Valerana wallichi*	*Valerianaceae*
29.	*Itolostema ada-kodicn*	*Asclepiadaceae*	59.	*Vateria macrocarpa*	*Dipteocarpaceae*
30.	*Kingiodendron pinnatum*	*Leguminaceae*			

Results, Discussion and Recommendations

The maximum score which a species can get was 48.58 species that scored above 30 were shortlisted for a detailed consultation to be organised at the National Botanical Research Institute Lucknow for further shortlisting to 25 species. The list of 59 species shortlisted are presented in Table 2. The species that scored maximum was *Panax pseudoginseng* with a total score of 46, scoring high due to its highly restricted distribution, assessment as being critically endangered, heavily traded, exploited from the wild, cultivation techniques not reported to be known to the project team and destructive methods of harvest. Other high scoring species (score > 40) were *Heracleum candolleanum, Mappia foetida, Decalepsis hamiltonii, Dyxoxylum malabaricum Salacia reticulata, Saussurea obvallata, Swerita oymbosa.* Species that closely lost (score 26-29) and could not be prioritised were *Asparagas rottleri, Caltha palustris, Coscinium fenestratum, Croton argyratus, Curcuma zeodaria, Gentiana kuroo, Polygonatum verticilliatum, Saussurea albescens and Veronia shevaroyensis,* mainly due to negative scoring. 75 species could not be considered for prioritisation as information was not available to the extent required for this exercise and hence placed under 'Data deficient species' for the present. However, literature is continuously being referred, to garner further information on these species. Some of the data deficient species includes *Costus lacerus*, a species reported to occur in the habitat similar to that of *Costus speciosus,* harvested along with the latter and presumed to possess similar medicinal properties. Through the methodology species like *Taxus wallichiana,* inspite being receiving conservation attention, inclusion of the species in schedule I of CITES and negative list of exports, attempts being made for vegetative propagation at institutes like the State Forest Research Institute, Itanagar, Arunachal Pradesh, could be shortlisted in the priority list for the reason, the species neither regenerate readily in the wild nor could be germinated in vitro conditions or could be propagated through tissue culture techniques. *Coptis teeta* got prioritised for similar reasons. On the contrary, species like *Rauvolfia serpentina*, although scarcely available in the wild, heavily traded alongwith *Rauvolfia tetraphylla* and other species under the same genera were be eliminated from the priority lists due to successful conservation efforts of many of the premier institutes in the country.

Distribution of the prioritised species through our exercise across different biogeographic zones, shows that maximum number (approximately 46%) of the species are from Western Ghats, followed by Western Himalaya, Eastern Ghats. Central India, Andaman and Nicobar Islands and the Indian Desert. The list of priority species is at table 2. A biogeographic zone wise distribution of priority medicinal plants is placed in table 3. Occurrence of maximum number of prioritised species in Western Ghats is an indication of better availability of information on the medicinal plant species of the Western Ghats, primarily due to there CAMP workshops organised by FRLHT on the medicinal plant of South India. Barring few species like *Tecomella undulata* occurring in the Indian Deserts and *Microstylis wallichii* in the Andaman & Nicobar islands, most of the species in our priority list have been assessed by CAMP. This therefore necessitated the project team to analyse the data deficient species. Although the analysis of the data deficient species is still in progress and is indicated that maximum number of data deficient species one from the Andaman & Nicobar Islands. Literature collected on medicinal plants from the Islands reported mainly on ethnobotanical uses providing scanty information on conservation status, regeneration ability and other information on plants to facilitate prioritisation.

This project also made an attempt to answer what aspects of conservation each of the priority species must address to. Some of these conservation issues are mentioned here under:

(i) Present distributional status : *Madhuca insignis* which has been reported to be possibly extinct would require an assessment of their present distributional status of *Angelica glauca* needs to be known as the species is reported to be not commonly available. Other species whose present distributional ranges that need assessment known are *Heracleum rigens* whose population has dwindled because of habitat fragmentation, and *Humboidtiara vahliana, Curculago orchioides, Garcinia rubro echinata, Gastrochilus longiflora and Plectranthes nilghericus.*

(ii) Use of medicinal species as substitutes and adulterants to other medicinal plants, Species like Cayratia pedata var glabra which is used as a substitute for Cayratia pedata var pedata has been assessed as critically endangered. Decalepsis hamitonii presently used as a substitute for Hemidesmus indcus is itself a monotypic and harvested prior to seed setting, severely affecting regeneration Embelica tsjeriam - cottom is possibly an adulterant Embelica ribes in on Ayurvedic drug. Myrsistica dactyloides is increasingly being used as a substitute of M. fragrone and the population is declining gradually.

(iii) Germination trials for Clerodendron serratum whose seed setting and regeneration capabilities are poor, Garcinia travanocoria whose seeds are recalcitrant, this plant is unisexual in nature hence fertilisation is difficult. Efforts to germinate and vegetatively propagate Taxus wallichiana should continue, in view of limited success achieved hitherto.

(iv) The trade aspect of specie like Coptis teeta, reported to be now in cultivation in Arunachal Pradesh is heavily traded be looked into. The species has also achieved little with regard to micropropagation through tissue culture techniques.

(v) Unscientific methods of harvest-Entire Moppia foetida is uprooted for extraction of wood. Resin collected from Kingiodondron pinnatum causes injuries to the plant. Forest Department of Kerala has reported low viability of this species.

(vi) Population Health Viability Analysis - Some of the species whose conservation status has now been assessed, distribution fairly known may require available population planning and risk analysis. Some of the species have been reported to be found in isolated patches in few areas. Gymnema khandalense is a case in point. The species is reported only in a case in point. The species is reported only in there locations in Maharastra and 1 in Kerala. Ilex khasiana is reported to occur in a few locations in Sikkim plateau. Kingiodendron pinnatum a race and endemic species for which cultivation techniques are known, is reported to possess very low seed viability. A population viability analysis is also recommended for Rheum nobile a species highly endangered in North Sikkim, Lovatera cashmeriana, Luvunga scandens, Meconopsis aculeata and vateria macrocarpa

(vii) Regeneration in wild - Some of the priority species would require management interventions to specifically address to the issue of regeneration in the wild. Two plant species were identified under this category viz., Holostema ado-Kodien, a species which is extensively used in Ayurvedic Medicinal Drugs and is reported to be easily propagated but regeneration in wild is severely affected due to the grazing pressure, Salacia oblonga is reported to be poor as fruits are attacked by pests.

(viii) Awareness on species with social values - *Saussurea obvallata*, a species assessed as endangered by CAMP is overexploited by the locals and tourists for offerings at the shrines of Kedarnath and Badrinath. Awareness amongst the pilgrims on the conservation status of this species may reverse the overuse of this species.

Acknowledgements

The project team places in record its gratitude to BSP. USA for the funding received for the study. We thank Mr. Samar Singh, Secretary General, WWF-India and Mr. Shekhar Singh, Chairman, BCPP, for their constant inspiration during the course of the study. Thanks are due to Ms. Sally Walker, 200, CBSG for providing us the taxon - data sheets of CAMPS on medicinal plants of South India information from which has been extensively used for prioritisation at WWF-India. We thank Archana for compiling information in the database created, Mr. S.K Katyal for meticulous record of project accounts, Dr. R.K. Avasthe, Sr. Programme officer Sikkim field office for some of the slides on medicinal plants. Finally, our sincere thanks to our colleagues Mr. Krishna Kumar & Mrs. Neelam Gautam. We thank Mr G. Sukumar, Ms Mallika V.P (who has recently left the organisation) and Ms. Chanda Kaura, for the Mr. Manoj, Ms Jolly Mukundan for the Secretarial help.

Annexure: Biogeographic Zone wise list of Prioritised Medicinal Plants

Western Ghats

1. *Ampelocissus indica*
2. *Cayratia pedata var glabrata*
3. *Cinnamomum malabarica*
4. *Cinnamomum wightii*
5. *Curcuma pseudomontana*
6. *Clerodendron serratum*
7. *Decalepsis hamiltonii*
8. *Embelia acutipetalum*
9. *Mapia foetida*
10. *Garcinia indica*
11. *Garcinia travancoria*
12. *Garcinia rubro echinata*
13. *Gymnema khandalense*
14. *Gymnema montanum*
15. *Heliotropicum keralense*
16. *Heracleum rigens*
17. *Humboltia vahliana*
18. *Kingiodendron pinnatum*
19. *Madhuca longifolia*
20. *Myristica dactyloides*
21. *Pueraria tuberosa*
22. *Plectranthes nilghericus*
23. *Salacia oblonga*
24. *Strychnos aenia*
25. *Swerita corymbosa*
26. *Tragia bicolor*
27. *Utleria salicifolia*
28. *Vateria macrocarpa*

Western Himalaya

1. *Angelica glauca*
2. *Arnebia benthemii*
3. *Fritillaria roylei*
4. *Saussurea obvallata*
5. *Saussurea simpsoniana*
6. *Heracleum candecans*
7. *Lavatera cashmeriana*
8. *Paeonia emodi*
9. *Microstylis wallichi*
10. *Taxus wallichiana*

Eastern Himalaya

1. *Aconitum ferox*
2. *Coptis teeta*
3. *Gastrochilus longiflora*
4. *Ilex khasiana*
5. *Luvunga scandens*
6. *Madhuca insignis*
7. *Paeonia emodi*
8. *Panax pseudoginseng*
9. *Rheum nobile*
10. *Saussurea simpsoniana*
11. *Taxus wallichiana*
12. *Valeriana wallichi*

Deccan Plateau

1. *Clerodendron serratum*
2. *Curculago orchioides*
3. *Swerita angustifolia*

Eastern Ghats

1. *Decalepsis hamiltonii*
2. *Embelia acutipetalum*
3. *Heracleum rigens*
4. *Myristica dactyloides*
5. *Shorea tumbuggaia*
6. *Ulteria salicifolia*

Andaman and Nicobar Islands

1. *Microstylis wallichi*

Desert

1. *Tecomella undulata*

Prioritisation of Wild Relatives of Crop Plants and Domesticated Animals of India

R.S. Rana and Sudipto Chatterjee

The role of wild relatives of crop plants (WRCP) and of domesticated animals (WRDA) in the improvement of economically important crops and livestock is now well established since they carry some useful genes not available in the germplasm of cultivated species and domesticated animals. These WRCPs and WRDAs form a very valuable component of agrobiodiversity which is being targeted desperately by biotechnologists and organised business sectors because of the genes of resistance to diseases and pests and adaptation to stress environments that they contain. These attributes contribute towards enhancement of productivity and expanding the areas of cultivation.

Transfer of useful alien genes has been very successful in crops such as wheat, cotton, maize, sugarcane, tobacco and peanut. These processes have obvious implications for issues such as access to genetic resources and Intellectual Property Rights. Many of these WRCPs and WRDAs, from which the crop plants and domesticated animals have evolved, continue to survive in the wild. They have the capacity to survive drought and flood, extreme heat and cold and have become adapted to cope up with many other natural hazards. The most important consideration for conserving WRCPs and WRDAs has been their ability to resist diseases and pests. They (WRCPs) may, however, also contain unknown traits like photosynthetic efficiency and quality traits which might prove beneficial to humankind and this is an additional reason for their conservation. However it is imperative to mention here that crossing of some of the wild relatives to the domesticated plants and animals still poses numerous impediments.

The National Bureau of Plant Genetic Resources (NBPGR), the National Bureau of Animal Genetic Resources (NBAGR) and the National Bureau of Fish Genetic Resources (NBFGR) are the country's nodal institutions with a mandate to conserve the nation's agro-biodiversity. The NBPGR has enlisted more than 320 species of WRCPs known to occur in the country (Arora and Nayar 1984). These species are vulnerable to the same kinds of threats as other wild species viz., habitat degradation and loss, over-exploitation and competition from the introduced species. Some of these WRCPs which are endemic and restricted to a limited geographical area are likely to be wiped out unnoticed from their natural habitats impending these threats.

Keeping in view the urgent need to understand the current status of these wild relatives, to assign priorities to attend to their conservation needs and to identify areas for their in-situ conservation to permit their continuing evolution, this project was undertaken under the Biodiversity Conservation Prioritisation Project (BCPP) of WWF-India which seeks to prioritise sites and species on their biological and socio-economic values in a participatory manner and draw strategies for conservation of biological diversity in India.

Objectives

The following were the objectives of the project:

1. To update the list of wild relatives of crop plants and domesticated animals of India, to assess their conservation status and to prioritise them for conservation.
2. To identify relevant institutions/organisations/NGOs who may contribute towards conservation of these wild plants and animals.
3. To collate information on distribution of wild relatives of cultivated plants and domesticated animals with distribution of tribal communities in India and study ethnobotanical relationships.
4. To prepare distribution maps of the prioritised species of wild relatives of crop plants and domesticated animals and identify suitable areas for *in-situ* conservation.

Approach

The list of wild Relatives of Crop Plants and Domestic Animals was prepared from available literature on the subject including NBPGR publications. For the WRCPs Arora and Nayar (1986) was referred and substantiated with additional information with the help of later publications. Very strict definition of wild relative of crop plants was not available. A species was considered wild relative of crop plant if one species under its genera is reported to be under cultivation. Wild relatives can be identified on the basis of morphological similarity or on the basis of genetic makeup. In literature, most of the wild relatives have been identified on the basis of their morphological similarities with their related cultivars. Wild relatives of crop plants show characteristics like, very low seed setting, early seed shedding, difficult to conserve *ex situ* etc.

All available information was categorised into their distributional range, consumptive usage and any other aspect which would aid prioritisation of the species. Those wild relatives which have been identified to be closest to their domesticated counterparts morphologically and genetically and have a limited distributional range, rare and endemic, those which are reported to be threatened due to overexploitation, species of very high socio-economic significance and also those species for which adequate information could not be obtained, were initially shortlisted. Final prioritisation was made on the basis of criteria mentioned below.

1. Species endemic to a particular region. Endemism was accorded highest priority.
2. Species having restricted distribution in one to two biogeographic zones
3. Species categorized as Critically Endangered due to overexploitation or habitat destruction.
4. Species that have contributed genes of resistances to present day cultivars and facing threats due to anthropogenic factors
5. Species having a potential of conferring useful traits
6. Species of high socio-economic significance like used for medicinal purposes, used as substitutes for food crops during stress periods like drought and famine, species used in religious ceremonies etc.

Since the existing information on wild relatives of crop plants is scattered, the effort was targeted primarily to collect information on WRCPs and WRDAs and compile the same at one place. For the purpose of prioritisation we did not assign any scores to the species as has been done in the case of prioritisation of medicinal plants of India (ARK Sastry and Sudipto Chatterjee, this volume)

On the basis of discussions with subject matter specialists, social scientists and stakeholders, and on the basis of literature survey, existing information on WRCPs and WRDAs is continuously being updated so that a revised list of priority species could be developed if need be. Distribution maps of the prioritised species were prepared on the basis of available information on the species from the herbarium of NBPGR at New Delhi. Since *ex-situ* preservation cuts off further evolutionary development necessitating thereby the habitat protection for *in-situ* conservation, some suitable areas have been identified for prioritised species. Adequacy of representation of these species in the national and international gene banks and also in botanic gardens or other living collections is continuously being assessed. For the wild relatives of domesticated animals information on the six identified taxa have been prepared from information available through available literature.

Wild Relatives of Crop Plants

India is one of the twelve regions of diversity of crop plants in the world. The very first synthesis of available information on the distribution, habitat preference, ecology, utility, diversity and other details about the wild relatives and related taxa of crop plants of the Indian region was made by Arora and Nayar NBPGR 1984. Their initial list of plants of agrihorticulture importance comprised over 1200 species out of which 300-320 more important ones were discussed in detail. They have discussed crop category wise areas of concentration in seven phytogeographic zones, India's notable contribution to the world's crop and their wild relatives include species from the *Oryza, Vigna, Artocarpus, Mangifera, Abelmoschus, Amaranthus, Dioscorea, Trichosanthes, Brassica, Sesamum, Corchorus, Crotolaria, Allium, Ammomum, Cinnamomum, Curcuma, Piper, Myristica, Zingiber* and *Saccharum.*

Arora and Nayar (1984) have given details of distribution and habitat preference of wild relatives of crop plants in India. Besides textual information, this includes marking of areas of concentration on maps in seven phytogeographic zones. The total number of WRCPs in these zones, according to Arora and Nayar (1984) is as follows:

Phytogeographic Zone	*No. of Wild Relatives*
Western Himalaya	125
Eastern Himalaya	82
North Eastern Region	132
Gangetic Plains	66
Indus Plains	45
Malabar / Western Peninsular Region	145
Deccan / Eastern Peninsular Region	91

Subsequently, Arora and Pandey NBPGR (1996) published the 'Wild Edible Plants of India - Diversity, Conservation and Use and deals with enumeration of various edible domesticated and semi-domesticated species of Indian origin or naturalized in India.

Category wise the wild relatives have been grouped as follows (Arora and Nayar 1984)

Crop group	*Species no.*
Cereals and millets	51
Legumes	31
Fruits	109
Vegetables	54
Oilseeds	12
Fiber's plants	24
Spices and condiments	27
Others	26

Wild relatives of Cereals

Oryza

The genus oryza includes 27 species of which 25 are wild and two are cultivated viz. *O.sativa* (in Asia) and *O. glaberima* (in Africa).

Of the 25 wild species, the following are found in the Indian union and were considered for prioritisation under this study.

1. O.nivara 2. O.sativa var. spontaneata 3. O. rufipogon (=O. fatua) 4. O. officinalis ssp. malam puzhaen 5. O. granulata (=O.meyeriana) 6. O. malabarensis 7. O. periennis 8. O.jeyporensis 9. O.inandamanica. Other species under the category 'rice' with genera other then Orzya were also considered for prioritisation. They are:

10. *Porteresia coarctata* 11. *Leersia hackelii* and 12. *Zizania latifolia.*

Of these fourteen wild relatives of crop plants seven species were prioritized. The prioritized species among the wild relatives of rice and reasons for the same are shown in Table 1.

Maize

Maize belongs to tribe Maydae of the family Graminae. Maydae includes eight genera, five of which are oriental (natives of the region extending from India and Burma through the East Indies into Australia and the Polynesian islands) and three are American: Zea, Tripascum (Gama grass and Euchlaena (Teosinte, closest wild relative of maize). The genera Zea has two wild relatives: *Zea perennis* and *Z. diploperennis* both having unusual disease resistance properties.

Recently, Dhawan (1964) has reported the occurrence of two primitive forms of maize - Sikkim primitive! and Sikkim primitive 2 in the foothills of North Eastern Himalaya. The discovery of this living fossil and primitive germplasm having evolutionary implications in the foothills of the North Eastern Himalaya, led to prioritisation of sp I and sp 2 in this project.

Minor Millets

The Indian and the African subcontinent are the most important centres of millet cultivation. The Indian gene centre exhibits diversity in specific minor millet species like *Coix-lacryna jobi* (soft shelled forms), *Digitaria cruciata var. esculenta, D sanguinalis, Echinochloa colonum, Eleusine coracana, Panicum sumatrense and Paspalum scrobiculatum.* Some of the millet species indigenous to India are *Paspalum scrobiculatum, Eleusine coracana, Ehinochloa oryzoides and Digitaria cruciata.*

The following genera under the different categories of millets were considered for prioritisation:

SMALLER MILLETS

1. *Setaria glauca*, 2. *Setaria pallide fusca*, 3. *Setarla sphacelata*, 4. *Setaria tomentosa*, 5. *Setaria verticillata*, 6. *Setaria viridis*, 7. *Trilobachne cookei*, 8. *Chionachne koenigii*

Table 1

Species Prioritised	*Reason for Prioritisation*
1. *Oryza nivara*	species of socio-economic significance as used in religious ceremonies, decreasing habitat and contribution of a gene for resistance to blast and grassy stunt virus.
2. *O.rufifpogon*	a species which is very difficult to conserve *ex-situ*. Very low production of seeds and seed shedding nature.
3. *O.malabarensis*	endemic to Malabar district
4. *O.jeyporeniis*	endemic rice of wetlands in Eastern Ghats
5. *O.inadamanica*	endemic to Andaman and Nicobar Islands
6. *O.meyriana ssp. granulata*	a species with a very specific habitat requirement, difficult to conserve *ex-situ* as it produces few number of grains which sheds early
7. *Porteresia coarctata*	a monotypic genus and species of significance for transfer of the trait for salt tolerance

Barnyard Millets

1. *Echinochloa colonum*, 2. *Echinochloa crusgalli (=Paniuim crusgalli)*, 3. *Echinochloa stagnina*

Finger Millets

1. *Eleusine compressa*, 2. *Eleusine indica*

Little Millets

1. *Panicum hippothrix (=P. obscurants, = Ischne obscuranse)*, 2. *Panicum psilopodium* var. *psilopodium* & *var. coloratum*, 3. *Panicum sumathense (=P.miliare)*, 4. *Panicum tripheron*, 5. *Pennisetum orientale*

Kodo Millets

1. *Paspalum scrobiculatum (=P. commersonii)*, 2. *Paspalum scrobiculatum var. commersonii & var. frumentaceum*

Digitaria

1. *Digitaria cruciata (=D.bifasciculata, D.paspalum var cruciatum)*, and 2. *Digitaria sanguinalis.*

Coix

1. *Coix aquatica*, 2. *Coix gigantea*, 3. *Coix lacryma jobi (=C.lachryma)*

On analysis of information available on the above, the following species under the category minor millets were prioritised and reasons for the same are provided herewith

Species	*Reason for prioritisation*
Panicum hippothrix	Distribution restricted to the Deccan
Setaria glauca	Wild type having restricted occurrence in Northern parts of Maharashtra
Chionachne semiteres	Localized distribution in Tamil Nadu in moist deciduous forest openings

Wheat

The cultivated tetraploid and hexaploid wheat are believed to have originated from ancient diploid wheat and related wild grasses by natural bybridization followed by chromosome doubling.

The species considered was *Aegilops touschii*, but due to its wide distribution in NW Himalaya. The species has not been prioritised.

Vegetables

The Indian subcontinent is one of the centres of origin and / or diversity in vegetable crops. Around 80 species of major and minor vegetables, apart from several wild /gathered kinds occur (Choudhury, 1967, Seshadri 1987) occur in the subcontinent. For vegetables liked Eggplant (*Solanum melongena*) Lablab bean (*Lablab purpureus*), Cucumber (*Cucumis sativus*), Ridge gourd (*Luffa cylindrica*), Wax gourd (*Banicasa hispida*), India is the primary centre of variability. This region is also secondary centre of diversity of crops like Cowpea (*Vigna unguiculata*), Okra (*Abelmoschus esculentus*), Chillies (*Capsicum annum*), Pumpkin (*Citrullus lanatus*) and Amaranthus species.

Amaranthus

This genus includes 60 species of annual herbs distributed in tropics of which around 25 occur in India. Only six wild relatives this genus was considered for prioritisation. These are: 1. *Amaranthus blitum 2. A. caudatus 3. A. gangeticus (=A. tricolor) 4. A. spinosus 5. A. viridis (=A.gracilis) and 6. A. paniculatus.* Due to their wide occurrence none of the species were prioritised.

Cucurbits

The Indian subcontinent is considered to be the centre of origin for a number of wild and cultivated cucurbitaceous vegetable crops. 110 genera and 640 species are found in India. 38 species are endemic to India.

Cucumis species: The genus Cucumis comprises of about 26 species. The Indian subcontinent is said to be the Centre of origin for *Cucumis sativus* and centre of diversity for *C.melo*.

India, Turkey and Afghanistan have been recorded as secondary gene centre for muskmelon. (*C.melo*) based on distribution of diversity.

In this section, the following four wild relatives were considered for prioritisation

1. Cucumus cetosus, 2. C.callosus 3. C.hardwickii and 4. C. prophetarum.

Of these, *Cucumis hardwickii*, the likely progenitor of cultivated cucumber and which has also been recently reported from peninsular India is prioritised.

Luffa

Indian sub-continent including south-east Asian countries are centre of diversity of Luffa species. Luffa comprises 9 species worldwide out of which 7 species are native to India. These are *L.acutangula, L.cylindrica, L.graveolens, L.hermaphrodita, L.tuberosa and L.umbellata. L.acutaugula and C.cylindrica* are cultivated. Indian gene centre has rich diversity in genetic resources of ridgegourd and spongegourd especially in eastern ,peninsular tracts, Indo-gangetic plains, north-eastern region and in tribal dominated belts of central India. *L.acutangula* is believed to have originated from India where wild forms still occur.

The following wild species were considered for prioritisation:

1. Luffa acutangula (Ridge Gourd) var. Longistylis, 2. L. Echinata, 3. L. Graveolens, 4. L.umbellata, 5. L.hermaphrodita (Satputiya) 6. L.tuberosa. Of these only *Lufa umbellata* was prioritised as its distribution is confined to the Eastern cost/ Coromandal belt.

Momordica

Genus Momordica is reported to have 60 species worldwide out of which 7 have been recorded in India.

Two wild species were considered for prioritisation:

1. Momordica cochinchinensis and 2. M.dioca

None could be prioritised for not meeting the criteria for prioritisation

Trichosanthes

India is considered to be the centre for origin for pointed gourd (*Trichosanthes dicoa*). It is extensively cultivated in Assam, Bengal, Orissa, North Bihar and Uttar Pradesh (Chandra Umesh et al. 1995). Trichosanthes has 22 species reported to be of Indian parts of Tropical Asia or Indo-Malayan region. Among these *T. anguina* (Snake gourd), *T. dioica* (pointed gourd) are cultivated throughout, the country.

The following wild relatives of Trichosanthes were considered for prioritisation.

1. *Trichosanthes anamaliensis, 2. T. cordata, 3. T. bracteata var.bracteata (=T.palmata), 4. T. cucumerina, 5. T. perottetiana, 6. T. nervifolia (T.cuspidata), 7. T.majuscula, 8. T. ovata, 9. T. tomentosa, 10. T. villosula.*

Of these, the following species were prioritised.

Species	*Reason for prioritisation*
T.nervifolia	Distribution restricted to Deccan peninsula
T.majuscula	Categorized as endemic/rare and overexploited type (Arora and Pandey 1996)
T.ovata	Categorized as endemic/rare and overexploited type (Arora and Pandey 1996)
T.tomentosa	Categorized as endemic/rare and overexploited type (Arora and Pandey 1996)

Dioscorea

Dioscorea is a large genus with about 600 tropical or subtropical species, of which 11 are grown for their stem tubers. Approximately 40 species are found to be occurring in India.

Paucity of time restricted us to consider only 14 species of wild relatives of genus Dioscorea. These are:

1. Dioscorea alata, 2. D. bulbifera, 3. D. glabra, 4. D. guinata 5. D. hispida (=D.daemona), 6. D.melanophyma (=D.tenuii), 7. D. oppositifolia, 8. D. pentaphylla, 9. D. pubera (=D. anguina), 10. D.quinata, 11. D. wallichi, 12. D. cylindrica, 13. D. prazeii, 14. D. spicata 15. D. intermedia, 16. D. tomentosa, 17. D. floribunda, 18. D. deltoidae

Detailed information on *D. cylindrica, D.prazei, D.spicata, D. intermedia and D.tomentosa* in terms of their distribution, consumptive usage and conservation status could not be collected. However we prioritize *D. deltoidae* (from Western Himalaya and *D. prazeri* (from Eastern Himalaya) as these two species are reported to be over exploited due to their higher percentage of diosgenin.

Abelmoschus

Okra (*Abelmoschus esculentus*) is one of the most important warm season vegetable crops grown in tropical and sub-tropical regions of Asia, Africa and America. Okra has a secondary centre of diversity in India, concentrated in the Indo-gangetic plains) north eastern region, North West Himalayas, Southern India and sporadically in the tribal dominated belt of Central India and the Eastern Ghats.

The following species, subspecies and varieties were considered for prioritisation under this project

1. Abelmoschus. angulosus, 2. A.tetraphyllus var. tetrapphyllus, 3. A. crinitus, 4. A. esculentus 5. A. ficulneus, 6. A. Manihot ssp manihot, 7. Abelmoschus moschatus (=Hibiscus abelmoschus), 8. Abelmoschatus ssp tuberoses and ssp moschatus and 9. Abelmosschus tuberculatus

The following wild relatives of Okra are being recommended for prioritisation through this study:

Species	*Reason for prioritisation*
Abelmoschus angulosus	Distribution restricted to the Western Ghats
A.crinitus	Rare and restricted to low rainfall areas in West Bengal
A.manihot ssp manihot	Distribution restricted to subtropical Himalayas from Kumaon to Sikkim (The species has recently been reported from Central India.

Colocasia

Colocasia is a genus of 13 species of perennial herbs distributed in tropical parts of South eastern Asia.

C.esculenta is extensively cultivated for the edible tubers.

Adequate information on the two wild relatives viz., *Colocasia affious* and *C.fallox* could not be collected for consideration.

Solanum (Nontuberous Types)

In India Solanum is represented by 45 species including 22 indigenous types (Deb 1980) 3 species *S.melongena*, *S.tuberosum* and *S. macrocarum* are cultivated and a total of 32 species are reported to be useful. N.I. Vavilov in 1951 considered it to be of Indian origin. *S.melongena* is believed to have been domesticated north eastern India where wild forms still grow (Kocchar 1981) Maximum diversity of solanum exists in Southern India, foothills of Himalaya and North-east region. The widely distributed species in the region includes *S.torvum*, *S.indicum*, *S.insanum*, *S. khasianum* (Gupta and Rai, 1995).

Under this project, the following wild relatives of solanum (non tuberous types) were considered.

1. Solanum incanum (=S. coagulans) 2. S. indicum (=S. anguivi), 3. S. melogena var incanum, 4. S. melogena var insanum, 5. S. potangi 6. S. straminifolium 7. S. surattense (=S.xanthocarpum) 8. S. torvum and 9. S. vagum.

On the basis of analysis of data the following (in Table 2) have been prioritized.

Legumes

Legumes are second only to the cereals as a source of human food. India holds rich diversity in grain mung bean, urad bean, chick pea, pigeon pea, cowpea and horse gram (Singh and Rana, 1995) Information on wild relatives of the following genera under the group legumes was collected and analysed:

Atylosia, Cajanus, Canvalia, Cicer and Vigna.

Atylosia

Atylosia, a genus of about 30 species occurring in Tropical Asia, Australia, Madagascar, and West Africa, constitutes the wild germplasm of *Cajanus cajan*. We considered 21 species under the genera Atylosia.

1. A.albicans 2. A. barbata,3. A. cajanfolia 4. A.candollei 5. A. elongata 6. A. geminiflora 7. A. goensis 8. A. grandifflora 9. A. kulensis 10. A. lanceolata 1. A.mollis 1. A.nivea 13. A. platycarpa 14. A. rostrata, 15. A. rugosa, 16. A. sericea. 17. A. trinervia 18. A. villosa 19. A. volubillis (=A. Crasaa) 20. A. scrabaeoides 21. A.lineata

On the basis of the data compiled the following (in Table 3) were prioritised.

Table 2

Species	*Reasons for prioritisation*
Solanum melongena var incanum	The species is closest relative of cultivated brinjal *S.melongera* and is found to grow in the Western and Southern parts of India.
S.potangi	has been categorized under endemic/rare/over exploited by Arora and Pandey 1996
S.straminfolium	identified as rare by Velayudhan (1996)
S.vagum	identified as rare by Velayudhan (1996) with distribution restricted to Tirunelvelli hills in Tamil Nadu.

Table 3

S.No	*Species*	*Reason for prioritisation*
1.	*Atylosia cajanifolia*	endemic to Orissa (Mahendragiri, Bailladilla range)
2.	*Atylosia candollei*	restricted distribution in the Nilgiris and Ceylon upto 4000ft.
3.	*Atylosia goensis*	distribution restricted to Western Ghats.
4.	*Atylosia grandiflora*	Categorised as Endemic /rare/Overexploited type by Arora and Pandey 1996 and Distribution restricted to Western Ghats, Kumaon and Upper
5.	*Atylosia kulensis*	Distribution restricted to Western Ghats and Kumaon
6.	*Atylosia lineata*	Distribution restricted to Western Ghats
7.	*Atylosia nivea*	Categorised as Endemic/Rare/Overexploited type by Arora and Pandey 1996, restricted areas near Zeronghuan, Burma.
8.	*Atylosia rostrata*	Distribution restricted to Concan
9.	*Atylosia rugosa*	Distribution restricted to Nilgiris in India
10.	*Atylosia trinervia*	Distribution restricted to Western Ghats

Cajanus

Vavilov (1939) considered India a primary centre of origin of the cultivated pigeonpea.

Reddy (1973) and De (1974) postulated that the genus Cajanus probably originated from Atylosia species through selection of single gene mutation.

Cajanas cajan since cultivated throughout India is not prioritised.

Canvala

Two wild relatives of genera Canavalia was considered:

1. *Canavalia virosa* and 2. *C. maritima* and both the species have been prioritised because its distribution is restricted to Western Ghats.

In the Indian gene centre, apart from rich genetic diversity in cultivated species (*C.arietinum*), two wild species *C. soongaricum* and *C.microphyllum* are enumerated in Indian Floras and Botanical accounts.

The fact that *C.microphyllum* is restricted to the temperate and alpine regions of Western Himalaya and the species reported to be at risk necessitates its prioritisation for conservation efforts.

Vigna

In India nearly 15 species of Vigna are known including important pulses like Mung, Urad, Moth and Lobia. India being an important center of diversity for Urad bean, a thrust for germplasm evaluation and exploration is an urgent requirement.

The following wild relatives of Vigna were considered for prioritization

1. Vigna grandis 2. *V.radiata var.sublobata* 3. *V. capensis* 4. *V. khandalensis (=Phaseolus khandalensis =P.grandis)* 5. *V.mungo var sylvestris* 6. *V.pilosa* 7. *V. trilobata (= Dolichos trilobatus)*, 8. *V.umbellata (=D.umbellatus =Phaseolus calcaratus)* 9. *V. vexillata*, 10. *V. dalzelliana (=Phaselous dalzelli)*, 11. *V. aconitifolia*, 12. *V. bournae*, 13. *V. grahamianus*, 14. *V.luteola*, 15. *V. maina (=V. radiata var seyulosa)*, 16. *V. wightii*, and 17. *V. minima.*

Among the vigna species considered the following (in Table 4) are being recommended for prioritisation

Fruits

Several fruit species of at least 20 genera such as Artocarpus, Citrus, Diospyros, Embelica, Ficus, Grewia, Juglans, Mangifera, Musa, Malus, Morus, Prunus, Punica, Pyrus, Ribes, Rubus, Syzygium, Vitis and Zizyphus offer great variability in India. Fruits like mango, several citrus fruits, banana, jackfruit, ber *(Zizyphys mauritiana)*, aonla *(Embelica officinalis)* bael (*Aegle marmelos*), phalsa (*Grewia subinequalis*) jamun (*Syzygium cumini*) karonda (*Carissa carandas*) etc are indigenous to India besides several other less known fruits.

India is the world's second largest producer of fruits with a germplasm that includes:

4	species of mango
107	cultivars of papaya
24	cultivars of pineapple
363	cultivars and 6 species of banana
123	cultivars
3	species of guava
451	cultivars of citrus

The wild relatives of the following genera were considered: Morus, Musa, Artocarpus, Phyllanthus, Prunus, Pyrus, Ribes, Rubus, Sorbus, Zizyphus, Citrus Crataegus, Docynia, Eriobotrya, Fragaria, Garcina, Malus and Mangifera

Morus

Morus, an important genus of family Moraceace is distributed in temperate and subtropical regions of both the hemispheres. Out of 68 species recognized from different parts of the world, 35 species are found in Asia and 14 are from continental America. In India the genus is represented by 4 species namely; *M. alba* and *M.indica* which are exploited for the purpose of sericulture and *M.laevigata* and *M.serrata* which are wild.

Among the aforesaid four species found in India out of a total of 68 species in the world: Morus *serrata* is the most

Table 4

Species	*Reason for prioritisation*
Vigna grandis	Distribution restricted to Khandala (Western Ghats)
V. khandalensis	found on the Western Ghats in Khandala (where the plant is restricted in occurrence) and in Konkan.
V. mungo var. sylvestris	Distribution restricted to Khandala and Concan range in Western Ghats.
V. vexillata	distribution restricted to Western Ghats.
V. dalzelliana	Restricted to Nilgiri and Palni hills (upto 900m) in Western Ghats, considered to be a wild form of rice bean, believed to be of Hindustan Origin (Vavilov 1949)

probable candidate for prioritisation as it is indigenous to India and found restricted to forests in North Eastern States upto an elevation of 1000-1400m.

Musa

It is believed to have originated in the humid tropical regions, somewhere in the mountainous region of Assam, Burma, Indo-China.

NBPGR, Shillong has reported four species of Ensete (*E.edule, E.agharkarii, E.glaucum and E.onperbum*) and 12 species of Musa in North-east India (*M. acuminata, M.balbisiana, M. cheesmani, M.flavifora, M.itinerans, M. nagensium, M.sikkimensis* belonging to Emusa section and *M.manrii M.ornata, M.rubra, M. sanguinea, M.velutina* belonging to Rhodochlamys section. *E.edule* is doubtful and according to Rao and Hajra (1976) *E. agharkarii* is synonymous to section *E.glaucum*.

The species which were considered for prioritisation are as follows:

1. *Musa acuminata*, 2. *M.balbisiana*, 3. *M.cheesmanii*, 4. *M.flaviflora*, 5. *M.itinerans*, 6. *M.kattuvazhana*, 7. *M.manii*, 8. *M.nagensium*, 9. *M.ochraceae*, 10. *M.ornata*, 11. *M.rosaceae*, 12. *M.sikkimensis*, 13. *M.superba and* 14. *M.velutina*.

In Table 5 we recommend prioritisation of the species for reasons mentioned thereof:

We could not collect information on the distribution of *M.ochraceae* and *M.ornata*, hence these two species have been shortlisted for future investigations.

Artocarpus

A genus of evergreen or deciduous trees comprising about 100 spp., distributed in the Indo-Malayan region and China, of which 18 spp. occur in India. The three wild relatives viz.,

1. *Artocarpus heterophyllus* 2. *A integer* and 3. *A.lakoocha* were considered and among the three *Artocarpus heterophyllus* and *A integer* both indigenous to India and reported to occur in the Western Ghats are prioritised.

Phyllanthus

About 24 species occur wild in India, and some ornamental exotics are planted in gardens. Only one wild relative *Phyllanthus indifisheri* was initially taken up for prioritisation but adequate data could not be collected on this species during the project period.

Prunus

The genus Prunus is large and variable, containing 140 species. The genus is distributed widely in north temperate regions. Of the 35 species of this genus in India, about 8 are wild economic types utilised as fruits.

The following wild relatives under genus Prunus was considered

1. *P.cerasoides*, 2. *P.cornuta var.vilosa* and *P.cornuta var.cornuta*, 3. *P.napaulensis*, 4. *P.prostata*, 5. *P.tomentosa*, 6. *P.wallichii*, 7. *P.jenkinsii* and 8. *P.armeniana*.

P.cerasoides, P.cornuta var vilosa, P.napaulensis and *P.jenkinsii* are recommended for prioritisation due to their restricted distribution in North East. Commercial exploitation of *P.napaulensis* is also reported. Information on three species viz., *P.prostsata*, *P.tomentosa* and *P.wallichii* is lacking in this study.

Pyrus

Genus Pyrus includes 30 species which are distributed widely in temperate Eurasia. 6 species are found in India between 700- 3000 m altitude. Of the three wild/lesser known species most favourite is *P.pashia* (wild pear) which occurs wild and also as semi-domesticated/cultivated species found to be growing extensively in hill areas of Western, Northern and Eastern regions. It is also reported from Nilgiris. It is believed to have originated from the Himalayan region.

The five wild relatives under genus Pyrus considered were:

1. *P.communis*, 2. *P.kumaoni*, 3. *P.pashia*, 4. *P.pyrifolia*, 5. *P.jacquemontiana*

Table 5

Species	*Reason for prioritisation*
M.acuminata, M.balbisiana, M.cheesmanii, M.flaviflora, M.itinerans, M.manii, M.nagensium, M.sikkimensis, M.superba and M.velutina	restricted distribution in North East.
M.kattuvazhana	occurs in Western Ghats
M.rosaceae	occurrence reported from silent valley

Table 6

Species	*Reason for prioritisation*
R.fruticosus var discolor -	distribution confined to Western Himalaya.
R.lineatus	distribution confined to North East, with maximum variability in Sikkim.
R.nutans	distributed in Western Himalaya
R.paniculatus and *R.rosafolius*	confined to temperate Himalaya, east of Khasi hills

On the basis of data analysis, *Pyrus kumaoni* (endemic to Western Himalaya - Kashmir to Kumaon), *P.pashia* (endemic, distributed in subtemperate to temperate Himalayas, used as rootstocks for peach), *P.pyrifolia* (found semi - wild in Nilgiris, used as rootstock) are recommended for prioritisation. Information on *P.communis* & *P.jacquemontiana* which could not be collected during the study period.

Ribes

About 150 species of Ribes occur in temperate and cold regions of the world. In India 8 species have been recorded which occur in North West and Western Himalaya.

The two wild relatives considered for prioritisation were:

1. *Ribes graciale* and *R. nigrum.*

Ribes graciale although used for breeding immunity to *Coronarium rubicula* and *R.orientale* is distributed widely in temperate and Alpine Himalaya from Kashmir to Assam upto 3500m has not been prioritised due to their wide occurrence. *Ribes nigrum,* on the other hand has restricted distribution in Temperate Western Himalaya (Kunawar to Kashmir upto 3600m), hence recommended for prioritisation.

Rubus

Rubus is a large genera of more than 400 species, mostly shrubs, they are chiefly natives of the colder and temperate regions of northern hemisphere. 429 or more species occur the world over of which 57 species occur in the Indian subcontinent. The north-western and Western Himalayan region contain 32 species and four varieties which is about 63 per cent of total diversity.

We considered the following wild relatives under genus Rubus:

1. *R.fruticosus var. discolor (=R.discolor)*, 2. *R.niveus (=R.albescens)*, 3. *R.lasiocarpus*, 4. *R.lineatus*, 5. *R.lanatus*, 6. *R.moluccanus*, 7. *R.nutans*, 8. *R.paniculatus*, 9. *R.reticulatus*, 10. *R.rosafolius* and 11. *R.ellipticus.*

The following were prioritised as given in Table 6.

Sorbus

Sorbus is represented by 100 species of which 21 are available in India with maximum concentration of diversity in North Western and Eastern region.

The wild relatives under the genus Sorbus considered for prioritisation were:

1. *S.acuparia*, 2. *S.cuspidata*, 3. *S.lanata* and *S.vestita*

All these species are widely distributed in the temperate regions in North East and from Kashmir to Kumaon, hence not prioritised.

Zizyphus

The genus Zizyphus Mill. (Rhamnaceae) includes 100 species. They are distributed widely in the tropics of Asia ad America and the temperate regions of both the hemispheres.

We considered 5 species of wild relatives under Ziziphus:

1. *Z.mauritiana var.fruticosa*, 2. *Z.xylocarpus*, 3. *Z.trinervia*, 4. *Z.rugosa* and 5. *Z.oenoplea*

Of these, *Zizyphus mauritiana var.fruticosa* (rarely found in rain shadow areas at lower elevations in Western Ghats), *Z.xylopyrus* (occurs rarely in semi - deciduous forests in Western Ghats) and *Z.trinervia* (confined to Western Ghats) are being recommended for prioritisation.

Citrus

India is considered to be the home of several citus species. Information collected from different herbarias in the country indicate that there are 23 Citrus species in India. There are three major centres of diversity:

(i) North-Eastern Region
(ii) North-Western Region and
(iii) Southern Region

Maximum concentration of wild species is in the North-Eastern region.

We analyzed information on the following wild Citrus species:

1. *C.aurantifolia*, 2. *C.baton*, 3. *C.ichangensis*, 4. *C.indica*, 5. *C.jambhiri*, 6. *C.latipes*, 7. *C.macroptera*,

Table 7

Species	*Reason for prioritisation*
Citrus indica	is the most primitive and perhaps the progenitor type and is highly endangered. This species is prioritised inspite of the fact that a Citrus Gene Sanctuary has been established on the recommendations of a task force which had recommended Tura range and its foothills as the most suitable site for the Gene Sanctuary. Certain other pockets where this species is still available are Garo hills in Meghalaya, foothills in Nagaland and Kajiranga forest in Assam.
C.inchangensis	confined to Nagaland
C.assamensis and *C.macroptera*	found in Meghalaya (Shella area on the southern slope of Khasi hills)
C.laltipes	found in Meghalaya (Shillong - Central Plateau of Khasi hills), species is cold resistant.
C.media	Shillong Plateau, wild in Khasi & Garo hills.
C.jambhiri	confined to eastern part of Punjab near Pathankot, used as rootstock.

8. *C.media*, 9 *C.paradisi*, 10. *C.regulosa*, 11. *C.reticulata* and 12. *C.sincusisra* and prioritised are shown in Table 7.

Docynia

Genus Docynia comprises of six species of which two occur in India. *D.indica* is an indigenous species also cultivated in temperate region of Eastern Himalaya. Both the species viz., *D.indica* and *D. hookeriana* was considered for prioritisation and both have been prioritised as they are confined to the Evergreen and Semi Evergreen forests of the North Eastern Hills.

Eriobotrya

Of the 30 species under this genus, 9 occur in India.. The three wild relatives considered for prioritisation were:

1: *E.angustissima*, 2. *E.dubia* and 3 *E.benghalensia*

Eribotrya angustissima and *E.dubia* which are endemic to central and Eastern Himalaya, are recommended for prioritisation.

Fragaria

The species of Fragaria are low growing perennial herbs confined to the north temperate zone and in the high tropical regions of the Western Hemisphere. Probably 20-25 species occur all over the world, out of which 5 have been recorded from India. 4 of these species are found distributed in the North-West and W. Himalayan region (Sharma and Chandel, 1996).

Following wild relatives under genus Fragaria were considered:

1. *Fragaria nilgerrensis* 2. *F.nubicola* and 3. *F.vesca*

Fragaria nilgerrensis which has restricted distribution in Nilgiris and Aka and Khasi Hills of Meghalaya have been prioritised.

Garcinia

It is a large genus of evergreen trees or shrubs distributed in tropical Asia, Africa and Polynesia and we considered the following wild relatives:

1. *G.andamanica*, 2. *G.andamanica var. pubesens*, 3. *G.atroviridis*, 4. *G.breviastris (=G.euginefolia)*, 5. *G.cadolliana*, 6. *G.calcyna*, 7. *G.cambogia*, 8. *G.cowa*, 9. *G.dulcis*, 10. *G.hombroniana*, 11. *G.jilineki*, 12. *G.kingi*, 13. *G.kurzi*, 14. *G.lanceaefolia*, 15. *G.microstigma*, 16. *G.nervosa*, 17. *G.pedunculata*, 18. *G.spicata (=G.ovalifolia)* and 19. *G.xanthochymus (=G.tinctoria)*.

All the species under the genus Garcinia except *G.lanceaefolia* & *G.xanthocymus* considered in this study, need urgent attention for their conservation. Some of them are rare and endemic to Andaman & Nicobar Islands. Fruits of Garcinia have medicinal value, juice given in bilious afflictions. The seeds of the fruit yield a valuable edible fat commercially known as Kokum butter. Garcinia is thus recommended as a priority genus by the project team.

Malus

It is believed to have originated in the Caucasus mountains of western Asia where vast forests of wild apple trees exist even today. Of the 35 species, 5 occur in the Himalayan region between 1650-3300 m. There are numerous Crab apple *(M.baccata var. himalaica)* trees growing wild from Kashmir to Kumaon to Bhutan and Khasi and Jaintia hills in Assam at altitudes of 1800-3000 m. It is believed to have originated from Western Himalaya. The species is resistant to cold and some types withstand temperatures as low as -55°C.

We considered the following three wild relatives under the genus Malus:

1. *M.baccata var himalaica* and *M. sikkimensis*

Of the 35 species of Malus, 5 occur in the Himalayan region between 1650-3300m. *Malus sikkimensis* - endemic to high altitudes in Central and North Eastern region and also used as a rootstock. This species is therefore shortlisted.

Q Mangifera

Wild forms of *M. indica* are known to exist in the peninsular tract, evergreen forests of NE Region and Terai ranges. In evergreen forests, wild forms of allied species *M. sylvatica* are found in NE Region. Tribal areas at the junction of Madhya Pradesh-Andhra Pradesh, Orissa-Madhya Pradesh and Gujarat-Rajasthan besides South Tamil Nadu and Kerala are prominent centres. Some species are native to NE India (Tripura, Manipur, Mizoram, South Assam, Chotta Nagpur plateau, Santhal region in Rajmahal hill) and the Andamans. It is reported that 4 out of 41 Mangifera species are native to India.

Species considered for prioritisation which are:

1. *M. andamanica*, 2. *M. gedebe*, 3. *M. khasiana*, 4. *M. quadrifida* and 5. *M. sylvatica*.

M. andamanica (restricted to Andamans), *M. gedebe* (restricted to Andaman and Nicobar) *M. khasiana* (restricted to khasi hills) are recommended for prioritisation.

Spices

The use of spices in India and elsewhere is of great antiquity. Apart from being appetizers, spices act as stimulants, carminatives and diuretics. Spices or their derivatives are also used in medicines, cosmetics and the tobacco industry. There are about 70 species cultivated in different parts of the world but nine: Pepper, Ginger, Cloves, Cinnamon, Cassia, Mace, Nutmeg, Allspice and Cardamom account for as much as 90% of the total world trade, Pepper being the most important. In India major spices produced are Pepper, Cardamom, Ginger, Turmeric and Chillies. Wild relatives in the following genera have been considered under the study: Allium, Curcuma, Elettaria, Piper, Zingiber, Alpinia, Amomum, Carum, Ginna momom and Myristica.

Allium

Allium cepa (Onion) and *Allium sativum* (Garlic) are the two most important of cultivated Alliums. Approximately 1000 wild species of Allium have been recorded through out the world.

Though 40 species are reported from India, the distribution of wild species still needs proper elucidation. Most of the Alliums in India are distributed in temperate and alpine zones of Himalaya.

Most of the species of Allium in India are distributed in Temperate and Alpine zones of Himalaya. NBPGR has recorded a rich diversity of 26 species of wild Allium in the Western Himalaya. A suitable site in West Himalaya could thus be considered as a probable site for Gene Sanctuary for Allium. From among the 4 species considered under the study three viz. *A. rubellum*, *A. tuberosum* and *A. schoenoprasum* are found in Western Himalaya and *A. jacquemontii* is distributed in Western Ghats. Hence all 4 are being put forward for prioritisation. Information on the following species of Allium reported from the Western Himalaya which could not be collected during the study period, needs to done in future prioritisation studies: *A. atropurpureum*, *A. atrosanguineum*, *A. auriculatum*, *A. carolianianum*, *A. caesium*, *A. clarkei*, *A. consanguineum*, *A. oreoprasum*, *A. fasciculatum*, *A. fedschenkoanum*, *A. prattii*, *A. prezwalskianum*, *A. schrenki*, *A. semonovii*, *A. stracheyi*, *A. thomsonii*, *A. victorialis*, *A. wallichi*, *A. govanianum*, *A. liliacinum*, *A. loratum*, *A. odoratum and A. platyspathum*.

Curcuma

It is not known in the wild state.

C. aromatica, popularly called the Cochin turmeric or Kasthuri manjal or yellow zedoary, is found wild in the forests of the Western Ghats and Bengal. *Curcuma angustifolia* is another wild species occurring in many of the forests in India is used as an arrow-root substitute. *C. zedoaria* (Zedoary) is another wild species which has plenty of starch and utilised for that purpose. This is sometimes cultivated.

The following wild relatives under genus Curcuma were considered:

1. *Curcuma amada*, 2. *C. angustifolia*, 3. *C. latifolia*, 4. *C. longa*, 5. *C. montana*, 6. *C. zeodaria*, 7. *C. aromatica* and 8. *C. caesia*.

From among the species considered following are recommended:

Species	*Reason for prioritisation*
C. latifolia	distribution confined to North East
C. longa	wild forms occur in Chota Nagpur area as undergrowth in forests

Elettaria

Cardamom consists of dried aromatic fruits and seeds of the genus Elettaria, indigenous to South India and Sri Lanka where it grows wild or semi-wild in the tropical rain forests. *E. cardamomum var. major* is the wild cardamom of Sri

Lanka and Southern half of Western Ghats. It is the primitive variety from which the cultivated variety *Cardamomum* is derived.

We prioritise this species since it is the most primitive variety from which cultivated variety cardamomum is derived.

Piper

Pepper is one of the most ancient crops cultivated in India and has probably originated in the hills of South Western India, where it is met with in a wild state in the rain forests from North Canara to Kanyakumari. About 30 species are found in South India of which *P. barberi* the sole survivor of an ancestral type that reached India from Central American region (Nirmal Babu et al, 1992) and is very rare (Gamble 1925). A large number of species of this genus have been recorded as occurring in wild in various tropical and subtropical parts of India, and reportedly used as substitutes or adulterants of the cultivated species.

The following were considered for prioritisation:

1. *Piper longum*, 2. *P.nigrum*, 3. *P.peepuloides*, 4. *P.schimidtii*, 5. *P.barberi*, 6. *P.hamiltonii*

Following species are recommended for prioritisation.

Species	*Reason for prioritisation*
P.nigrum	Wild dioecious forms indigenous to damp forests of Malabar coast of South Western India
P.barberi	Reported to be almost extinct in Red Data Book (Nayar & Sastry 1988), reported lately by Nirmal Babu (1992) and Mathew and Mathew (1992).

Zingiber

Zingiber officinale, the cultivated zinger, is native to South eastern Asia. Two other species, *Z.zerumbet* and *Z.casumunar* are also cultivated to a very little extent, but often found wild. The rhizomes of these are used in medicine. The rest of the Zingiber species are wild.

Following were considered for prioritisation:

1. *Zinziber purpureum*, 2. *Z.capitatum*, 3. *Z.cassumunar*, 4. *Z.officinale* and 5. *Z.zerumbet*.

We also considered prioritisation of two species under the genus Alpinia since it is a related genera.

1. *Alpinia galanga* and 2. *A. speciosa*

Zingiber purpureum with distribution confined to Western Ghats and close relative of Zingiber and *Alpinia galanga* & *A.speciosa* restricted to North Eastern evergreen forests, are being recommended for prioritisation.

Ammomum

Ammomum subulatum (Greater Indian Cardamom) in consists of dried, nearly ripe fruits of Ammomum species growing wild or cultivated in Nepal, Bhutan and foothills of the Himalayas in the eastern part of India. Seeds of another species *A. aromaticum* (Bengal Cardamom) as well as *A.subultuna* are used as cheaper substitutes for true cardamom

Information was collected on following two species:

1. *Ammomum.aromaticum* and 2. *A.subulatum*

Amomum subulatum and *A.aromaticum*, both used as substitutes for true cardamom and having restricted distribution in Eastern Himalaya as undergrowth in evergreen forests are being recommended for prioritisation.

Carum

Caraway consists of fruits of *Carum carvi* and *C. bulbocastanum*. Both these species are herbs growing wild in the South-west foothills of the Himalayas. Caraway is also cultivated to a limited extent in Kashmir, Uttar Pradesh (Kumaon and Garhwal districts) and Himachal Pradesh (Chamba and Kinnaur districts)

The following were considered for prioritisation:

1. *Carum.bulbocastanum* and 2. *C.carvi*

Carcum bulbocastanum with much variability in North Western Himalaya (Kashmir to Kumaon, 2000 - 3500m) and habitat of alpine stony meadows, was prioritised.

Cinnamomum

It is a genus of about 270 species of shrubs and trees distributed in Asia and Australia. About 20 species occur in India (WOI).

C.verum (Cinnamon) and *C.tamala* (Tejpat) are two economically important species. Cinnamon is indigenous to Sri Lanka and South India. (Kocchar, 1981)

We considered prioritisation of the following four species:

1. *Cinnamomum impressinervium* 2. *C.zeylanicum* 3. *C.macrocarpum* and 4. *C.pauciflorum*

From among the Cinnamomum species, *C.impressivervium* confined to Sikkim Himalaya at elevation of 4000 - 6000ft and used as adulterant of Cinnamon, *C.pauciflorum* confined to Sikkim Himalayas and Assam and *C.zeylanicum* confined to Western Ghats are being recommended for prioritisation.

Myristica

Myristica fragrans, the source of Nutmeg and Mace, is considered to be a native of Moluccas introduced into India by about 18th century.

Following three species were considered:

1 *M.beddomei*, 2.*M.malabarica* and 3.*M.dactyloides*

Myristica beddomei confined to Southern hills of Nilgiris and Anamalai, *M.malabarica* found in humid tropical forests of Southern Peninsular region and *M.dactyloides* a species of medicinal value and assessed as Endangered by the Conservation Assessment Management Process (CAMP) workshop organized by Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore are also recommended for prioritisation.

Bewerages

Camellia

The exact geographical centre of origin of tea has not been settled. It is believed to have originated either in India or China or even both.

Camelia, a genus of 45 species of evergreen shrubs and trees distributed in the tropical and subtropical parts of Asia. Three species are reported as growing wild in India. These are *C.caudata*, *C.caduca* and *C.kissi*. Information could be collected only for *C.kissi*, which reveals that the species is confined to Eastern Himalaya, Assam and Kissi Hills (500-800 ft). No wild germplasm has been used in tea improvement.

Coffea

Genus Coffea comprises 50-60 species indigenous to tropical Africa and Asia. Besides the cultivated species (*C.arabica*),5 or 6 wild species viz. *C.bengalensis*, *C.fagrens*, *C.jenkinsii*, *C.khasiana* and *C.travancorenses* have been recorded from India particularly from tropical Himalayas and higher elevations districts of Southern India. As regards the use of wild relatives, In Colombia, wild forms of *C.arabica* and *C.liberica* are being used to confer resistance against the fungus *Hemileia vastatrix* which causes coffee rust.

No species under the genera Coffea has been prioritised.

Fibre Crops

Corchorus

Corchorus is represented by about 40 species distributed throughout the tropical regions of Africa, South America, Australia, China and South East Asia. In India 8 species are found. *C.capsularis* and *C.olitorius* are commercially cultivated for fibre, while *C.aestuans*, *C.depressus*, *C.fascicularis*, *C.trindes*, *C.trilocularis and C.urticaefolia* are wild.

According to Kundu (1959), the primary centre of origin of *C.olitorius* is Africa with a secondary centre in India or Indo-Burma. India is a primary centre of origin of *C.capsularis* and possesses a rich diversity.

No species under the genera Crotolaria has been prioritised.

Gossypium

The genera has 20 species out of which only 4 are considered to be of economic importance.

G. arboreum is most widespread of all the species of Old World Cottons, being distributed throughout the rain- fed savannah, areas from Africa, through Arabia and India, to China, Japan and East Indies . Truly wild perennial types are found scattered throughout the range of species while no truly wild annual forms have been met with. Its origin is obscure, but it is considered to be Asian since the area of its greatest variability is found around Bay of Bengal. In India, the races found are bengalense, burmanicum, cemum, indicum, all of which are cultivated types.

The centre of variability of *G.herbaceum* in India is Gujarat where the whole range of forms is found.

Gossypium is not a priority genera.

Crotolaria

The genus Crotolaria, a large group of annuals or perennial herbs and shrubs is distributed tropics and subtropical regions of the world showing major distribution in tropical Africa followed by centre of variability in the south east Asia and Central America. Of 450 species, 90 species occur in India. 30 are confined to peninsular region. Some of the important species for the aforesaid purposes are *C.juncea*, *C.striata*, *C.burhia*, *C.retusa*, *C.spectabilis and C.verrucosa*. *C.juncea* is the most widely cultivated fibre plant of India, Pakistan and Brazil. This species has never been reported in wild form nor its origin known. Species endemic to the peninsular region and confined to the Nilgiris and Palni hills are *C.maduraensis*, *C.sandoorensis and C. grahamiana*. Species having wider distribution from North Western Himalaya to the tropical region are *C.retusa*, *C. spectabilis*, *C.albida*, *C.mysorensis*, *C.medicaginea and C.striata*

Variability was found in *C.ferruginea* for drought resistance, *C.burhia* for low rainfall requirements, *C.triquetra* for salt tolerance. Some of the endemic types such as *C.sandoorensis*, *C.penducularis*, *C.lutescens* are now reported to be rare and endangered due to habitat disturbance.

The species prioritised are *C.madurensis*, *C.sandoorensis*, *C.grahamiana*, as they are endemic to Nilgiris and palni hills. *C.peduncularis and C.lutescens* is prioritised as the species is reported to be endangered.

Oil Seeds

Among oilseeds Sesamum sp and Brassica sps were considered. The following species of Sesamum were considered:

1. *Sesamum indium (=S.orientale)*, 2. *S.lacinatum*, 3. *S.mulayanum (=S.indium)*, 4. *S.prostatum*, 5. *S.malabaricum*, 6. *S.alatum*, 7. *S.capense* and 8. *S.radiatum*

The species recommended for prioritisation are:

S.lacinatum: distribution confined to Southern parts of Deccan Peninsular, extending to Cochin, also resistant to shoot Webber, Drought.

S.alatum: Only species found to be resistant to phyllody.

S.prostatum: distribution confined to coastal Andhra Pradesh to Tamil Nadu, on Sandy hills near the sea, found to be extremely resistant to pests and diseases, drought resistant. Information on *S.malabaricum*, *S.alatum*, *S.capense* and *S.radiatum* needs to be collected and complied by the project team.

Among Brassica species, *B.tournefortii* (wild Turnip), which grows sporadically in few pockets in Northern parts of Rajasthan, high oil content (40%), is recommended for prioritisation.

Sugars

Genus Saccharam was considered under sugars. Of the six recognized species of Saccharum, *S.officinarium, S.barberi and S.sinense* are cultivated and *S.robustum, S.edule and S.spontaneum* are wild. Wild relatives of Saccharam viz. *S.spontaneum* and *S.robustum* have conferred vigour and disease resistance to the cultivated *S.saccharum* and this has had a major impact on world sugarcane production. In India, the limiting factor to sugarcane production was the 'Red Rot' disease. The resistance was acquired from wild Indonesian *S.spontaneum*, which also provides resistance to two other diseases of Sugarcane, Smut (*Ustilago scitaminea*) and Sugarcane Mosaic Virus. *S.spontaneum* clones from India have been used widely as source of resistance to Gummosis and Root Rot diseases in Sugarcane.

Wild Relatives of Domesticated Animals

The following relatives of the domesticated animals were considered and are being recommended for prioritisation

Oxen

(i) Gaur *(Bibos gaurus ?) Bos gaurus*
The gaur is believed to be the wild progenitor of the semi-domestic mithun (gayal, drungox or dulong), *Bibos frontalis*, a ceremonial ox of the hill tribes of Assam, Bhutan, Bangladesh & Burma. Out of two subspecies of *B.gaurus* recognized, *B.g.gaurus* occurs in India & Nepal.

There are three main causes for the decline in numbers habitat destruction, indiscriminate hunting and diseases such as rinderpest, foot and mouth disease. In India rinderpest severely affected herds in Mudumalai & Bandipur sanctuaries in Aug. 1968 when 300 - 500 animals are said to have died. Gaur is listed as vulnerable by the World Watch List for Domestic Animal Diversity (WWLDAD).

(ii) **Mithun**: It is a semi - domesticated form derived from the Gaur. In India, there are some 50,000 head of Mithuns in the jungles of Arunachal Pradesh.

(iii) Wild Yak *(Poephagus mutus?) Bos grunniensis*

The species inhabits remote areas of Tibetan Plateau adjacent highlands in China and Northern Ladakh. It may still occur in more remote areas of Kashmir & possibly Bhutan. Within Indian limits Yak occur in Changechemmo valley in Ladakh, Sikkim and Arunachal Pradesh. Yak populations have suffered a marked reduction as a result of uncontrolled hunting.

The Wild Yak's Conservation Status is listed as Endangered by WWL for DAD

(iv) Wild Asiatic Buffalo *Bubalus arnee* (Wild Asiatic buffalo) is the ancestor of domestic water buffalo. Most of the truly Wild Asiatic Buffalo are to be found in or near the Brahmaputra valley in the provinces of Assam, Arunachal Pradesh & Meghalaya in India. Only other areas having their population are in Indravati valley Park & locally elsewhere in Indravati valley in west of the Madhya Pradesh - Orissa border. They occupy currently 1500 sq. km in Assam, 200 sq. km in Arunachal Pradesh. Total population estimates - 3300-3500. The major threat to its survival is the loss of its riverine habitat to human settlement & cultivation, and competition for forage by domestic stock. It is listed as 'Endangered' in schedule one of Indian Wildlife Protection Act (1972) which prohibits both its killing & capture, it is however frequently hunted & killed by tribal people. The species is also listed as Endangered by WWL for DAD.

Sheep and Goats

(i) Wild sheep (Ovis orientalis)

Distribution restricted to Gilgit, Astar and Ladakh, Northern Tibet, Punjab, Sind, Baluchistan and South Persia.

Asses

(i) Indian Wild Ass - *Equus hemionus khur*

Confined to Rann of Kutch in North Kathiawar Peninsula of India. Total numbers are said to be about 2,000. "Surra' due to infection with *Trypansoma evansi*,

Category		*Species*	*Reason for Prioritisation*
I. CATTLE	Gaur Mithun Yak Wild Asiatic Buffalo	*(Bos gaurus)* *(Bos frontalis)* *(Bos grunniens)* *(Bubalus arneae)*	Conservation Status: **Vulnerable** Conservation Status: **Endangered** and Species of Social Significance Species of Social Significance Conservation Status: **Endangered**
II. SHEEP	Shapu Agali Bharal or Blue Sheep	*(Ovis orientales)* *(Ovis ammon hodgsom)* *(Pseudois nayaur)*	Restricted distribution Restricted distribution Restricted distribution
III. GOAT	Himalayan Tahr Nilgiri Tahr Siberian Ibek Markhor Wild goat	*(Hemitragus jemlanicus)* *(Hemitragus hylocrius)* *(Capra ibek sibrica)* *(Capra falconeri)* *(Capra hircus)*	Restricted distribution Restricted distribution Restricted distribution Restricted distribution Restricted distribution
IV. ASS	Indian Wild Ass	(Eqqus hemionushkhur)	Confined to Rann to Kutch
V. PIG	derivatives of *Sus Scrofa*		

brought on to the Rann by domestic camels and other livestock is one of the threats to survival of wild asses apart from competition for grazing. The species is listed as Endangered by WWL DAD.

Wild Pig

Only one wild species has been considered: *Sus scrofa andamansis* restricted to Andaman & Nicobar Island. The wild pigs are now seriously threatened by increased contact with recent immigrant groups, high levels of deforestation, logging agricultural encroachment.

Red Jungle Fowl

Among the birds, the Red jungle fowl (Gallus sp.) was considered but since the species is not under immediate threat, it has not been shortlisted for prioritisation.

Conclusions

To sum up, this project has been designed to update the documentation, areas of distribution and assess the conservation status of wild relatives of crop plants and domesticated animals that are native to India, or have become naturalised here, with the objective to suggest primarily the appropriate areas for their *in situ* conservation and sustainable utilisation. Materials studied so far include wild relatives of the cereals, legumes, vegetables, spices, fruits, oilseeds, beverages and fibers. Distribution maps for several of this plants have already been prepared . It may be possible to link some of them to areas of ethnic diversity. Database created on the wild relatives of crop plants and domesticated animals is continuously being updated through latest literature.

This work is significant considering that these wild relatives contain valuable genes for resistance to virulent diseases and pests, adaptation to stress environments, male-sterility, higher photosynthetic rate(WRCPs), superior taste and flavour to name some of them. Since these genes are being sought out desperately by Agribased industry for development of superior plant varieties and animal breeds, this aspect is relevant to the proposed legislative measures for plant variety protection (and Farmers Rights) and Biodiversity conservation (and regulation).

Acknowledgements

We place on record our gratitude to BSP, USA for providing financial support to the project. Our sincere thanks to Shri Samar Singh, Secretary General, WWF-India and Shri Shekhar Singh, Chairman, BCPP for encouragement and their valuable suggestions.

Thanks are due to Shri A. R. K. Sastry for his valuable suggestions during the course of the study and also to Dr. P. L. Gautam, Director, National Bureau of Plant Genetic Resources (NBPGR), New Delhi, Dr. R.K. Arora, Co-ordinator for South Asia, International Plant Genetic Resources Institute, New Delhi, Dr. Velayudhan, Scientist-in-Charge and Dr. John K. Scientist, NBPGR Regional Station Thrissur.

We acknowledge generous help of Senior Scientists and Staff of Herbarium and Library at NBPGR, New Delhi for providing invaluable information which made the study possible. We also thank all who contributed to the project through their research publications although we do not name them individually here.

Thanks to Archana for meticulous compilation of information of WRCPs and WRDAs.

At our work station in WWF-India, we thank Mr. S.K. Katiyal for record of project accounts, our colleague Mr. Krishna Kumar for all the support and, Mr. Manoj & Mr. Rohit, Ms. Mallika and for secretarial help.

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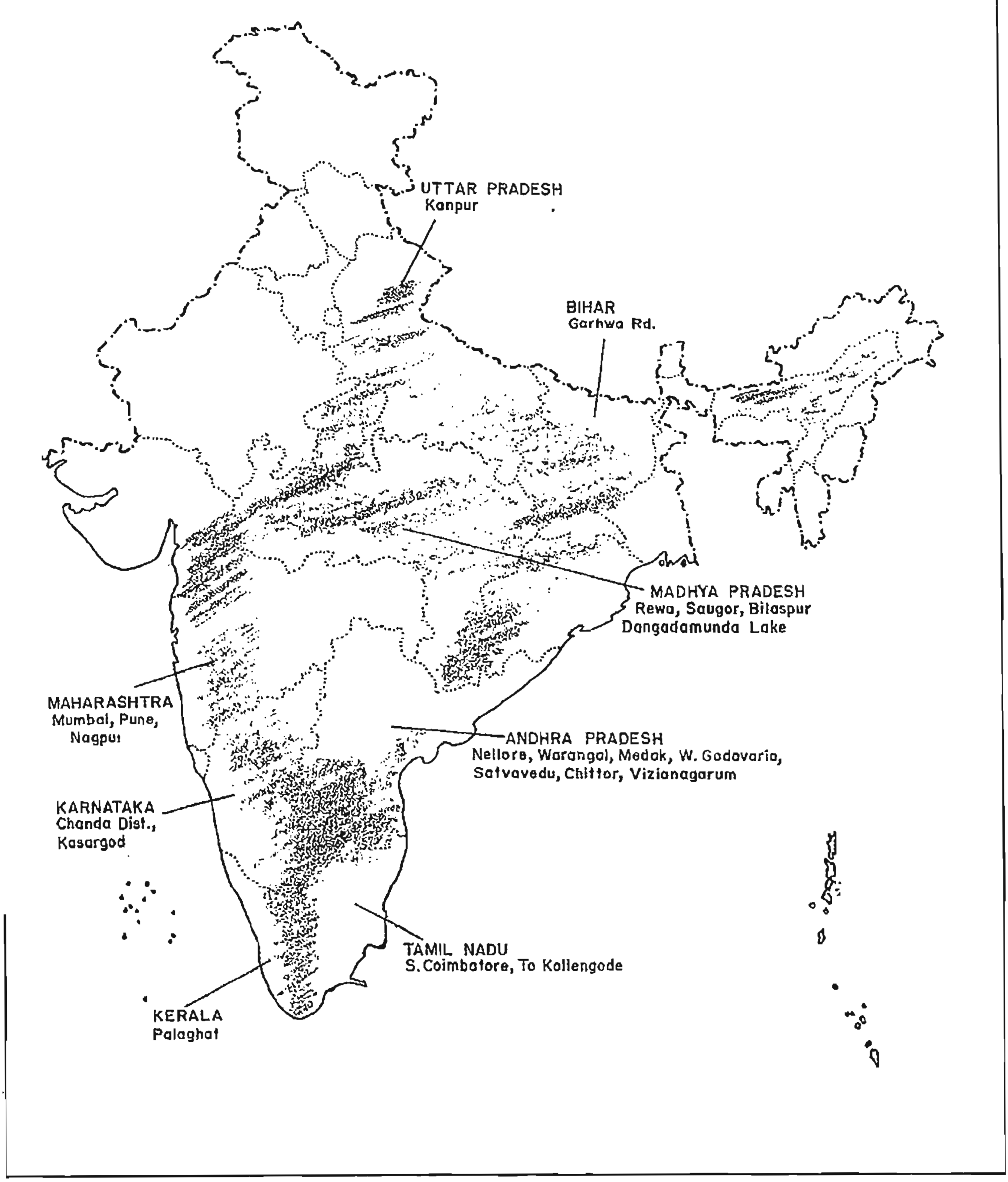
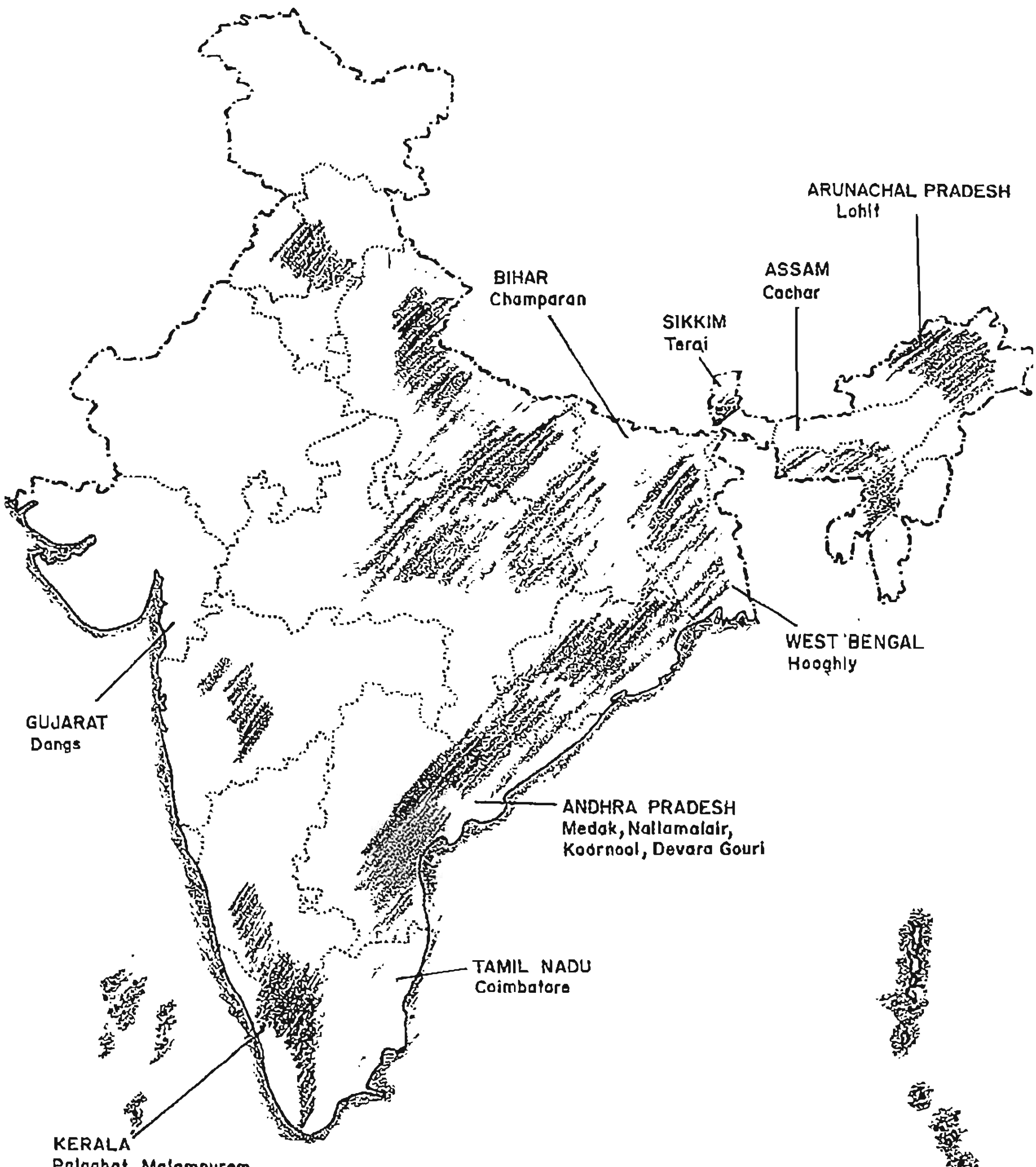
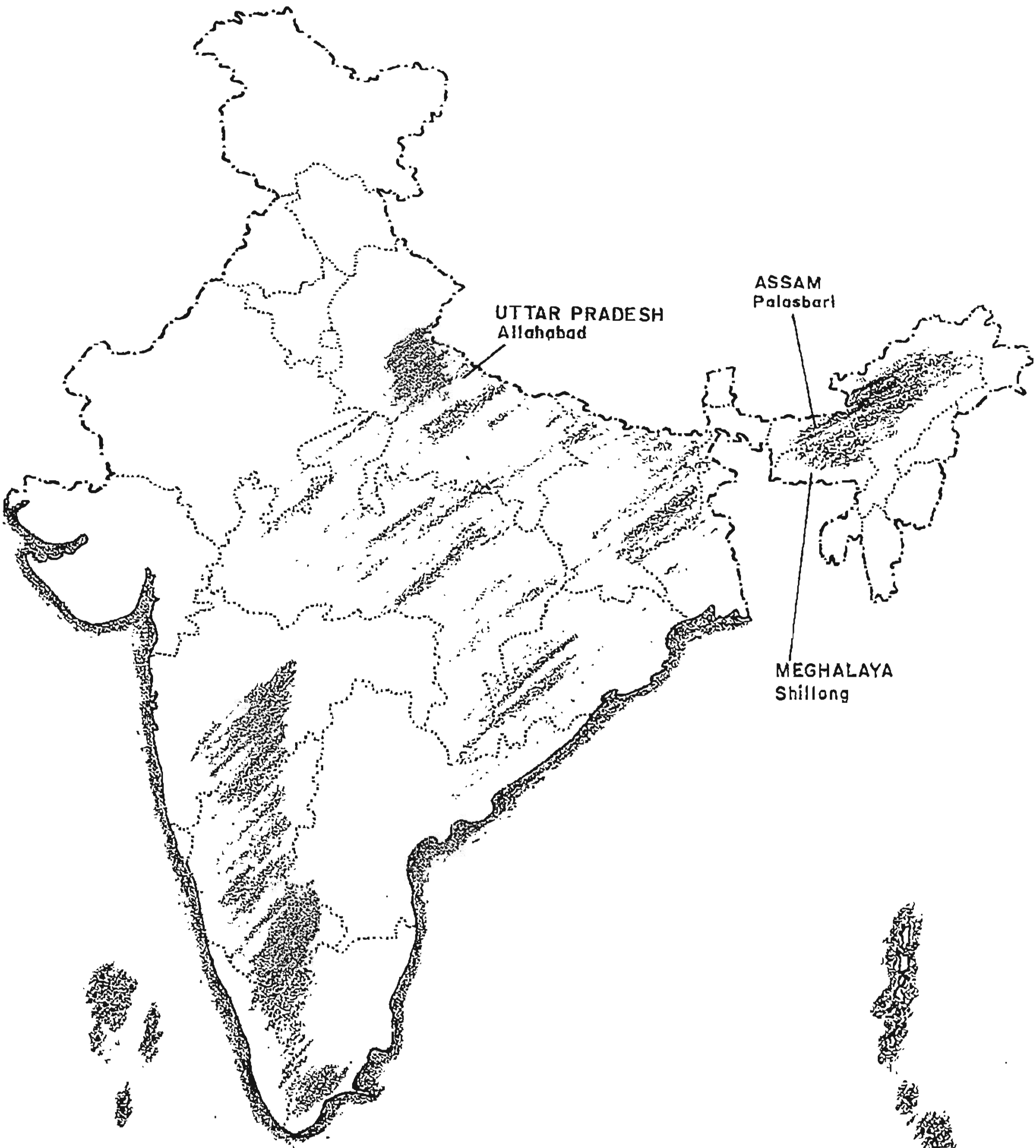
Distributional range and some collection points of *Oryza nivara*



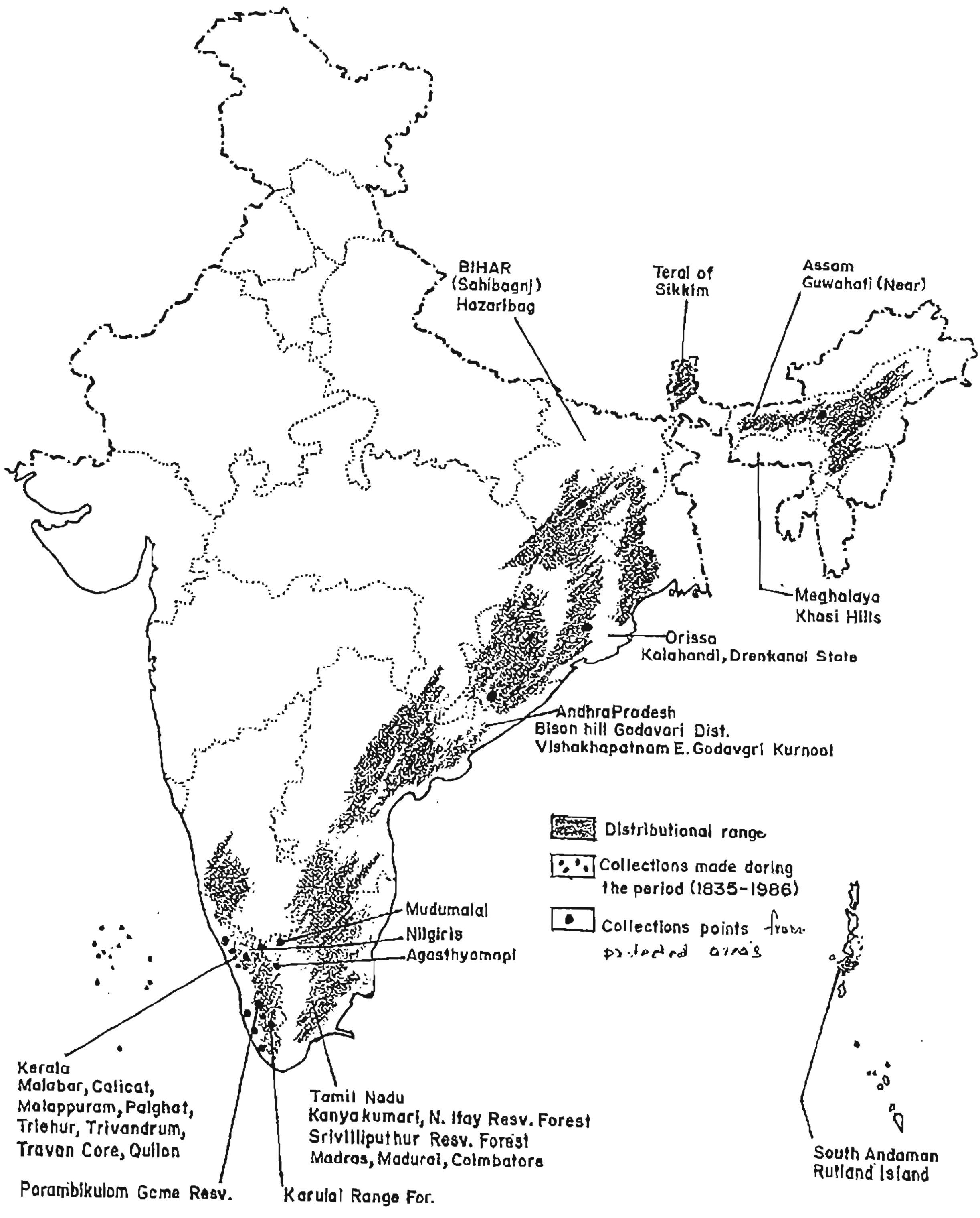
Distributional range and some collection points of *Oryza officinalis*



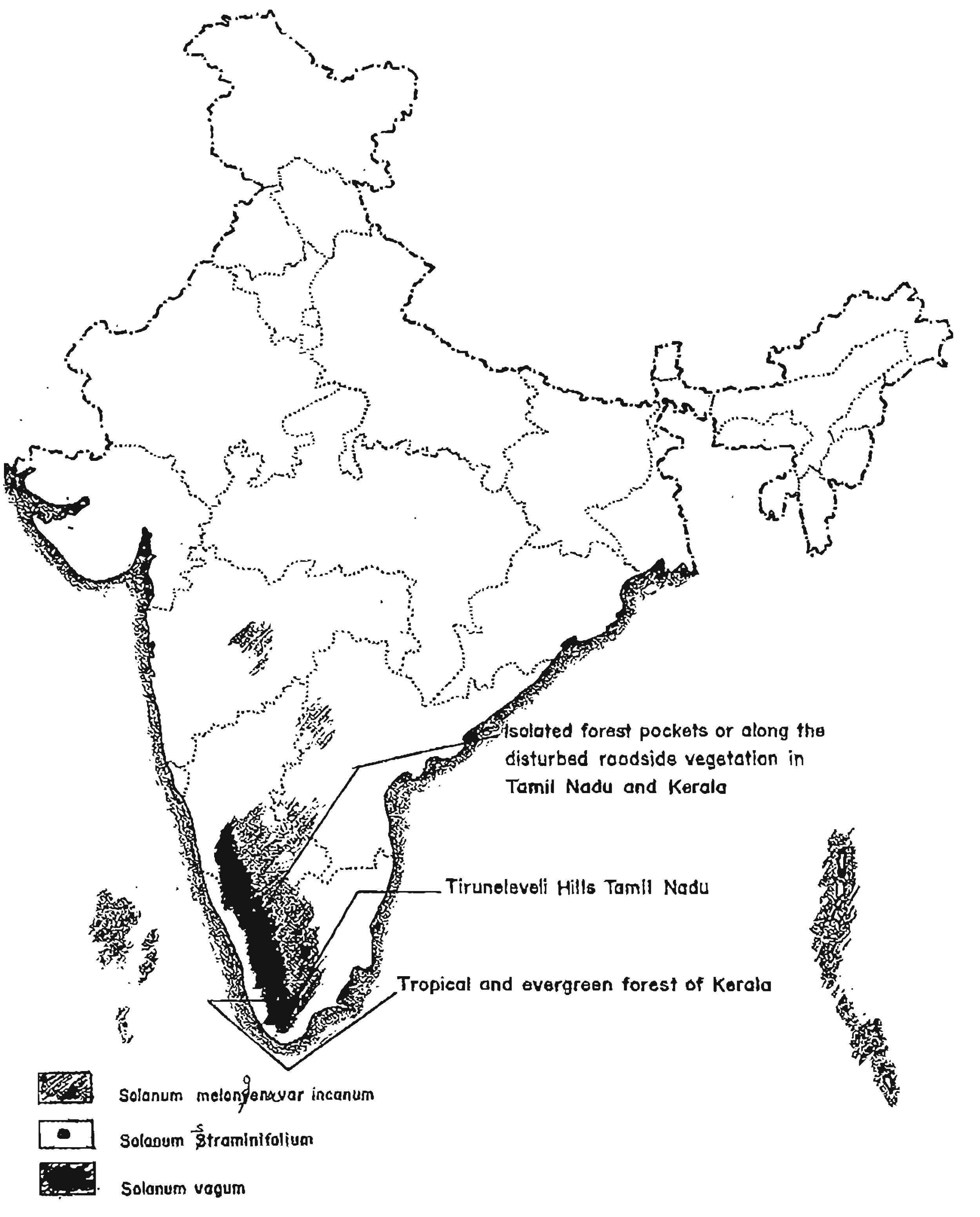
Distributional range and some collection points of *Oryza rufipogon*



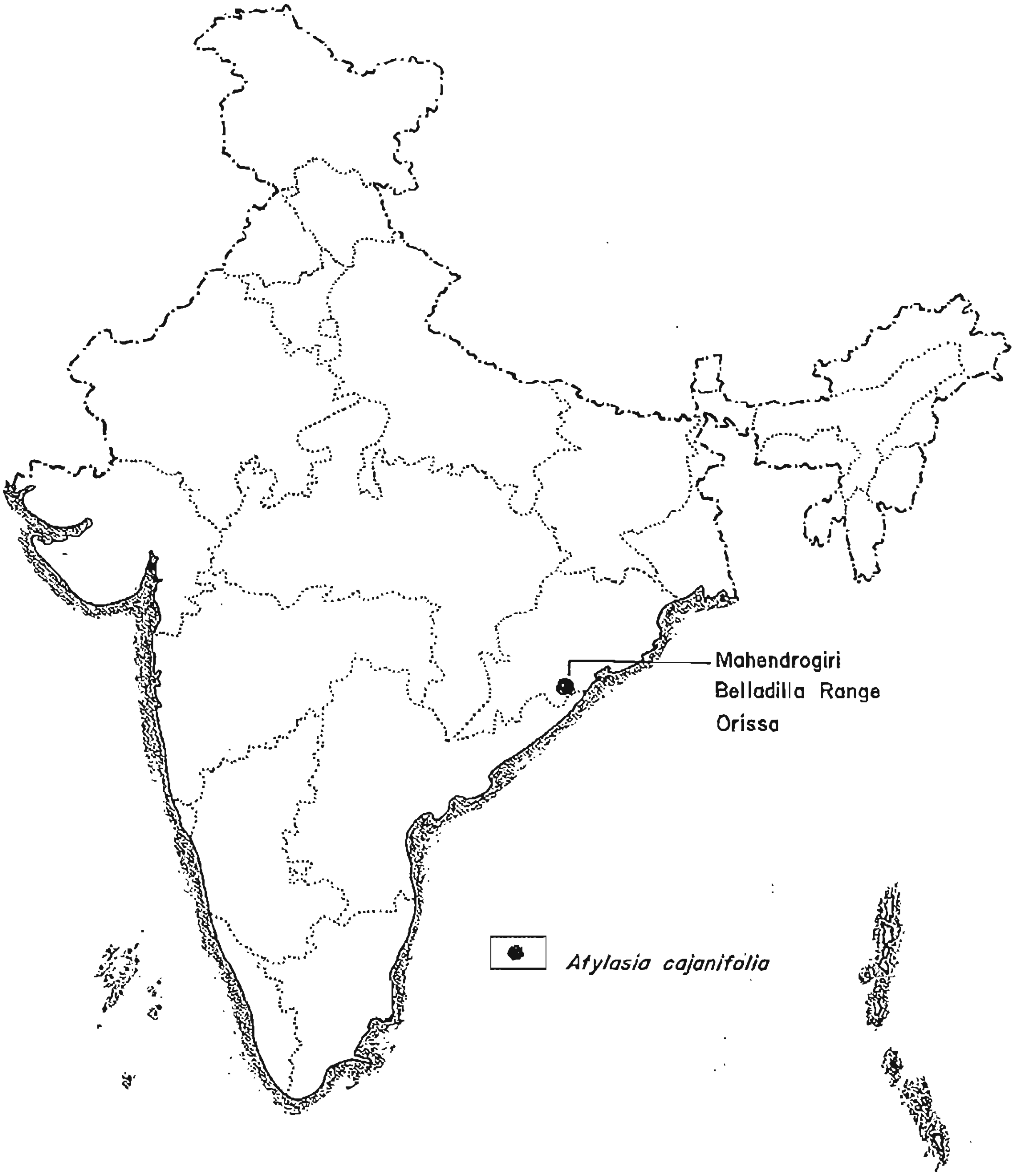
Distribution and some collection points of *Oryza granulata*



Distribution range and collection point of wild Relatives of *Solanum*



Collection point of
Atyosia cajanifolia



Prioritising Macro Strategies

Gender: The Missing Link in Environment Conservation

Aditi Kapoor

Women and the Environment

There is little doubt today that natural resources - soil, water, air, flora and fauna - are indispensable to the livelihood of rural women. Women do much of the work on the land, in the forests and with the livestock and contribute substantially to household incomes. Ironically, although women are often the most affected by the widespread depletion of these resources, they have little power to do anything about it. Their voices are muted in their own households and communities. Such help, advice, communication that come from the outside too is usually directed at men.

This gender blindness is not surprising considering that gender and environmental issues have traditionally been dealt with separately by academics, researchers, policy-makers and technologists. Environmental literature tracing the historic evolution of ecology has ignored women's ecological role. For instance, *The Organic Farming Source Book* (Alvares, ed 1996) details the traditions of producing and processing food in India but has nothing specific on the role of women in agriculture. While a lot has been written on bio-diversity in recent years, particularly after the United Nations Conference on Environment and Development held at Rio in 1992, women's role in bio-diversity management has continued to be neglected (MSSRF 1997). Interestingly, this has happened despite a growing concern with and much work done on people's participation in environmental regeneration and resource management. Literature on gender has also circumvented women's role in bio-diversity conservation. This includes the government's *National Perspective Plan for Women:* 1988-2000 (GOI 1988a) and *Shramshakti - Report of the National Commission for Self-employed Women and Women in the Informal Sector (GOI 1988b).*

Today, though all environmentalists recognise that women possess specialised knowledge about flora, fauna and ecological processes, and agree that women's participation is necessary to tackle the environmental crisis, this has not yet informed policies or field programmes on bio-diversity. Policy makers, primarily urban-based and male, are only now beginning to realise that incorporating a gender dimension in bio-diversity conservation would greatly enhance the efficacy of the programmes. Even the methodologies of 'rapid rural appraisal' and 'participatory rural appraisal' being used by international and national agencies in designing field projects have not yet adequately tuned into women's needs and aspirations. Understanding women's needs and aspirations requires time, patience, an ability to 'listen' and understand rather than just hear, and an appreciation of the categories and language women use to describe their worldview. Even in the rare cases where 'ask the women first' dictum is followed, 'participation' is limited to consultation, planning and management while political and economic questions of women's control are ignored (Krishna 1996: 118).

Making bio-diversity management gender responsive requires 'listening' to women, and not just 'hearing them out.' It means recognition of and building upon women's knowledge-base, their skills and ensuring that women have control over the processes of change. For instance, government and externally-initiated community-level afforestation and conservation programmes claim to form 'new' rules which bar villagers from cutting trees for fuelwood but permit gathering of fallen leaves, twigs and branches for their use. Traditionally, women have observed these very norms while gathering firewood. Even today, 75 per cent of firewood for rural domestic use in Northern India conforms to this unwritten rule (Agarwal 1995).

Understanding and Applying the Concept of 'Gender'

'Gender-focus' in development theory and praxis has come to mean 'women-focussed' or 'women-centred' rather than encompassing the complementary roles played by both the male and the female sexes in all social processes including managing the natural environment. There is thus a need to understand what 'gender' means and how it is to be construed with respect to bio-diversity conservation and management.

'Gender' is not Exclusive to Women

In any discussion on 'gender' *there is a need to keep women's interest central but not exclusive because men need to change just as much as women to accommodate women's interests.* Within households, in fact, women do not distinguish between the well-being of males and females (though in extreme forms of patriarchy women, ironically, favour the opposite sex) and do not advocate fulfilment of their needs at the cost of the menfolk. A gender perspective endeavours to bring about a structural change in processes and institutions that are dominated by patriarchal interests so as to correct this skewed control. The aim is to create viable spaces for women so as to equip them with opportunities and access to economically productive resources as well as to 'social resources such as knowledge, power and prestige' (Saxena 1993). In other words, men's interests need to be aligned with those of women.

On the ground, both men and women are active agents in securing the material needs of a household. For instance, available literature suggests that women prefer planting of broad-leaved species which will meet their subsistence needs for fuel and fodder to men's preference for growing more commercial species like eucalyptus or teak, the timber of which is used for house construction and for making agricultural implements. However, there is not necessarily a contradiction between the two kinds of needs since both are necessary for household security. A gender sensitive approach would find a solution that satisfies both needs rather than pits one against the other by focussing only on women's needs. *For instance, subsistence and consumption needs of women can be met from forests by encouraging regeneration of shrubs and low-market value but high bio-mass plants like agave and trees such as prosopis, ber, neem, and karanji, so that women's usufruct rights enable conservation of the afforested areas (Saxena 1993). Market demand for commercial plantations would then be met from private lands. Farmers could raise multiple purpose trees to meet subsistence as well as income-generating needs.* This would require a reversal of the government's forest and agricultural policies both of which favour men's primary interest for cash-income rather than assuring women's subsistence needs (Saxena 1993).

Studies have also found that targetting women exclusively for environment regeneration has often aroused suspicion and resentment among the men of the community and hindered implementation of the projects. This, for instance, was the experience of People's Education and Development Organisation (PEDO) in its work with women in wasteland development in Bicchiwara block of Dungarpur district, Rajasthan. The organisation found that though women could easily be inspired to become organised and develop the wasteland for fodder and fuel collection, they faced strong opposition in their own families and in society at large. Holding of joint meetings of men and women initially helped create a more non-threatening atmosphere and benefitted the project work (Sarin and Sharma 1993).

There are other interesting field examples of how *men need to be involved in 'gender-focused' projects for successful implementation.* Village women in the bhal region along the Gulf of Cambay in Ahmedabad district, Gujarat, for instance, have secured water supply and successfully afforested saline wastelands while achieving a better status in the eyes of their menfolk and community male leaders by very tactfully involving men in their work and giving the men equal importance in the village's achievements (Barot, 1992). In the well-documented case of women successfully greening the Bankura wasteland in West Bengal, men were consciously involved both in the management of the cooperative as well as field staff. These men established a good rapport with the women leaders. Another factor which contributed to success in this case was the emphasis on imparting training and professional management skills to the women as an integral part of project implementation. More attention could, however, have been paid to training the women in the scientific and technical aspects of afforestation and in the rearing of tasar cocoons (MSSRF 1997). Value-addition and skill upgradation for women in any environmental project are as necessary as physical inputs such as good quality seeds.

Empowering Women

At another level, the 'gender-focus' in environmental policies and programmes has generally been limited to improving women's living conditions, as in ensuring access to fuel and fodder, without addressing the power relations between men and women, both within households and in communities. In other words, most policy-makers and researchers are content with addressing women's practical needs but pay little attention to questions of their empowerment, or what are termed as women's 'strategic' needs. Addressing these strategic needs helps women achieve more self-confidence, better economic and political opportunities, a better status and role in decision-making vis-a-vis the men in the community. *While it is necessary to address women's 'practical' needs, these are only pre-conditions for women's empowerment.* This, for instance, would mean empowering women as potential leaders in conservation efforts by assuring them of long-term rights over land/ water/ forest and other productive resources; and by gender sensitising the wider rural and institutional leadership to make it more responsive to women's needs and aspirations.

In the case of bio-diversity conservation in forests, for instance, information on sexual division of labour should include description of differential access to and control over resources and benefits. Customary law recognises women's right to the income from forest products collected by them and any curtailment of their daily access to essential non-timber forest products (NTFPs) could wipe out avenues of their income. Again, without land tenure or ownership rights, women are less likely to invest in long-term conservation practices. This is especially because women without such rights are excluded from the decision-making sphere where (male) land owners, and those with ownership rights on forest produce, take decisions which affect women's work on these lands (see, for instance, the Panchmahals example below). Also, access to other productive resources is often linked to ownership of, or rights to, land. For instance, access to credit often requires land as collateral. On forest lands too, if women have no assurance that they would have long-term rights to harvest what they plant today, they may not be willing to put in much effort in conservation. At another level, ownership and control of property contributes immensely to women's economic well-being, social status and empowerment (Agarwal 1994), thereby increasing their efficiency in implementing conservation programmes.

In the Panchmahals district of Gujarat, for instance, women own little land or property and so decision-making concerning land is almost an exclusive preserve of men. Women have found it difficult to break this barrier. It has been impossible for women to undertake environmental regeneration and bio-diversity conservation on private lands. They have directed their energies to common lands though there is an acute scarcity of common lands. Yet, despite a "no objection certificate" and panchayat resolutions supporting their right to work on the land and use its usufruct, the legal validity of this arrangement is uncertain. The biggest problem the women groups face is how to legally secure their rights to the produce of the land they are developing with so much effort (Sarin and Khanna, 1993). This would require legal literacy, effective political voice on decision-making bodies at various levels and productive campaigns. All these are possible when *women's strategic needs are integrated into 'women-focused' environmental projects from the very beginning. Any discussion or planning on gender and bio-diversity conservation is incomplete without recognising the power balance between men and women. Yet the majority of interventions, at both policy- and field-level, ignore this reality.*

Gender: Not a Homogenous Category

A third way in which 'gender' is often conceptualised is to exclude all other factors, such as caste, class, age, religion and ethnicity which divide society and which influence development processes. In reality, however, *'gender' is not a homogeneous category and policy interventions need to take into account economic and socio-cultural realities of different communities.* This way of looking at 'gender' is largely due to the initial advocacy done by eco-feminists who hold that 'nature is the embodiment of the feminine principle' and identify women with nature, and men's exploitation of nature with men's exploitation of women (Shiva 1988). Women are seen to be 'just like nature', caring, nurturing, sharing and life-giving. This ideology, however, ignores the fact that socially ascribed gender relations are neither universal nor static but vary across, and within, cultures, time and space.

Gender roles are influenced by economic, political and environmental factors. 'The link between women and the environment lies in the interactive effects of ideology and material conditions, rather than being rooted mainly in ideology or women's biology' (Agarwal 1995). For instance, upper class, urban-based women, can be as exploitative of natural resources as the men. It is also well known that women's economic roles are determined by caste, class and religion. The worst victims of the environmental crisis and those who are bereft of control over resources are mainly women dalits, tribal women and lower caste women. Looking across cultures, though hunting is accepted as a male preserve, Sumi Krishna's study in Mizoram has revealed that in the Mesolithic period women participated in hunts and even today both men and women have knowledge about animal ecology. Similarly, ploughing is generally men's work but women in the Kolli Hills in Rajaji Namakkal district, Tamil Nadu, also use the plough (MSSRF 1997). In communities where gathering is the major contributor to the households, men's share in gathering is substantial (Krishna 1996: 114)

Women: Oriented to Subsistence

Another aspect of a gender perspective on environment deals with the subsistence oriented use of natural resources as against their commercial exploitation. In the patriarchal, industrial mode of development, a primary objective of conserving bio-diversity is to exploit these resource commercially rather than to fulfill the sustenance needs of households. Experience has proven that most rural women tend to have a greater interest in preserving and conserving cropland, forests and other natural resources for perpetual use while men are more often concerned with converting these resources into cash (MSSRF 1997). In the mid-1980s, for instance, tribals from a number of villages mobilised themselves to protect their devastated forests in the Santrampur taluka of Panchmahal district, Gujarat. The men, however, had identified regeneration of teak, used for timber in house construction and for making agricultural implements, as the primary objective rather than regeneration of firewood and green fodder (Sarin 1995). *Policy interventions designed from women's perspective are likely to lead to more sustainable bio-diversity conservation than interventions framed by men* *which are directed more towards conserving commercial species.*

Women's Ecological and Economic Roles: Myths and Realities

The main reason for the divorce between gender and environment can perhaps be traced to the dominant patriarchal interests which govern the household, the community and the State and which have failed to provide viable spaces for women. So, though rural women have been primarily responsible for gathering, processing and producing food for the household, they are considered to be 'just' housewives, confined to household chores. Consequently, they are considered economically unproductive and thereby ignored. Further, all house-holds are believed to be male-headed and it is taken for granted that men take care of women's material and economic interests. It is also generally accepted that women are not able to think, plan or act on their own; are not able to identify their problem areas and propose solutions; are shy of participating in public affairs; and so do not want to take on decision-making roles.

In reality, about 84 per cent of all economically active women in India are engaged in agriculture and allied activities like livestock, forestry and fisheries, compared to 63 per cent of all economically active men (GOI. 1995). Of the women workers, majority are cultivators or work on the fields as agricultural labour. The rest are engaged in livestock, forestry and fisheries. In economic terms, agriculture contributes over 30 per cent of the GNP and accounts for 60 per cent of employment. *Women's substantial contribution to agriculture, as well as to food processing and marketing, should entitle them to benefits from major state-sponsored programmes by providing access to productive resources such as land and credit. Women's participation in agricultural extension, training and research also needs to be expanded.* Women extension workers constitute a mere 0.59 per cent of farm extension workers (GOI 1995). Interaction between women farmers and male extension agents is severely restricted due to social norms. As a result, exchange and up-gradation of skills and access to appropriate inputs gets neglected.

Among forest communities, women and girl children are the main gatherers of forest produce for subsistence and sale. They are also wage-employees of the State Forest Departments (and the Forest Department's private contractors) since the nationalisation of the NTFPs. According to the World Bank 1991 report, *Gender and Poverty in India*, women constituted the majority of workers engaged in the NTFPs economy (Sarin 1994). *There is an urgent need for initiating official surveys on the number of women thus employed by the Forest Departments for gathering NTFPs, the wages they earn compared to the price the products fetch in the market, the time the women spend in gathering this produce and the substantial revenues earned by these departments.* Two of the main cash earners among NTFPs, sal seeds and tendu leaves, are collected primarily by women (Sarin 1994).

Catering to women's needs and including them in the plans and programmes for environmental management and regeneration is necessary also because almost 30-35 per cent of rural households are estimated to be headed by women. These households are dependent almost exclusively on their income, in cash and in kind. Even where there is a male earner, women's earnings contribute in a major way to the household's survival (GOI 1995). Women's contribution to cash income of the household is higher in villages close to forests than in commercialised villages (Chambers et al 1989). The collection of NTFPs such as essential oils, sal seeds, tendu leaves, gums and resins, tans and dyes, lac, tasar and tamarind is a good source of cash income for women because of the increasing commercial value of NTFPs.

The well-known Chipko movement of 1973, when the Garhwal hill women hugged trees to prevent them from being axed revealed the strength of women in the public sphere. Subsequent studies on protection of common lands have proved that women and communities are more effective at protecting and regenerating degraded lands and forests than either the state or private landowners (MSSRF 1997). The more successful community-level Joint Forest Management initiatives in West Bengal and elsewhere have demonstrated how women can gain both materially as well as in status if they play an effective role in local-level forest protection committees.

Women in Bio-diversity Projects

Government bio-diversity conservation projects have not only been consistently gender-blind but also promoted policies which have been detrimental to women's interests and are resulting in erosion of their knowledge about bio-diversity. Benefits from the government's social forestry programmes, for instance, were cornered by the better-off farmers rather than by smaller farmers and the land-less (Chen 1993). Almost 50 per cent of rural female workers are classified as land-less labourers and this proportion is rising. Social forestry also promoted timber species rather than those which gave women fuelwood and fodder (Chen 1993, Saxena 1993). *Gender-sensitive policies which favour planting of usufruct-based trees such as neem, mahua, tendu, sal, arjun and tamarind, which benefit women, rather than species such as teak, eucalytus and pines, are called for. Such social forestry projects should then be extended to reserved and protected forest lands (Saxena 1993).*

Nationalisation of NTFPs appropriated women's customary rights over forest produce and exposed women gatherers to increased harassment at the hands of forest officials and private contractors. This reduced their collection and income (Saxena 1993). *Gender-sensitive policies require restoration of customary rights and a more open system of marketing NTFPs where women are able to control factors such as value-addition and pricing.* Modern technology is often cited to be gender-biased because it caters to men's needs. For instance, in the case of *sal* trees, a common source of income for poor women gatherers, the modern technology of multiple shoot cutting pushes the leaves out of reach of women (MSSRF 1997).

Joint Forest Management programmes, operating in about 17 states, have been criticised primarily for two reasons: for not providing for women's representation on the joint committees, and for promoting planting of timber producing rather than usufruct species and thereby barring women's access to the protected forests. This has increased the time spent by them in accessing fodder, fuel-wood or its alternatives, and other NTFPs (Sarin 1995). Women face shortage of fuelwood, fodder and earnings from other NTFPs where forests are degraded. *JFM policies need to encourage active participation of women in the committees, and to provide for alternative forms of fuel and income-generation activities.*

Women's Bio-diversity Knowledge Under Threat

Natural resource depletion and dwindling bio-diversity is eroding women's elaborate knowledge about seed varieties, forest herbs and other plant species; and their time-tested technologies for the processing and preservation of these products. Modern technologies like irrigation and high-yielding seed varieties have reduced area under traditional crops and methods of seed selection and preservation (MSSRF 1997). Displacement of agricultural and forest communities in the wake of mega dams; setting up of industries and other 'development' projects have taken women away from their natural resource and knowledge base. Agricultural policies encouraging cash crops with no incentives available for cultivating traditional varieties, and promoting consumption of just a few cereals, mainly rice and wheat, through the Public Distribution System, have led to erosion of women's knowledge of diverse plant species.

The Global Environment Facility-funded Eco-development plans for bio-diversity conservation in selected National Parks and Sanctuaries too are not gender sensitive. Though women are to be involved in the implementation of the programmes, there is no proposal to revive and protect women's customary rights over land/ water/ forests nor do the plans recognise local traditional knowledge (Kothari 1997). Much of the knowledge of bio-diversity and of indigenous bio-technologies, including indigenous herbal systems of medicine, rests with women. Any involvement of *mahila mandals* in the eco-development strategies will be cosmetic unless *programmes are re-defined from a women's perspective and their knowledge is preserved and enhanced. Women, with a little training, can function as taxonomists or be responsible for preparing and maintaining community bio-diversity registers.*

Even environment regeneration projects such as afforestation, wastelands development, water harvesting systems, and Joint Forest Management have either ignored the gender dimension or focused on women in an extremely limited fashion. Even in the more successful women-focused initiatives, women's role as experts on bio-diversity has not been explicitly recognised and, therefore, not built upon (Datar, 1998; Proffenberger and McGean, eds, 1996; Singh and Ballabh, eds, 1996; Singh and Burra, eds, 1993). *Policy interventions need to integrate bio-diversity conservation in all environmental programmes which due focus on the recognition, documentation and up-gradation of women's knowledge about bio-diversity.*

Of special concern are fisher-women whose livelihood and knowledge is threatened by rapidly flourishing mechanised fishing and aqua-culture. Though India's 7500 km long coastline and the many rivers support numerous fishing communities, conservation of marine bio-diversity continues to be low on national priority. The strong movement among the local fisher-folk to safeguard their own livelihoods has made policy makers sit up. However, ecological concerns, local knowledge about fish diversity and other marine flora and fauna have not yet become part of these campaigns. With diminishing fish stock and expanding industrialisation of marine activity, women are increasingly being employed as wage-labour. However, though the work performed by the women is the critical task that enhances the value of the product, the women do not even receive minimum wages and are at the bottom of the ladder in terms of status (Joseph and Prasad, eds 1995).

In the inland fishery sector, contracts to fisher-men's societies and fisher-men's development agencies are displacing women from their traditional rights over the small catch and in the processing operations. Fishing contracts in ponds and tanks in small towns and villages are also affecting the common resource base of the fisher-women (Kurien 1996). Women, involved in all processes after the fish catch comes in, are not only knowledgeable about the various species but are also skilled in value-addition including processing, drying, curing and even net making. The market, however, is primarily male dominated. *Policy interventions are needed to safeguard women's customary rights over the small catch and to* *strengthen the forward linkages so that women can organise themselves and effectively market their produce. At another level there is a need to integrate their knowledge with the remote sensing global imagery of marine bio-mass. With their remarkable knowledge, women can benefit the marine industry as experts on marine diversity (Kurien 1996).*

Lessons from NGO Experiences

While government-initiated bio-diversity projects have been gender blind, a few NGO-initiated programmes have some lessons on how conservation strategies can be made more gender sensitive and how women can play a more effective role in bio-diversity conservation.

Social Action with Rural and Tribal Inhabitants of India (SARTHI) has *integrated community women's knowledge about medicinal herbs, plants and nutritionally important trees into the wastelands development programme involving women's groups* in the Santrampur block of Panchmahals district, Gujarat. Significantly, however, the recording of women's local knowledge of medically useful flora was not part of the original project design. The need for such a step came to the fore at a training programme conducted by SARTHI for *dais* (midwives, both traditional and modern) in response to the women's demand for access to improved health services (Sarin and Khanna 1993). The inherent link between health, nutrition and environmental degradation is obvious from a gender perspective of bio-diversity management. Recognition of these links not only ensures bio-diversity management, but also enables fulfillment of women's practical and strategic needs as was proved in the SARTHI's programme. While the forests of Santrampur block became rich in medicinal herbs and plants, the local women and children's health and nutritional problems were met and, most importantly, trained cadres of village women skilled in health care and para-veterinary emerged.

Women of the Aravali's in Rajasthan have similarly integrated revival of traditional water harvesting system with bio-diversity conservation leading to their empowerment. Catalysed by a local NGO, Tarun Bharat Sangh, village women from Gopalpura, Gujjaron Ki Losal, Bhanvata-Kolyala and Hamirpur in Alwar district, have come out from their isolated, veiled existences into the open - joining hands with their menfolk in building *johads*, the old water harvesting check-dams. These have led to regeneration of the forest cover in the villages. They have organised themselves into informal women *Gram Sabhas*, undertaken employment generation activities such as weaving of baskets from the indigenous varieties of 'Champuria' grass replenished in abundance in the village forests and *revitalised the Ayurvedic health system by regenerating many indigenous species of roots and herbs. Women are serving as Ayurvedic doctors in their own villages (GPF & FAO 1998).*

Women Conservers - Forging Forward and Backward Linkages

Women perform much of the harvesting, seed selection, sowing, storage and other processes which conserve and enhance crop diversity (Kothari 1997). This is reflected in Navdanya, a national *in-situ* genetic resources conservation initiative which networks community-based genetic resources conservation centres at the grassroots. The programme was started by a New Delhi-based NGO, the Research Foundation for Science, Technology and Natural Resource Policy. The farmers associated with Navdanya are mainly marginal farmers and peasants in so-called 'backward' but resource-rich areas of the Garhwal Himalayas and the Western Ghats, and some drought-prone areas in Karnataka. Here the green revolution has either not made a dent or has not delivered its promises because of its capital-intensive nature. In many cases, these marginal farmers are women for whom the use of traditional seed means the difference between survival and non-survival (Shiva, et al 1995). Women in the more ecologically devastated areas, particularly in the Himalayas, have been primarily responsible for agriculture because of the extensive out-migration of adult males to the plains and larger cities in search of livelihood. This process has been termed 'feminisation' of agriculture. Conserving agricultural diversity for these women not only secures food for their families but also enlarges their options for meeting their non-food bio-mass-based needs such as fodder, fuel, thatch for the house and raw material for marketable crafts.

'Navdanya places the farmer at the centre of conservation, [and] relocates in her/him control over the political, ecological and economic aspects of agriculture' (Shiva, et al 1995). While the dominant system of agriculture does not recognise farmers' contribution to breeding and therefore awards breeders' rights only to the seed industry or to researchers, in the partnership model promoted by Navdanya, farmers and scientists are equal partners. Further, seed conservers need markets which they can control. Navdanya strengthens farmer-to-farmer, farmer-to-scientist and farmer-to-consumer linkages. This is a model which policy makers can adopt. However, while Navdanya inherently gives due importance to women farmers, national policies and programmes modelled on the Navdanya experience will need to include special measures to be gender focused. *Community-level programmes should be designed in collaboration with women seed producers, conservers and processors and women's groups should play a central role in the implementation of programmes.*

Further, policies will need to ensure gender sensitisation of the various stake holders, including male and female extension workers. Extension workers, men and women, cannot successfully cater to women workers unless they are trained in motivational and conflict resolution skills needed to galvanise workers into action and break social barriers in a patriarchal society. *Gender-sensitisation of the scientific community would include building upon traditional practices rather than transplanting laboratory experiments to the field. Gender sensitising the district and state bureaucracy would mean creating an environment where women can seek information fearlessly and negotiate as equals. To make markets more women-responsive, policies need to encourage setting up of appropriate inter-linkages such as cooperatives, self-help credit groups, grain banks, local-level societies in order to bypass middlemen and/or help in processing, marketing and branding of farm-based products.*

Also, like Navdanya, policies and externally-initiated programmes should act as catalysts to facilitate women conservers and natural resource managers to build up their capacities so that ultimately they manage to control the political, ecological and economic aspects of conservation. "*In situ* conservation is first and foremost a political commitment and cannot be sustained through subsidies and external support alone" (Shiva, et al 1995). The national government's endeavour to devolve political and economic powers to the local Panchayats is also a step in this direction. Just as the Panchayati Raj's success or failure depends on the decentralisation power of the policies which govern it, *women's strengths in conservation can be augmented, and benefitted from, if the bio-diversity and agricultural policies involve as well as empower them. This requires a political recognition of women in their own right.*

Women and Medicinal Plants

Another successful gender-sensitive bio-diversity conservation effort that has lessons for public policy is being coordinated by the Bangalore-based NGO, Foundation for Revitalization of Local Health Tradition (FRLHT). The project aims at conserving and sustainably using medicinal plants for Primary Health Centres (PHCs). The project has set up a network of over 55 medicinal plant conservation sites in Kerala, Karnataka and Tamil Nadu in collaboration with State Forest Departments, local NGOs and research institutes. The Foundation recognises that women are perhaps the biggest single group to possess knowledge about home remedies from medicinal plants. This knowledge is mainly inherited by daughters and is thus preserved over generations. Women's groups are one of the village-level organisations targetted by the Foundation for conservation and use of medicinal plants. Women are trained in growing medicinal plants extracts of which are used in PHCs. These plants are grown in kitchen gardens by the women since women have direct access to, and control over, this patch of land. Kitchen gardens have multiplied through self-help training groups and 377 women's groups had set up 5162 kitchen herbal gardens till March 1998. Some women's groups are also growing medicinal plants on marginal lands and field bunds.

The Foundation has also set up Medicinal Plant Conservation Parks where women grow herbal plants. These Parks also act as a market intermediary by selling medicinal plants seedlings to women and purchasing medicinal plants grown in kitchen gardens. These plants are then sold by the Parks to various user groups. Self-help training groups also use the medicinal plants nurseries attached to these Parks.

While the Foundation has emphasised women's involvement in conserving medicinal plants, policies based on this model need to go beyond by enabling women to emerge as leaders in this area. Capacity enhancement based on local skills and knowledge should form a necessary part of environmental and agricultural policies relating to medicinal flora and bio-diversity. This would mean *policies and programmes empowering women to become doctors, teachers, trainers, researchers and policy makers in the area of medicinal plants both in traditional medicine and in modern medicine. Further, women should not be limited to kitchen gardens but given access to, and rights over, revenue or forest land for growing herbs and empowered to establish forward linkages with markets.* For instance, Gram Panchayats in Himachal Pradesh had the powers to levy collection fees for harvesting medicinal plants till as late as 1971 when it was constituted as a full state (Gadgil 1998).

According to the Foundation, the utilisation of medicinal plants is already very sophisticated in India. In its original form and with some technical enhancements, the tribal, ayurvedic and other indigenous health systems could provide the world with medicine rather than raw plant material (Kothari 1997) which is currently being exported, both legally and illegally. Modern medicine too is heavily dependent on medicinal plants available in India as is indicated by the keen interest shown by several leading pharmaceutical multinationals, such as Cargil Inc., Unilever, Hoechst, Sandoz and Ciba-Geigy, in Indian germplasm. Transnational companies are setting up ventures, often in collaboration with Indian partners, for prospecting and for drug or seed production. Rural Advancement Foundation International (RAFI) has estimated that pharmaceutical corporations cut their costs of screening a new plant for genetic properties by 50 to 90 per cent if they have access to traditional knowledge about the plant (Kothari 1997). Home gardens are often used by women to grow diverse wild and indigenous species. Policy makers can indeed capitalise on rural women's specialised knowledge in this sector with appropriate interventions that empower these women to challenge global powers.

Valuing Women's Knowledge

Even as a beginning has been made to record the rich bio-diversity of the country, due consideration should be given to women's knowledge in the various Community Bio-diversity Registers under preparation. *Recording of names of the women seed conservers and seed producers, women's knowledge about the various forest species of flora and fauna, their utilization and the value-addition technologies used are all necessary to make women more visible in bio-diversity policies and programmes.* Giving due importance to women as bio-diversity experts is not going to be easy in a patriarchal society. *Policy interventions need to encourage collection of gender desegregated data, and develop systems of rewards and social recognition for bio-diversity conservation efforts where women have been active participants.* These interventions would not only preserve and rejuvenate ecological diversity but also contribute to the enhancement of the economic and social status of rural women.

The ongoing People's Bio-diversity Registers (PBRs) Project (Gadgil 1998) is a step in the right direction but unless women's knowledge is scrupulously included, these data collections may become another tool in the hands of those who want to appropriate women's traditional knowledge and deny them benefits resulting from these. *The PBRs should be prepared in a participatory manner and should be open documents easily accessible by the public (Gadgil 1998).* For instance, they could be put up in public places. If such transparency is maintained, women would benefit from it. A PBR both documents the status of local bio-diversity resources as well as records local knowledge of these resources. Where women are primarily responsible for collecting bio-mass, they often have greater knowledge of the status of such resources. Women in many parts of Himachal Pradesh have extensive knowledge about this and women groups have been at the forefront of many local conservation initiatives; in the Chuhar valley of Mandi they are protecting forests not only from timber smugglers but even from their own men (Gadgil 1998).

In the wake of the Intellectual Property Rights emanating from the World Trade Organisation/General Agreement in Tariffs and Trade, bio-diversity registers would facilitate sharing of benefits with the actual producers and innovators of biological diversity. These would be used as evidence of people's knowledge of the various uses of bio-diversity resources including as therapeutics, cosmetics, and as pesticides (Gadgil 1998). *For this, a national community register would have to be built based on the community registers* so that the government can deal with the property regimes now threatening traditional owners of bio-diversity knowledge. The privatisation of bio-diversity can also be countered if *state policies facilitate networking among communities with regard to these registers.* Such efforts would also have to be coordinated amongst people's organisations across the developing countries to become a countervailing force to the IPR regime (Shiva et al 1995).

There is an urgent need to *develop effective benefit sharing mechanisms which give due consideration to women bio-diversity experts in the community. Policy interventions need to design programmes which would empower women to express, own, and control bio-diversity knowledge.* This is easier said than done because access to the patent regime requires awareness, information, legal knowledge and ability to bear the cost of access. Rural women experts are illiterate and bereft of these 'modern' resources. Policy interventions should aim at *encouraging involvement of catalyst agencies such as NGOs and promoting education and empowerment of women* not only to benefit from the IPR regime but to make women's role in bio-diversity conservation more effective.

Further, no models exist yet for equitably sharing the benefits of traditional knowledge between communities and the institutions or agencies which profit from the traditional knowledge of these communities. It is also not clear *who* the benefits should go to - individuals, families, community-leaders, representative NGOs or government agencies? (Kothari 1997). Further, it might not be always possible to determine what traditional knowledge is 'private' from that held in common by the community. However, *policies regarding target beneficiaries have to explicitly consider the stake of women in this debate.*

The unique model developed by the Thiruvanthapuram-based Tropical Botanic Garden and Research Institute (TBGRI), for instance, is still not clear on how the benefit will actually flow to the tribals whose knowledge of a forest herb, *Trichopus zeylanicus*, has resulted in the development of a drug called *jeevni*. TBGRI developed the drug based on the properties of the herb used by the Kani tribe as anti-fatigue and restorative medicine and transferred the technology to a private ayurvedic company in Coimbatore. TBGRI is to transfer 50% of the license fee and 3% of the royalties to the state Tribal Welfare Department to be used for the Kanis. Whether the funds will flow to the Kanis or not is one question. Another is the fact that nowhere do gender concerns figure – neither in the information flowing from the tribe to the TBGRI; nor in the benefit sharing model agreed upon. *Policy interventions on benefit sharing models need to incorporate gender-sensitive clauses.*

Women and Gene Banks

Examples of informal *ex situ* conservation by women, who preserve seeds to be grown in home gardens or in fields, already exist. However, access by rural women to government-owned gene banks is problematic; just as most rural women have lacked access to credit, education and other productive and empowering resources. *Policy interventions need to promote information campaigns and decentralise delivery mechanisms for accessing gene material.*

Women often have 'scientific' knowledge about genes and cross-fertilisation, only this is expressed in a language different from that used in modern science. Women's knowledge and innovations also reflect real-life situations and the scientific community would benefit interacting with such women experts. *Informal ex situ knowledge should form the basis of ex situ data banks and women can be encouraged to re-establish in situ conservation. For this, the male-dominated scientific community needs to be gender-sensitised.*

Legal Provisions to Support Women

Women's role in both *ex situ* and *in situ* conservation would be enhanced if gender concerns are incorporated in laws governing bio-diversity. Unfortunately, the drafts of the two key Acts announced by the government are not gender sensitive though women will be radically affected by the provisions of the Acts. The draft Biological Diversity Act, 1998, proposed by the Ministry of Environment and Forests, and the draft Plant Variety Protection and Farmers' Rights Act proposed by the Ministry of Agriculture, for instance, do not provide for *gender-specific databases and information systems or for gender-oriented participatory research, or for gender-monitoring of related policies (such as policies on the IPRs) and project plans.*

The Acts also adopt the conventional 'top-down' approach. This is ironical since the Acts aim at protecting traditional knowledge and farmers' rights. Yet, the holders of such knowledge and the seed conservers are inadequately represented in the decision-making structures set up by the Acts which do not require *setting up of structures at the district and village levels to decentralise decision-making powers while resting the final authority in the national-level apex body.*

Each of the draft Acts propose to set up an apex National Authority, comprising mainly bureaucrats and technocrats, for enforcement and implementation of the provisions of the Acts, but do not ensure gender parity in these bodies. Suggestions have been made to give gender representation 'due regard' or include a representative of the National Commission for Women (MSSRF 1997) in the Authorities. However, rather than the vague 'due regard' or inclusion of a representative from the NCW, which does not specialise in environmental issues, it would be worthwhile *to reserve at least one-third of the seats for bio-diversity experts from gender-oriented institutions/ organisations. Similar provisos should govern state-level and other parallel bodies. Besides, it should be mandatory for inclusion of at least two experts on women and bio-diversity in the various committees to be set up by the apex bodies.*

The Bio-diversity Act provides for the funds to be utilised for 'socio-economic development' of the conservers of biological resources in areas from which these resources, and/or knowledge thereof, have been accessed for the purposes of IPRs. The Gene Fund is proposed to be used for recognising, rewarding and supporting farmer-conservors of genetic resources. *The proposed National and State-level Bio-diversity and Gene Funds in the respective Acts should include a clause ensuring that benefits reach deserving women in the communities benefiting from the funds. The Acts should also explicitly incorporate gender concerns in the guidelines relating to 'equitable' benefit sharing and protection of farmers' rights.*

To safeguard the rights of traditional knowledge holders and farmers' rights, the provisions regarding appeals against decisions taken by the Authorities in the Acts *should provide for public hearings at the state, district and village-levels to enable women easier access.*

Women's Representation in Decision-making Structures

Given the extensive and proactive role that women play in natural resource management, *there is an urgent need to set up gender sensitive institutional frameworks and include more women in decision-making structures, particularly those relating to agriculture, forestry and science. A sex desegregated data of existing institutions is also necessary.*

While more girls than boys opt for life sciences at the university level, in bio-diversity research institutions their number is negligible (MSSRF 1997). Further, few women occupy senior positions in scientific research institutions, or undertake field explorations. In the National Academy of Agricultural Sciences, for instance, less than 3% of the 225 elected Fellows, skilled in plant breeding, genetics, soil conservation and other specialities, are women and most of them are either from the social sciences or are nutritionists (MSSRF 1997). The Indian Forest Service, opened to women as late as in 1980, too has few women. In the last decade, about 4 to 5 women joined each year and in 1995 less than 3% of the total cadre strength of 2,576 were women; and women constituted less than 1% of the rangers and foresters. (MOEF 1995, MOEF 1996). Women are hardly represented in the Botanical and Zoological Surveys of India. Nor are they visible in institutions such as the National Bureaus of plant, animal and fish genetic resources, the national gene banks, the Forest Survey of India and Wildlife Institute of India.

Correcting this gender-bias in professional and scientific institutions needs a special drive to recruit women and generating awareness programmes in collaboration with educational institutions. More important, a change in the terms and conditions of these jobs is needed to make them more gender sensitive. For instance, transferable jobs are inconvenient for women as are postings to relatively inaccessible or 'unsafe' areas. At the field level, allocating areas to individual field workers like extension workers or forest rangers are impractical for women who would prefer to work in groups. Thus, instead of allocating so many villages, or hectares of protected forest to individual women workers, the same can be the responsibility of two or more staffers. Touring in pairs is better than touring alone where women are concerned. Experience has shown that women are most effective when working as a collective, drawing comfort, inspiration and strength from each other rather than working alone in conservation projects.

The current management systems of these institutions need to be made more women-sensitive through gender sensitisation of the male decision-makers and workers, modification of working conditions to, for instance, include flexible working hours, home-based assignments, provision of creche and other support facilities for women officers and workers.

A More Gender-Sensitive Development Model

Ultimately, institutions need to work within a more gender-responsive macro environment governed by an alternative mode of development which accords more importance to sustainability and equity. Current efforts are aimed at trying to 'fit' or 'mainstream' women in the dominant consumption-led economic growth pattern with the hope that the fruits will trickle down to the rural women. Poverty alleviation schemes, 'co-option' of NGOs to improve delivery mechanisms of goods and services, promotion of labour-saving devices to 'lighten' domestic work and earmarking some positions for women in certain decision-making institutions will not deliver justice to women.

An alternative strategy, more suited to concerns of women, would, for instance, take into account the yawning gap between the rich and the poor and between men and women, not only in terms of income but with regard to other productive economic resources including land. This gap would be measured in terms of food security, access to health, nutritional status, educational and intellectual stimuli and the relative competence of men and women in achieving greater control over their lives.

Gadgil and Guha see a ray of hope in the path that the environmental debate is taking in India (Gadgil and Guha, 1992). While the dominant Western mode of development favours conservation of forests not because they are central to economic production but for enhancing 'quality of life'. In India, forests are linked to production systems and though there is a conflict in the claims of the agrarian and the industrial sector over the natural resources, alternative means of managing natural resource management are, fortunately, part of this debate. Though Gadgil and Guha make no mention of women's ecological role in this debate, there is little doubt that without a gender perspective guiding conservation programmes, the very survival of society will be at stake.

Conclusion: Giving Women their Due

Despite the present patriarchal set up, there is a growing belief that greater involvement of women is essential in dealing with the ecological crisis. Increasingly, government officials, funding agencies and NGOs are realising that conservation programmes which involved women have been far more successful than those where women had no role to play. This process of involving women, however, needs to be taken further by viewing women as more than mere 'beneficiaries' of conservation programmes. Rarely are women asked what they think. Incorporating a gender dimension in conservation programmes means learning how to 'listen' to them, not just by hearing them out but by understanding the categories and language women use to express their perceptions. Women have to be involved in the entire process of designing and implementation of the conservation programmes.

A critical aspect of women-centred conservation policies and programmes is how 'gender' is understood. Experience has proven that though gender-sensitive policies and programmes keep women's needs and desires central, they should also focus on enhancing the role men play in supporting women-focussed conservation programmes. Indeed, 'gender' encompasses men as well as women and both have complementary roles to play in all social processes including in managing the natural environment. At another level, gender-responsive policies and programmes usually cater only to women's 'practical' needs for water, food, fodder and other material goods and services; these policies and programmes should give equal attention to addressing women's 'strategic' needs for empowerment through education, improved health, skill up-gradation and recognition of their ability and talent.

Gender sensitive policies imply a subsistence orientation as against commercial exploitation of natural resources which is dominant in the current male-dominated, industrial mode of development. Policies should also go beyond the distorted belief that women are confined to household chores and are economically unproductive, incapable of pro-active participation and unable to take on decision-making roles.

Government's agricultural and conservation policies, such as the green revolution, promotion of cash crops, social forestry, joint forest management and nationalisation of NTFPs, have not only been gender blind but worked against the interests of women by promoting crops, trees and market conditions which do not fulfil women's needs and upon which they have no control. These policies have contributed to rapid depletion of bio-diversity and, correspondingly, threatened women's traditional knowledge related to flora and fauna.

On the other hand, several ongoing efforts initiated by NGOs such as Social Action with Rural and Tribal Inhabitants of India (SARTHI), Navdanya and the Foundation for Revitalisation of Local Health Traditions (FRLHT) provide viable models for involving women in bio-diversity conservation. Government policies and programmes can fruitfully learn from these efforts. There is also an urgent need to compile a gender-sensitive bio-diversity database and develop gender sensitive policies on benefit-sharing in the wake of the Intellectual Property Rights regime of the World Trade Organisation.

Another set of challenges is to bring about structural changes in the patriarchal set up, to introduce gender sensitive laws, to include more women in decision-making bodies and to transform notions about the actual division of work and resources between men and women. These structural, attitudinal and policy changes are necessary in the long run to ensure a more equitous and sustainable future. For instance, even after 15 years since entry into Indian Forest Service was allowed to women, they comprised less than three per cent of the total cadre strength in 1995. Women are barely visible in institutions such as the Botanical and Zoological Surveys of India or the National Bureaus of plants, animal and fish genetic resources. Women are hardly represented even in the agricultural and scientific institutions such as the Indian Council for Agricultural Research. Ironically, many rural women have immense knowledge about wild food plants, medicinal plants, seed selection and conservation, food processing, soil conservation and water harvesting systems, to name just a few 'expert' areas.

Policy Suggestions and Roles of Different Agencies and Actors

What roles do different agencies and actors need to play to ensure that women participate equally in the selection, implementation and control of environmental policies and programmes, and particularly in bio-diversity conservation? The gender-blindness of existing plans, policies and programmes as well as lessons and suggestions arising out of some positive experiences have been discussed at length above. Policy suggestions relating to various aspects of gender and environment have been italicised in the text. A summary of these suggestions is given below specifying the roles of different agencies and actors.

Role of the Government

- Preparing national-level and ecological zone specific gender desegregated database on bio-diversity based on community bio-diversity inventories
- Integrating gender analysis and gender monitoring into project plans from the very beginning.
- Making environmental laws and intellectual property rights laws gender-sensitive.
- Introducing the gender dimension in models of benefit sharing with regard to IPRs.
- Enabling women to own cropland/ forest land on a long-term basis through leases or other kinds of contracts.
- Adhering to women's customary rights over land/ forests/ water bodies where they still exist and re-establishing these rights where needed.
- Giving adequate representation to women in decision-making bodies and in administrative structures.
- Undertaking gender sensitisation of decision making bodies at all levels through adequate representation of women, training programmes for men and women and modification of working conditions.
- Using the institution of Panchayati Raj for gender sensitive environmental programmes.
- Recruiting more women extension workers in natural resource management and equipping men and women workers with the skills required to motivate, inform and involve rural women in environmental regeneration and preservation programmes.
- Encouraging participation of women and ensuring success of environmental programmes through provision of credit, training, technology and a fair market to the women and by making the project design flexible enough to accommodate field-level innovations.
- Giving incentives, rewards and recognition to women who conserve agrodiversity, bio-diversity, traditional knowledge on genetic enhancement and revitalise conservation traditions.
- Building partnerships with NGOs who work with women and the environment and facilitating networking of these and of gender-responsive community people's groups.

- Encouraging direct participation of traditional, community-level institutions particularly women's groups like *mahila mandals*, in planning and implementing gender sensitive environmental conservation programmes.
- Making education for girls and women part of environmental programmes in partnership with NGOs where necessary.

Role of NGOs/Local Groups

- Facilitating preparation of gender desegregated community bio-diversity databases.
- Working with women's groups and towards training and capacity building of women in environmental programmes to equip them for leadership roles and as agents of change.
- Gender-sensitising and strengthening community-level organisations and local institutions, including the Panchayati Raj bodies, engaged in environmental programmes.
- Facilitating revitalisation of conservation traditions
- Empowering women in dealing with issues such as 'prior informed consent' with regard to transferring local genetic material and traditional knowledge under the IPRs regime.
- Informing women of their legal rights and using the modern information technology for exchange of information and for networking.
- Facilitating networking of women's groups working on conservation.
- Forging linkages between the various actors such as the government, research institutions and the marketplace to ensure women's effective participation in environmental regeneration and preservation.
- Monitoring environmental programmes with questions such as 'who gains what and who loses what?' in terms of the satisfaction of women's practical needs for bio-mass and strategic needs for empowerment.

Role of Academic and Scientific Research Institutions

- Undertaking research on the extent of women's contribution to bio-diversity management and the effects of modern processes like education, rural-urban migration and changing market conditions on their roles in natural resource management.
- Developing parameters, models and analytical tools for gender analysis of policies and programmes.
- Promoting research on women-friendly and environmentally benign crop varieties, farming and forestry technologies by involving women in the design of research programmes.
- Enhancing women's role as decision-makers, technologists, scientists and field-level workers.
- Building upon field-level knowledge and technologies used by women rather than relying on laboratory-to-field applications.
- Decentralisation of research centres to include empowered participation of community-level leaders in 'traditional' sciences.
- Assisting in training, and learning from, field-level agriculturists, fisher-women, forest-women.
- Funding promising traditional practices for regenerating genetic varieties and preservation/processing techniques used by women on the farms, in coastal areas and in forest lands.
- Simplifying scientific jargon so that women in the field can understand and relate to scientific discoveries and innovations in the field of environment preservation.

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Gender Analysis for Stakeholders in Biodiversity Prioritization: Suggested Methodology

Gopa Pandey

Biodiversity Prioritisation and Gender

The communities inhabiting areas of rich biodiversity are often tribal or rural. The men and women in these communities have strong conviction about life and outputs of plant and animal species surviving next door. Since they are continuously withdrawing products from natural ecosystems, their knowledge and perception of flora and fauna is most authentic and dependable for academicians, conservationists and resource managers. It is difficult for development managers to prepare a database for prioritising biodiversity conservation without this supplementary knowledge. Therefore, an approach involving direct feedback from local communities will be appropriate in terms of assigning priorities. Since these communities are constantly using resources, they are a dependable source of information on chronological population dynamics of species around them, especially plants. The uses of leaves, flowers, fruits, seeds, bark, root or tuber etc. in various ways, ranging from food to medicinal purposes, are more common in dense interior forest areas with fringe populations. As some of these products are closely linked with survival needs of people, their qualitative observations may help tremendously in prioritizing biodiversity. Among people, it is not an exaggeration to assert that men and women, linked with differential activities and products, exhibit variations in assigning priorities to areas or species. Often when managers, researchers and others, approach these fringe communities, they leave out observations, concerns and preferences of women. In exceptional cases women may also be contributing equally to a surveying agency, but in general they are likely to be ignored or left out while such surveys are being carried out.

Reasons for Gender Concerns

Biodiversity prioritization is a common concern for conserving rare, threatened, and endangered species and habitats. The reason why this concern has evolved is due to overuse of resources beyond their replenishing capacity. When use of resources is talked about, those who are using the resources have to be thought of. In an ideal forest ecosystem in the Indian context, women appear to be the single largest clients of goods and services produced by a forest. Starting from availability of water for households to daily basic needs of fuelwood and fodder, and to less frequent harvesting of specific, rare medicinal plants to cure someone, on a non-commercial basis, women are the major users of biodiversity resources. Of late, the extraction of some vegetation components for supplying to commercial entrepreneurs has become a great threat to biodiversity. This type of extraction may not be done willingly by the inhabitants of fringe areas. Yet, their economic status leaves them with little choice but to yield to external pressures, surrendering their valued plant species to the greed of the market in exchange for petty cash.

It is a matter of great satisfaction that more and more organizations and individuals are coming forward to contribute in prioritizing biodiversity conservation. An approach to extract the best possible information from local inhabitants is suggested here to make surveys and studies more accurate on the basis of authentic information. This addresses the need for eliminating a bias in recording observations on sites and species. This approach is modified from Socio-Economic Gender Analysis (Thomas-Slatyer et. al. 1995) and Gender Analysis Work Out Manual by FAO (Wilde and Vainio-Mattila, 1995). Initially, these methodologies were prescribed for gender sensitive planning through Participatory Rural Appraisal (PRA). Subsequently, this approach has been applied to design studies for designing, implementing and monitoring gender segregated knowledge and its utility into a holistic approach. The use of this approach is based on the primary hypotheses listed below:

I. Women are an integral part of forest ecosystem in fringe communities.

II. Women are closely associated with forest areas for withdrawal serving their basic needs.

III. Women are deeply concerned with multiplicity of products from biodiversity rich areas.
IV. Women have knowledge of a variety of species yielding products that they use and register their observations on cover or density of these species.
V. Women spend more time in forests for gathering products sustainably.

These hypotheses may be translated into a gender sensitive planning profile and observations during surveys or Rapid Rural Appraisals (RRA) which may be recorded on appropriate worksheets. The methodology is described in a flexible form so as to leave ample space for site-specific study design needs.

Analytical Framework

While prioritizing, certain questions are to be responded to in four different sets. This approach has been outlined by Wilde and Vainio-Mattila (1995) in the framework of context, activity, resource and program action. The profiles for these frameworks are outlined to answer some inherent questions related to them. A worksheet is developed by using each of the four profiles. If observations are recorded by this method, focused indices of prioritization may be developed which are gender sensitive. A detailed outline of these four stages of using gender analysis for biodiversity conservation prioritization follows. This framework is a tool for answering some basic questions raised in the four profiles.

Context Profile

This aims at tracing linkages of physical, social, economic and environmental contexts with the existence of species and their condition. For instance, what is getting better in terms of conservation of species in the immediate habitat of these communities may be registered. In terms of supports and constraints, the prioritization of which area will make life better and which area will make life worse may be answered. Highlighting the supporting factors will instantly reflect which aspects or conditions are under physical constraints. Here the inhabitants may point out the disappearing populations of specific species due to over exploitation and the resultant reduction in the extent of multiplicity of products. The worksheet may be used in the context of environmental, institutional and demographic constraints and supports, an example of which is elaborated in the matrix (Table 1). The inventory of species is invariably available in the concerned Forest Working Plan of an area. However, updating of this information is needed to reflect the current status of the habitat. Since women are key resource persons for indigenous technical knowledge about medicinal or other uses of species, proper documentation can be done with their help.

Activity Profile

This component answers the question of division of labor between men and women. Women are prime gatherers of non-timber forest produce from the forest areas. While they traverse the forest areas daily to collect fuelwood, fodder and other products, they also notice the shrinking populations of specific species which are of use to them. In contrast, men tend to take up only economically productive jobs and their vision is restricted to a limited sphere of collecting economically valuable products including cash yielding timber. The priority assigned to a particular area for conservation by men may not match the preference of women. From the Activity worksheet (Table II), it is apparent that regular occurrence of an activity may yield more authentic information on biodiversity conservation needs. The information emerging from sources using forests less frequently may not be completely accurate.

Resource Profile

This profile underlines the resources used by men and women from the existing habitat. In terms of preference ranking of PRA, the species of use to men and to women have a different priority. It is also important to extrapolate precipitation of benefits from use of a specific resource. The decision to prioritise areas for biodiversity conservation may be taken by men on the basis of attributes that are different from those that are used by women. Therefore, assigning importance to one category of species for conservation prioritization may help in natural conservation of another associate species. The matrix in the worksheet may be examined for resources of land, training and extension against access, control and benefits. The initial training skills on registering changes and recording observations should be accessible by women also.

Program Action Profile

The strategies evolved for conservation of biodiversity should be acceptable and suitable to the inhabitants living within and around forests. Often severe restrictions on entry and gathering activities inside biodiversity rich areas bring hardship to women. Any conservation action plan should incorporate alternative sources of supply of resources so that the survival needs of local communities are not hampered. The focus on participating opportunities and interventions required may be discussed with people and suitable conservation strategies may be evolved. It is possible to discuss prioritisation with exclusively women's groups and subsequently bring up the points made by them in common meetings. This facilitates free and frank expression of opinion by women regarding their preference. In the worksheet, a matrix of program objectives and activities including priority sites, species and strategies may be assessed against gender considerations and recommendations from men and women may be presented in a consolidated form.

Way Ahead

For a detailed and accurate gender sensitive approach to biodiversity conservation prioritization, the Gender Analysis (GA) is an effective tool. This approach can be standardized in future projects so that the variations in preferences of local communities are reduced to a minimum. A host of detailed and accurate information can be collected by using GA. Data collection can be approached through simple RRA and survey methods. Studies conducted for prioritization should also look into the existing Forest Working Plan of the area under consideration, as it contains an inventory of species. An easier triangulation will be possible if existing local knowledge is checked against this inventory. The situational, institutional and dispositional barriers retain women in a very inert space and most of the planning and decision making on use of common property resources is done without consulting them. In the specific case of biodiversity conservation prioritisation, valuable information may be gathered by creating a space for women on survey platforms. Unless facilitated, women are unlikely to open up and contribute to data collection processes on their own.

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Table 1: Context Profile Worksheet

Context	*Constraints*	*Supports*
Environmental	Forest degradation, Soil erosion, Non-availability of products, shrinking biomass	Vicinity of forests Potential of land Past inventories evident
Institutional	No rights with women Extension approaches absent	New approaches Indigenous technical Knowledge (ITK) utility of resources
Demographic	Intense occupation Male outmigration increasing workload.	Women know more about sustainable extraction of resources

Table 2: Activity Profile Worksheet

Location	*Activities*	*Gender*	*Time*
State Forest	Biomass Collection (Fuelwood, fodder, small timber) NWFP, Gathering	W/M W	Regularly Occasional
Farmlands	Land preparation Transplanting Weeding Harvesting	M W W M/W	Seasonal Seasonal Seasonal Seasonal
Homestead	Cooking-small ingredients Child rearing-medicines, biodiversity rich sites Processing harvest Small industries	W W M M	Daily Daily Seasonal Occasional

Educational and Awareness aspects of Biodiversity and its Conservation

Erach Bharucha

Introduction

In a biorich patch of forest in the Western Ghats there was a small grassy opening. In the middle of the forest glade there was a small V - formation of well laid out wild fruit surrounded by pebbles and a row of sticks. It seemed like a ritual site, or an offering to the local forest deity. It was neither. According to local children, it was their own farmyard! A game in which the local wild cucubits were cows and buffaloes, the pebbles the walls of the farm and a fence of sticks. For the children of the forest, the vegetation around the glade can be compared to the sterile plastic toy's of urban children. The forest children however collect their 'toys' from the forest - know their names and how to look for them in the wild. Creating their farmyard is a learning experience of the biodiversity that envelopes their lives.

Contrast this with an urban group of M.Sc. students, with a background in biological sciences who, when shown a pond, were unable to identify the squiggly creatures in the water as mosquito pupae. They had only seen this as a giant comma shaped object drawn on a blackboard or as a smudged picture in a textbook. Its relevance to scale or to its habitat was totally lacking.

The foremost institution that spread information on the wonders of India's plant and animal wealth perhaps the most venerated of India's conservation NGOs is the Bombay Natural History Society (BNHS). No organization can be said to have played a greater role in supporting the cause of Nature Conservation in our country.

In 1969, WWF-India was established. Based initially in Bombay, it later shifted to New Delhi. Its establishment in Delhi led to a closer interactions with the Government and it was thus able to influence policy and implementation of conservation efforts more effectively. WWF has been running a campaign to enhance awareness, that includes adults through its publications and children through a large network of 'Nature Clubs of India', which are active mostly in urban areas.

A large number of small but extremely important NGOs, spread across the length and breadth of India, also sprang up between 1960 and 1980. Their influence towards conserving India's biodiversity through public awareness has been important.

Aims and Objectives

The goal of the BCPP's Environment Education and Awareness strategy is two fold. It envisions identifying gaps in the education system in relation to biodiversity and provides inputs into how these lacunae can be filled. It identifies the strengths and weakness of the existing awareness enhancing programs and identifies several strategies that could be used to enhance awareness that would lead to conservation action. The scale of this project covers National, Regional and Local level initiatives.

The conservation education program identifies those individuals who maximally effect biodiversity and those who can maximally induce a change in behavior of a large number of people to conserve biodiversity.

This Report is based on a variety of studies designed for different target groups which when appraised together provides an overall picture of biodiversity awareness and educational levels in diverse groups of people in our country.

The major objectives include:

1. To study the status of education and awareness aspects of biodiversity conservation. (This includes formal curricula, activities of NGOs and the information provided through mass communication).
2. To assess the levels of information and gaps in knowledge in different sections of society Urban, Rural, Wilderness dwellers and key individuals who manage biodiversity.
3. To establish how an interest in 'nature' conservation is initiated in society.
4. To establish how information changes to awareness and produces a concern for biodiversity which leads to conservation action.
5. To conceptualize and design a more effective method of enhancing knowledge of biodiversity in the educational sector.

6. To identify the most effective methods to sensitize different target groups towards bringing about conservation. Thus prioritizing the most important methods to influence people so as to move towards a mass awareness movement.

Method

A variety of studies were designed, aimed at assessing the level of information and degree of awareness of biodiversity among various groups. These studies analyzed—information, awareness, concern, and action for biodiversity conservation, in specific target groups.

The different modules of the study broadly include:

The Status of **information** in different target groups and important sectors.

Analysis of the level of **awareness** on biodiversity issues in different target groups.

Assessment of individual responses on their **concern** for biodiversity conservation and **actions** they have done or can suggest for its conservation.

Analysis of behavioral features at specific community level.

Documentation of individual and community participation in conservation actions.

The Methodology used for these multiple studies included a study of biodiversity issues dealt with in curricula, an analysis of information in the teacher community and information that students have assimilated at school and college level. These focal surveys were done in urban as well as rural settings.

School level surveys have also focused attention on non-formal conservation education and assessed the value of additional inputs into the formal system through NGOs. The impact of such programs in the same region with and without the program at the school level were compared.

The biodiversity issues contained in syllabi of ten Universities has been reviewed. College students have been interviewed to appreciate the origin of information that they have on biodiversity from different inputs.

The sources of information on biodiversity in different communities - urban, rural, wilderness have been analysed through a set of questionnaires and semi-structured interviews.

The adult population of individuals who have displayed an interest in conservation form an important study group. A questionnaire to BNHS members and WWF subscribers were circulated especially with a view to identifying 'trigger' mechanisms that initiated their interest in wildlife and conservation.

A group of Case studies at the community level where education and awareness enhancing inputs have led to Environment action have been documented.

Traditional concepts leading to conservation such as sacred groves have also been documented. Special efforts have been made to understand if there has been a direct link between tradition and conservation or if the action is an indirect outcome. It has been frequently suggested that sacred groves have been protected as gene pools of biodiversity. The study addressed this contentious issue by a careful study of sacred groves at a regional level.

A survey of environment educational and awareness material has been done to identify its spread and effectiveness.

A specific study done in a biorich hotspot in Mulshi taluka in the Western Ghats, identified gaps in local knowledge through carefully conducted surveys.

The Status of *Information* in Different Target Groups and Important Sectors

1. Information on Biodiversity in Education:

A) School level (Study 1)
   (a) Status of curricula at School level.
   (b) Information available in the teacher community and methodology in use by teaching faculty. (Study 2)
   (c) Status of awareness levels in school children. (Study 3 & 4)
   (d) Students compared for level of awareness with and without environment programs. (Study 5, 6, 7, 8, 9)

B) College level
   (a) Status of curricula at College level (Study 10)
   (b) Status in college students (Study 11)
   (c) Status of curricula at University level (Study 11)

2. Level of Information on Biodiversity Conservation: (Study 12)

Status of information in the average individual in:
   (a) Urban people (Study 13)
   (b) Rural people
   (c) Wilderness people
   (d) Key groups that manage biodiversity - IAS, IFS
   (e) Information dissemination through mass communication
   (f) Information dissemination through the NGO sector - WWF, CEE etc.

This focuses attention on the level of information on the importance of conserving biological diversity, rather than on general ecosystem goods and services, or glamour species.

3. *Assessment of indicators of information levels on biodiversity in concerned institutions in Government and NGO sectors*

A) ***Mass Media:*** (Study 14)

A review of the frequency with which biodiversity figures in different mass communication media programs, its content and context.

(i) In Newspapers
(ii) In Television programs
(iii) In Radio programs

B) ***In Parliament:*** (Study 14)

A review of the questions in parliament on biodiversity related issues, during the recent past and the nature of the questions and responses.

C) ***Content in NGO Programs:***

Analyses of Levels of Awareness of Biodiversity Issues in Different Target Groups (Study 15)

This aspect of the study evaluates and documents reactions to specific questions related to biological diversity to assess the level of awareness on the different types of conservation issues in specific target groups. The study focuses attention on aspects such as:

I. Are people aware that the term 'biodiversity' includes all living plant and animal species?
II. Do people know that genes/species and ecosystems are all included in different levels of 'biodiversity'.
III. How do people appreciate and rate the importance of biodiversity as a natural resource of economic value.
IV. Are people aware that most of our biodiversity lies in:
   A. Wilderness ecosystems - forests, wetlands, grasslands, coasts, rivers, mangroves, marine areas etc.
   B. As a part of traditional agricultural systems.

I. Are people aware of India being a 'mega diversity' Nation.
II. Are people aware of the reasons and consequences of extinction.

Assessment of individual responses on their initiation - awareness - concern - actions, for biodiversity conservation

1. analysis of trigger mechanism among highly aware individuals. Wwf-i, bnhs. (study 16)
2. gaps in implementation for environment education. (study 17)
3. examples of actions initiated through non-formal environment education. (study 18)
4. case study on the uksn environment education program. (study 19)
5. a study of traditional perceptions that have led to conservation action of biodiversity through sacred groves. (study 20)
6. information available in print material for analyses and reporting on biodiversity conservation for education and awareness aspects (study 21)
7. local perception on biodiversity and 'gaps' in knowledge. (study 22)

Studies

The Status of Information in Different Target Groups and Important Sectors

Study 1

Information on Biodiversity in Education

The National Council for Educational Research and Training (NCERT) has provided guidelines to change school curricula and has introduced conservation and wildlife issues into curricula in the recent past. This focuses greater attention on a variety of environment related concerns, such as pollution and natural resource use. Biodiversity conservation and its objectives seem to have remained underrepresented.

Studies on present curricular patterns done at the Bharati Vidyapeeth Institute of Environment Education and Research have shown that the Maharashtra State Coiuncil for Educational Research and Training (MSCERT) has attempted to bring in conservation concerns into the curriculum in even language text books, their selection of topics has however been inappropriate.

A serious lacunae is the inability of teachers to convey information on biodiversity as it has not been introduced into their own training programs at the B.Ed. level. An inability to use audio-visuals and lack of time and permission for field trips all add up to an inadequate delivery system to produce conservation consciousness.

Matrix of Target Groups and Domains of Environmental Consciousness

	Information	*Awareness*	*Concern*	*Action*
1. Education				
School:				
Curricula: Study 1 - Biodiversity in curricula	✓			
Study 2: Biodiversity information in the teacher community	✓			
Study 3: Analysis of biodiversity information among school students	✓			
Study 4: Study of Conservation education profiles among school children		✓		
Study 5: Efficacy of non-formal environment education	✓	✓		
Study 6: Comparison between urban and rural school students' perceptions of biodiversity	✓	✓		
Study 7: Study of environment education for enhancing concern	✓	✓	✓	
Study 8: Environment education for action generation aspects	✓	✓	✓	✓
Study 9: Possible 'trigger' sources for biodiversity conservation	✓	✓		
College and University:				
Study 10: Curricula Analysis of syllabi at College & University Level	✓			
Study 11: Students Analysis of information and awareness levels among college students	✓	✓		
2. Awareness				
Urban, Rural, Wilderness	✓			
Study 12: Assessment of levels of information in different sections of society	✓			
Study 13: Sources of information on biodiversity in an urban society	✓	✓		
Key groups (IAS, IFS, teachers, professors)	✓			
Judiciary	✓			
Sources of information	✓			
Mass Communication	✓	✓	✓	✓
Study 14: Assessment of coverage of biodiversity issues in the mass media, parliament, concerned sectors in Government and NGOs	✓	✓	✓	✓
Parliament	✓	✓	✓	✓
NGO sector	✓	✓	✓	✓
Study 15: Analysis of awareness on biodiversity in different target groups	✓	✓		
Study 16: Analysis of trigger mechanisms among highly aware individuals	✓	✓	✓	✓
Study 17: Gaps in implementation	✓	✓		
Study 18: Examples of actions initiated through non-formal environment education				✓
Study 19: Case study on the UKSN environment education program	✓	✓		
Traditional values			✓	✓
Study 20: A study of traditional perceptions that have led to biodiversity conservation			✓	✓
Study 21: Information available in print material	✓			
Study 22: Local perceptions on biodiversity and gaps in knowledge	✓	✓	✓	

✓ Indicates studies that have provided inputs on assessing the level of consciousness.

Study 1a. Biodiversity in Curricula

School Level

Biodiversity is covered in both science and geography without creating associations or conceptual linkages between these two approaches. Though a sizable proportion of the curricula in different states includes biodiversity related issues, i.e., animals, plants, ecosystems, that they are a part of biodiversity is not made overt. The need for the conservation of biodiversity is left out when teaching the lesson. Unless teachers are oriented towards concerns such as extinction and its effects, the concepts remain unclear.

Although the issues dealt with concern plants and animals and their relationship to ecosystems, they do not touch on the value of biological diversity as a major component of the natural resources that we use for our day to day lives. Another gap is the lack of information on genetic diversity and the effects of its loss both from the wild and from cultivars.

Study 2. Biodiversity Information in the Teacher Community

Analysis of Biodiversity Information among School Teachers

A randomly selected group of 31 school teachers from different schools in Pune were asked to enumerate the first mammals, birds and plants that came to their minds. The responses were most frequently associated with the more 'glamorous' species.

A group of urban teachers in Pune who have had no access to a conservation program were shown a set of slides of common as well as important endangered animal species. Their most frequent response was 'don't know' for any species other than the tiger, elephant, peacock and lion. Even deer and antelopes could not be differentiated.

Study 3. Analysis of Biodiversity Information Among School Students Based on Wild Species Identification

In the 17 states from which data is available, there are more than 7 crore (70 million) students. Of these, at the primary level there are 1.06 crore, middle level 3.66 crore and higher secondary level 2.39 crore students in 1995. This reflects the enormous number of students that could be accessed through a formal conservation education program in the country. Even a small percentage of these large numbers cannot be accessed by non-formal NGO programs such as Nature Clubs or through specific eco-clubs which are supported by a government sponsored Program.

A group of 540 school students in Pune of standards IV to IX, were shown three sets of slides of common and important endangered animals, birds, insects and reptiles.

Mammals: Recognition was highest among the mammal species and lowest among the birds. Many students made no response to a number of the slides. This can be explained by a number of reasons. For instance, the children may either have been so impressed by the slides, that they did not have the time to respond, or conversely, they were just not interested. If the latter case is true, it indicates that non-formal education methods do not reach all the students. Though the majority of the students were unable to identify species, they were able to correctly group deer, butterflies, caterpillars, snakes and ducks. Antelopes could not be differentiated from deer and the leopard was mistaken as the cheetah by more than half of the students.

Birds: The most common response was 'don't know'. Only one species, the peacock, was correctly identified by all the students. Apart from the weaver bird or baya, none of the other species could be correctly identified by more than 3% of the students. When accessed again, it was found that this 3% had been exposed to several 'bird watching' experiences in the past and had developed a personal interest.

Insects and Reptiles: While the overall performance is dismal, more students were able to correctly identify different species of insects and reptiles than of birds. This may be because insects and reptiles are most often referred to as 'pests' and 'dangerous' creatures.

It is apparent that none of the usual sources of information (books, television, parents, school curricula etc.) are adequate for creating an interest and appreciation among school students for 'lesser' species. Only interpretive nature experiences, conducted by resource people, appear to be capable of sparking off such interest.

Study 4. Information on Biodiversity in School Children Based on Level Expected on Wild Domestic Species and Ecosystems

Levels of information in school children on biodiversity

A survey of 1161 school students between standards VI and IX was conducted in eight different regions (Himachal Pradesh, Uttar Pradesh, Assam, Nagaland, Delhi, Bihar, Orissa and Maharashtra) in order to assess the level of biodiversity information. The level of awareness was categorized into four different classes - high, moderate, low and unaware.

The level of information was calculated from the overall performance based on the following parameters:

Level	1	2	3	4	5[1]	6
High	Mentios three levels of biodiversity - genetic, species and ecosystem.	Knows local or Indian endemic, endangered/ rare species.	Mentions uses of wild plants and animals in medicine, traditional rituals, ethnobotany, tourism, pharmaceuticals, for ecological balance and as gene pools.	Mentions Food, housing, transport, fuelwood and fodder, herb cultivation for medicines, pisciculture, industrial applications, pharmaceuticals	Ranks between Insects Forests Coral reefs Seas Wetlands Fungi Deserts Farms Zoos Birds Mammals Gardens Plantations Laboratories Urban areas	Ranks between PAs, education of local people, afforestation, gene banks, conservatories, legislation, prevention of deforestation and poaching etc.
Moderate	Mentions different species and ecosystems	Knows some Indian and local species	Mentions medicinal uses and for ecological balance.	Food, fuel, fodder, medicinal applications	Forests Seas Coral Reefs Wetlands Insects - all ranked highly	PAs, prevention of deforestation, afforestation
Low	'All living plants and animals'	Has recorded few Indian wildlife species	Timber and food uses	Timber and food uses	Has placed the above categories low in the ranking scale	Prevention of deforestation and hunting
Unaware	Unanswered	Mentions only domestic species and/or exotic species or unanswered	Unanswered	Unanswered	Unanswered or skewed ranking	Unanswered

[1]whereas perceptions on the relative importance might differ, - the question is designed to determine whether certain groupings can be ranked correctly. Those systems and taxa that should have had high ratings include forests, insects, coral reefs and seas. Mammals should be ranked lower than birds. Zoos and gardens should be low in the ranking scale. Deserts should follow all the other ecosystems. Some of the words are introduced to check on the understanding of issues, such as plantations, which are mono-cultures and thus have low diversity levels.

A small percentage (0.60%) of the sample of school students had 'high' levels of information. Almost half (42.64%) were in the 'unaware' category.

There were 22.22% of the students in the sample distributed in the high and moderate category, while a significant 77.18% were in the low and unaware category.

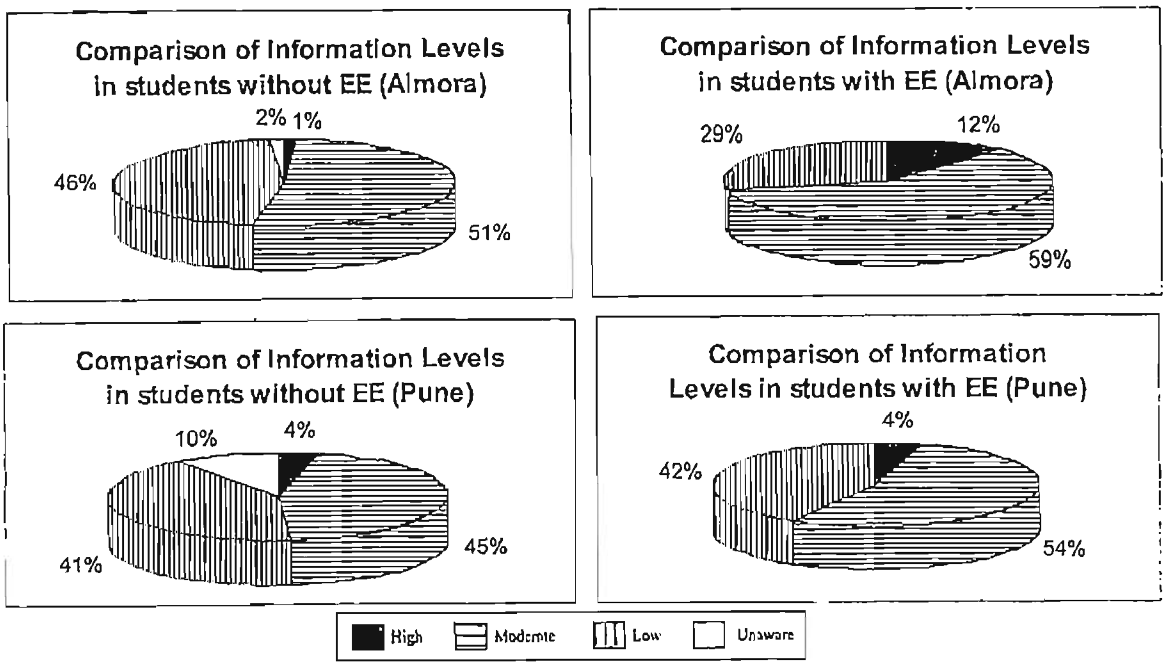
Very few students were in the high level of awareness category in all eight states. Among the high degree of awareness there are only 0.50% to 4.0%. In Uttar Pradesh (Almora) 52.0%, Delhi 48.0% and Maharashtra (Pune) 45.0% were the only states where close to half the students had a moderate level of awareness. Orissa had 82.47% students in the unaware category. The students sampled in Chail in Himachal Pradesh and in Bihar were also significantly unaware, with 65.90% in Chail and 61.91% in Bihar in this category. More than half the students sampled in Assam (57.14%) and Nagaland (60.00%) had a 'low' level of awareness.

*Study 5. **Efficacy of Non-Formal Conservation Education in Enhancing Biodiversity Information***

Efficacy of environment education (EE) programs in enhancing biodiversity awareness among 566 school students

The tables indicate that environment educational programs have enhanced biodiversity information at the school level. These findings are strengthened by the fact the two sample areas were very different in most respects.

This study has revealed the lack of awareness of biodiversity related issues in a large number of school children from both Almora and Pune. It has demonstrated the extent of enhancement in the level of information in the students who have access to an environment education program. This study specifically identifies the need for curricular based activities to enhance the information base on which attitudinal changes can be initiated. This would lead to an increase in the proportion of aware and concerned individuals with a willingness to act for conservation. Children from a rural setting have a distinct advantage over urban children. This comes from a closer relationship to their environment. Though there have been few studies that have documented whether students who have no formal education or are drop-outs have a greater amount of information on biodiversity, this has been suggested by Anil Gupta's studies through SHRISTI in Ahmedabad. If this is so, formal education must be accused of suppressing the innate desire of a child to expand his/her knowledge of biological diversity.



*Study 6. **Comparison Between Urban and Rural School Students on Perceptions of Biodiversity Use that Indicate the Level of Awareness in the Study Group***

The study quantifies among 794 students the wide differences in perception of biodiversity between 326 urban and 468 rural students. There, is however, an increasing "urbanisation" of knowledge even in the rural areas, with 'development' increasingly reaching into rural areas. This has led to changes in certain aspects of the traditional knowledge systems and resultant confusions in the perception of the value of natural resources. This is further aggravated by the expansion of television to the rural hinterland. Even the children of wilderness dwellers have begun to be affected by these influences..

Urban children felt biodiversity was important for its own sake, and was related to rainfall, and exchange of gases. Rural students more frequently said that biodiversity was related to subsistence resources, that it provided fuel, fodder, shade, and shelter for animals and prevented soil erosion. They thus associated biodiversity with forest landscape elements.

Study 7. Study of the Effect of Environment Education for Enhancing Concern Levels

A study of the level of environment 'awareness' and components concerned with biodiversity conservation was done in two groups of schools in Pune with and without an environment education program. The study covered 325 students without an EE and 510 with the program.

Students were asked whether they strongly agreed, disagreed or had no opinion on the following statements. The expected response is given below each statement.

1. The mass media (television, radio etc.) promotes environmental awareness to a large extent

   Disagree

2. Newspapers give a wide coverage to environmental issues

   Disagree

3. Studying about the environment is important for the well being of human life

   Strongly agree

4. Pune faces a large amount of air and noise pollution problems due to the increasing number of vehicles on the roads

   Strongly agree

5. Paper, bottles and plastics can be recycled and reused

   Strongly agree

6. It is important to conserve electricity and water

   Strongly agree

7. A diversity of plants, animals and birds is necessary for supporting our lives

   Strongly agree

8. National Parks and Sanctuaries are necessary to protect plants, birds and animals

   Strongly agree

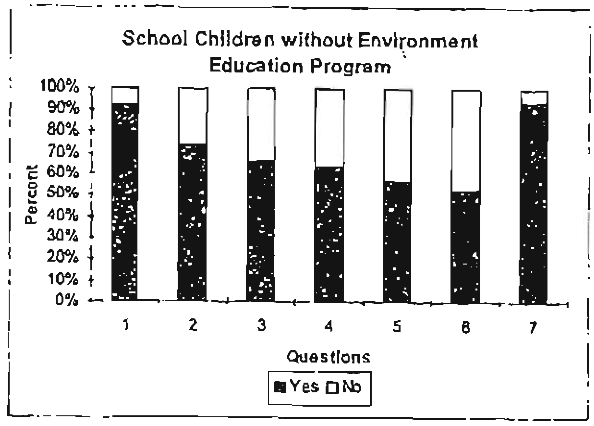
The pattern of responses from the group of students who had been oriented to environmental issues showed a greater degree of concern, when compared to the control group. This goes beyond recognizing facts that are related to information levels on these issues and indicates a more sensitized group of individuals who are concerned about the conservation of natural resources.

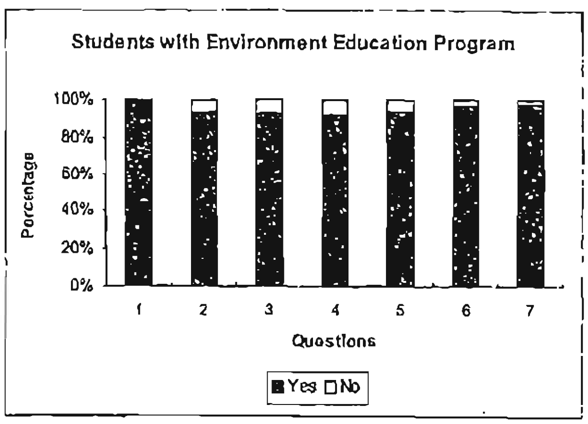
Study 8. Environment Education for Action Generation Aspects

Two groups of students were tested to observe differences in the action oriented aspects and involvement in environment and nature activities

Observations:

1. I enjoy nature trips, bird watching, star gazing.
2. I am conscious of using water and electricity carefully every day.
3. Environment education through audio visuals, film shows, poster displays, dance etc. has a greater impact on me than the usual classroom teaching methods.
4. Environment includes cleanliness and tree plantation.
5. I take part in the conservation of nature by getting involved in environmental activities.
6. I explain the need to conserve our natural resources to my family and friends.
7. I want to do something to save our environment.





The study has demonstrated that there is a need for environment education, especially through field trips and nature studies to enhance concern and provide action orientation for biodiversity conservation at the School level. It is equally important that this is considered as a part of the curriculum so that it is taken seriously by the teachers, the students themselves as well as their parents.

Study 9. Possible 'Trigger' Sources for Biodiversity Conservation Action

'Trigger' sources at school level:

Students were asked to rank various sources that could have provided them with information or generated an interest in biodiversity.

Our experience with groups of 'conservation people' seems to show that nature experiences had either initiated or considerably enhanced their commitment. Though we generally feel that school curricula is inadequate in its coverage of environment and conservation issues, it is rated very high by the students themselves. This is indicative of the low proportion of the community covered by NGO or Government programs that are expected to enhance awareness levels. This validates the viewpoint that conservation awareness must become a part of environment education through the formal curriculum.

Sources of Information at the School Level

Source	*Maharashtra*	*Assam*	*Bihar*	*Orissa*	*Himachal*	*Nagaland*
Parents/Elders	1	7	1	3	2	2
School	2	2	2	2	1	3
Books	5	1	3	1	4	1
Television	3	3	4	4	3	4
Specific Person	6	5	7	7	7	8
Job	8	8	8	9	8	9
Outdoor Experience	7	4	6	5	6	5
NGOs	9	9	9	8	9	10
Newspapers	4	6	5	6	5	6
Government Agencies	10	10	10	10	10	7

Study 10. Analysis of Syllabi in Ten Universities

(A) College Level

An analysis was done of the B.Sc. curricula of Jammu University, Punjab University, Harayana, Delhi University, North-Eastern University, Gujarat University, Bansthali University, Kurukshetra University, Marathwada University and Pune University.

The curricula was analyzed of the botany, zoology, chemistry, microbiology, and the arts and commerce faculties. The commonest topic dealing with biodiversity was ecology, in all the Universities. Wildlife conservation was dealt with in six of the Universities. Conservation or conservation biology as a separate head was dealt with only by the North-Eastern Hill University, Shillong.

(B) University Level

The curricula for M.Sc. level in Pune University was screened to identify the number of topics and the amount of time provided in the course to issues related to biodiversity conservation, directly or at least indirectly.

M.Sc. Botany:

Topics on conservation ecology - 10 lectures.

Topics on conservation of rare and endangered medicinal plants - 3 lectures.

Topics on conservation of genetic resources in current researches in ecology - 10 lectures.

M.Sc. Zoology:

Topics on Conservation of Natural balance in Terrestrial ecology.

M.Sc. Environmental Sciences:

Nil

Study 11. Analysis of Biodiversity Information and Awareness Levels in College Students from the Science, Commerce and Arts Faculties

(i) Analyses of biodiversity awareness at college level

College students of Pune, from the science, arts and commerce streams at the B.A./B.Com./B.Sc. level were interviewed to assess their level of awareness of biodiversity issues. Among the 330 students of different colleges, 111 were Science students, 145 were from the Arts and 74 from Commerce.

Analysis of Biodiversity Awareness at the College Level

Group	*Total*	*High*		*Moderate*		*Low*		*Unaware*	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Science	111	13	11.71	39	35.13	52	46.84	7	6.30
Arts	145	9	6.21	40	27.58	56	38.62	40	27.58
Commerce	74	9	12.16	28	37.83	26	35.13	11	14.86
Total	330	31		107		134		58	

(ii) Main sources of information on biodiversity, as suggested by college students

College students were requested to identify and quantify where they had obtained information on biodiversity. A list of sources were suggested which indicated the proportion each student ascribed as a source of information.

Table 11.2: Main sources of information on biodiversity as suggested by college students

Source	*No.*	*%*
School curricula	38	25.33
College curricula	22	14.67
Newspapers	Nil	0.00
Periodicals	Nil	0.00
Books	30	20.00
Television*	32	21.33
Individuals	15	10.00
NGOs	1	0.67
Others (outdoor)	12	8.00

[*DD1 (Living on the Edge, Heads and Tails, Terraview), Discovery, BBC-World]

Among college students, there is no appreciable difference among the science and arts students. A majority of the students rate books, television, school and college curricula as being important sources of information on biodiversity conservation. Significantly newspapers and periodicals in this small sample are not rated as important sources of information. NGOs have evidently not contributed towards providing information even among urban college students. This is reflected in the small number of college students who are members of NGOs such as WWF, BNHS or other groups. As these organizations cannot be expected to influence the thinking of a large number of people, the possibility of including non-formal environment education techniques into curricula at college levels, is perhaps the most important method to enhance biodiversity awareness.

Study 12. Level of Information that could Lead to the Enhancement of Biodiversity Awareness in Different Communities

The large number of individuals interviewed from the seven states were from widely different lifestyles and backgrounds. These questions have also been assessed along subjective lines during informal meetings.

	Glamour species (animals)	*Useful species (plants)*	*Unused species (plants and animals)*
Urban people	+++	+	—
Rural people	+	+++	-
Wilderness people	++	+++	+
Key groups	+++	+	-
Mass Media	+++	—	—
NGOs	+++	++	+

The grading scale is based on decreasing levels of information from (+++) to (—).

12.1) Assessment levels of information in different sections of society

This study focuses attention on the level of information in several urban target groups to assess the proportion that have different levels of information on biodiversity. This study has special problems as the word 'biodiversity' means little to most individuals. Analyzing the level of information thus needs a priming of the word without actually providing information that is being quantified.

In the majority of the groups studied among a general urban educated class of people, the level of biodiversity information can be said to be at a low level. In the 'low' category, the percentage varies from 38.00% to 50.00% in the different groups. Among the groups, a slightly smaller proportion, 12.00% to 26.37% are seen in the 'moderate' level group. The proportion is considerably smaller in the 'highly aware' group ranging from 2.00% to 16.00%. The aggregate percentage reflects the information available in different walks of life in an urban setting and amounts to only 6.05% being highly informed, 24.71% being moderately informed, 31.67% with a low level of information and 25.79% who are uninformed.

Table 12.1. Levels of Information in different sections of Society

		High		*Moderate*		*Low*		*Unaware*	
Group	*Total*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
College Students	421	31	7.36	111	26.37	179	42.52	100	23.75
Teachers	78	2	2.56	15	19.23	33	42.31	28	35.90
Professionals	150	3	2.00	18	12.00	57	38.00	72	48.00
Senior Citizens	25	4	16.00	6	24.00	11	44.00	4	16.00
Housewives	20	2	10.00	3	15.00	10	50.00	5	25.00
Total	631	42	6.05	149	21.47	261	37.61	179	25.79

Study 13. Sources of Information on Biodiversity in an Urban Society

A small sub-group of educated people from different walks of life and of varied age groups in Pune were accessed to identify the sources of information on biodiversity that they felt were important for initiating an interest in conservation.

Study 14. Assessment of Indicators of Information Levels on Biodiversity in the Media, Parliamentary Questions and Concerned Sectors in Government and NGOS

This covered various sectors that are actually concerned with conservation action or can influence policy and implementation.

Table 13.1. Sources of Information in an Urban Society

Groups	*Sources**							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
College Students	11.50	10.03	15.77	12.12	11.64	13.28	5.74	19.41
(Science)	11.32	15.78	14.05	12.66	13.61	9.80	3.60	18.77
(Arts)	12.15	2.93	14.16	15.29	7.65	22.21	7.78	17.22
(Commerce)	11.04	11.37	19.11	8.40	13.66	7.82	5.85	22.24
Professionals	9.36	7.93	19.11	12.86	11.57	5.98	10.62	22.18
Senior Citizens	7.36	4.52	31.93	9.73	14.13	10.25	4.33	17.73
Housewives	8.08	3.58	27.83	9.27	11.87	19.43	0.75	19.17

**Sources:* 1 - School curricula (S), 2 - College curricula (C), 3 - Newspapers (NP), 4 - Books (B), 5 - Magazines (Mag), 6 - Individuals (I), *In Newspapers (All India)*

News clipping analysis: (Source material for data - IIPA).

Newspaper clippings from national papers in 1993-96 have been analyzed subject-wise in relation to biodiversity conservation related issues. The most frequently recurring topic in the 3 year period relates to wildlife with 1044 articles. There were 810 articles on Protected Areas, 727 on forests, 548 on biodiversity itself, 499 on intellectual property rights and 408 on animals and birds. Less commonly, articles covered pesticides or agriculture in relation to biodiversity issues.

Questions related to biodiversity conservation in Parliament

A review of the questions in parliament on biodiversity related issues in 1993, and the nature of the questions and responses was done. This has been documented for the frequency with which various categories of questions were asked. Source material of the data was 'Environment In The Indian Parliament', Lok Sabha 1993, WWF-I ENVIS Centre 7, Indira Gandhi Conservation Monitoring Centre, for the Environmental Information System of the MoEF, GOI, March 1997.

The focus has been to establish the major concerns that figure in parliamentary debates related to biodiversity and its conservation. The 180 questions asked during the one year period can be grouped into two major categories. The first relate to forests, plants and trees. The second to wildlife and protected areas. Both are related to the conservation of biological diversity without overtly manifesting such a concern. 'Biodiversity' itself hardly gets a mention.

The questions varied in frequency from as low as 2 per month, to a maximum of 29 in the first group and from 2 to 23 on the wildlife and Protected Area issues. This shows a generally low frequency of questions considering the level of importance these issues should be given in the context of preserving our biological resources.

There were 98 questions related to forests, plants and trees of which 22 were primarily related to forests. There were three questions on mangroves and four on sandalwood. Thirteen questions appear to have focused around conservation and development concerns.

In the second category the number of queries raised regarding protected areas and wildlife, were lower than those related to forests, plants and trees. There were 13 questions that pertained to national parks. Most of the other queries appeared to be placed before Parliament between two to seven times per year. Poaching for instance, was raised only thrice, wildlife trade thrice, and skins twice. Thus CITES related questions have figured only eight times in the year. Human kills by wildlife were brought up on seven occasions.

Parliamentary debates on biodiversity and its conservation as a specific concern appear to have not figured at all during the year 1993, though these were being intensively debated in NGO and scientific circles.

Content in NGO Programs

An analysis of the activities listed in the WWF Directory of Environmental NGOs demonstrates the issues that they are involved with. The NGOs are mostly associated with environment education, while conservation education is part of the mandate of very few organizations. Similarly, environmental awareness is much more frequently a major concern while awareness of the need for biodiversity conservation is infrequently dealt with. This shows that most NGOs do not have the level of expertise on biodiversity conservation which is essential to make them feel comfortable to deal with these issues in their programs. Action orientation in environment programs is a major concern of nearly 75% of the NGOs studied. Only 21% deal with research, while an even lower 9.7% deal with conservation research. Educational material is developed by 31% of the NGOs. Among the states, 17% in Himachal Pradesh and 20% in Maharashtra work on conservation education, which is much higher than the other states.

Study 15. Analyses of Awareness on Biodiversity Issues in Different Target Groups

This aspect of the study evaluates and documents reactions to specific questions related to biological diversity, to assess the level of awareness regarding the different types of conservation issues in various target groups. This study assess awareness about the importance of biodiversity, where it is located, India's megadiversity status, the consequences of extinction, etc.

School students, from all the states assessed, felt that major wildlife protection is synonymous with biodiversity conservation. The use of biodiversity for traditional medicines was ranked second by all the students. There were some variations in their perceptions as regards the other options, but the students did not see biodiversity as being important for pharmaceutical industries, except in Orissa, where pharmaceutical exploitation was ranked third. Genetic Engineering was ranked third in Bihar, Himachal Pradesh (HP) and Nagaland, but sixth in Assam and Orissa. Eco-tourism was not considered to be an important reason for the preservation of biodiversity.

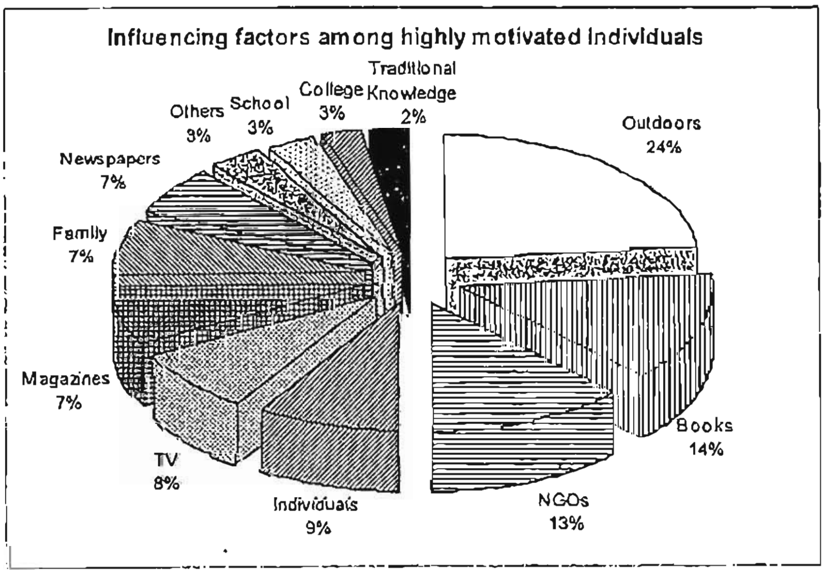
Different groups of adults from each of the eight states feel that the primary reason for the conservation of biodiversity is the protection of wildlife. The preservation of biodiversity for use in traditional medicines has been considered relatively important by all groups except professionals in Orissa. Tourism is felt to be the least important reason for biodiversity conservation. The exploitation of biological resources for pharmaceutical use is also not considered important, except by three groups - teachers in HP and Orissa and advocates in Orissa. Genetic engineering has been ranked highly by teachers and advocates in Bihar and by professionals in Orissa. These findings reflect the fact that there is little awareness about the use of biodiversity resources, apart from the obvious wildlife values. The fact that biodiversity needs to be preserved for local people's utilization and traditional medicine is appreciated by most of the groups accessed.

Study 16. Analysis of Trigger Mechanisms Among Highly Aware Individuals

A group of highly motivated individuals from WWF, BNHS, and other local NGOs were accessed to ascertain the primary influencing factors that were responsible for their interest in nature conservation.

A definite finding is that these individuals ascribe a much higher value to outdoor experiences than any of the other groups accessed. This indicates that carefully conducted nature experiences that are sensitively interpreted could be used to initiate an interest for conservation among much larger numbers of people. NGOs have also been ranked highly by 'conservation people', though this was to be expected as all the respondents were are members of one or more nature oriented organization. Specific individuals appear to be a very important 'trigger' source for these motivated group of individuals. Many specifically mention Salim Ali, Jim Corbett and others as primary motivating influences. Again this is to be expected as being part of nature organizations allows greater access to such individuals. Newspapers, magazines, television and familial influences are all ranked more or less equally.

Perhaps the most critical observation is that school and college education systems have played a minimal role in creating and maintaining an interest in nature conservation. More than half (52.35%) of these individuals were initiated into nature conservation between the ages of 7 and 22. This reflects the importance of introducing conservation awareness programs at the school and college level.



As might be expected, all individuals in this group put Nature Conservation above any other issue that affects daily life.

Factor	*Human Rights*	*Animal Rights*	*Nature Conservation*	*Poverty*	*Religion*	*Women's Issues*
Rank	2	3	1	4	6	5

Study 17. Gaps in Implementation

An Analysis of the Recommendations of the International Conference on Environment Education (Organized by the Indian Environmental Society, 1982).

In 1982, an International Conference on Environment Education was organized in Delhi. This conference identified 131 recommendations. A review of these expected actions planned in 1982 shows that only 2 were fully implemented, 15 were well implemented, 53 were partially implemented and 61 were not implemented. The high failure rate of these recommendations have been analyzed as being primarily due to an inadequate identification of who should take these actions and the allocations of funds for these initiatives, through plan and non-plan sources.

Study 18. Examples of Actions Initiated Through Non-Formal Environment Education

Case Studies

(i) *Aundhe Village, Lonavla, Maharashtra:* As part of the Bharati Vidyapeeth Institute of Environment Education and Research's School Environment Education Program (SEEP), school children of a village school in Aundhe village, Mawal taluka, Pune District were introduced to the concepts of composting as a means of reducing garbage output and recycling plastics to create an income generation source. On their own initiative, the children called a meeting of the village women where they explained the concept of composting vegetable wastes. They convinced the women to separate their household garbage and started a compost pit in the school premises. The village women now leave their kitchen waste in the pit, which is looked after by the children. The children have offered earthworm cocoons to anyone who wants them so that they can start a compost pit in their own homes and use the compost in their kitchen gardens. The school students have organized a scheme whereby they move around the village collecting plastic wastes which they then sell.

(ii) *Pune, Maharashtra:* A student member of the Kirloskar Cummins Nature Education Program saved a snake which had entered a mock fort made during the Diwali celebrations. He had previously been exposed to snakes by the program, where experts from the Katraj Snake Park had explained that most of the snakes that were found around Pune were non-poisonous. The student telephoned the Snake Park and actually prevented the crowd from killing the snake, by telling them that someone from the Park would take the snake away.

(iii) *Pune, Maharashtra:* The BVIEER runs the SEEP program in the Bal Shikshan Mandir, Pune. When the Pune Municipal Corporation was going to fell all the trees along a major road in the city for the sake of road widening, a motivated Principal mobilized her students to protest the loss of a valuable asset. The students wrote a street play about the importance of old trees and the role they play in an urban ecosystem. They moved along the Ferguson College road, performing the play and informing the passerby of the importance of the asset which they were going to lose. They then approached the Municipal Commissioner and staged a protest outside his office. They spent the rest of that day and most of the next collecting signatures for a petition and making posters which they displayed in a 'street exhibition'

(iv) *Pune, Maharashtra:* After exposure to the SEEP program, students of the P.E.S. Modern School, Pune, have attempted to create a 'plastic free zone' in the premises.

(v) *Pune, Maharashtra:* Students of an Environment Center started by SEEP in the Bharati Vidyapeeth Kanyashala felt motivated enough to go around the entire school and explain concepts of garbage segregation and management to students not exposed to the program.

(vi) *Chakrashilla Wildlife Sanctuary, Salcocha, Dhubri, Assam:* During the early eighties, the fourteen year old son of a local landowner, Soumyadeep Dutta, initiated into nature conservation by the WWF, began visiting a remote area to build on his bird watching skills. As his visits to the area increased, he realized the importance of this pristine, relict patch of forest. With the help of his sister, aunt and the then president of the WWF-North East, he established an NGO called Nature's Beckon. Slowly influencing friends and family, Nature's Beckon began working with the Rava tribals of Chakrashilla. Many years later, with conclusive evidence of a population of Golden Langoor (Presbytes geei) in the area, Soumyadeep was able to convince the State Forest Department to notify the area as a Wildlife Sanctuary. What is unique about this sanctuary, however, is that there is no active 'policing' by the Forest Department - local people have taken on this responsibility themselves.

Study 19. Case Study on the Uttar Khand Seva Nidhi's (UKSN) Environment Education Program

The Workbook Program of the UKSN

Five schools, in which the UKSN's environment workbook program is being conducted, were visited. During these visits, discussions were initiated with the principale and the teachers, on the outcome of this program. Principals of the schools expressed their wish to continue with this program as it was proving to be very effective for the student's understanding about their surroundings.

Of the 575 student responders, a rapid statistical survey of the proformas show varying information on biodiversity related environment concerns. Their focus of attention is on agricultural aspects of the environment, as it deals with all their life support systems. Though it is difficult to assess to what extent this is directly related to the workbook program, the level of information on these issues is considerably higher than expected.

Study 20. A Study of Traditional Perceptions that have Led to Conservation Action of Biodiversity Through Sacred Groves

The cultural and biodiversity values of 40 sacred groves in the Mulshi Taluka have been evaluated.

A total of 156 responders from 30 villages were interviewed to provide a data base on the 'dev rais' (sacred groves) within their village surrounds. These individuals were randomly selected. The survey is thus indicative of the perceptions of the average village dweller from this tract of the Western Ghats. Of these, 'key individuals' that were identified through the random survey were also met to collect more detailed source-material for specific information on the biodiversity of the groves and the methods used in the traditional patterns of life, which has led to their conservation.

Conservation Value and Level of Intactness

The groves have been classified for their present conservation status into three groups. This grading scheme takes into account the 'intactness' of vegetation, their species richness and the proportion of large trees, and the presence of unique species. This is countered by the degree of threat acting at present, that lowers their long term conservation potential.

Of the 40 *dev rais*, 7 are extremely valuable, 30 are of moderate importance, while 3 have very little conservation significance.

This study has shown that over half of the local responders still feel a deep sense of veneration for the deities and groves that their forefathers have worshipped. Sacred groves are protected out of traditional beliefs that their desecration can lead to ill health or serious calamities, rather than out of ecological needs or as resource banks. Irrespective of the reasons the rites and traditional behavioral patterns lead to pro-conservation behavior.

A possible conservation strategy would be to maintain certain traditional perceptions by translating them into modern concepts of conserving biological diversity. In many instances such parallels can be drawn and local people would easily accept that their forefathers had values from a different perspective that is not relevant today. If the age old fear-element is used as the prime motivation for conservation, this would in future fail to lead to conservation.

Study 21. Information Available in Print Material for Analysis and Reporting on Biodiversity Conservaiton for Education and Awareness Aspects

An indication of the type of information available in print material can be assessed through a review of the reference material used to compile this report. It shows the wide range of material from scientific books and journals, reports to 'people friendly' periodicals, magazines, newsletters etc.

The material demonstrates that information categories of different levels and content can be identified in each of the materials that have been reviewed.

Table 20.1: Analysis of 156 responders - Peoples perceptions of sacred groves

	Affection			*Veneration*			*Respect*			*Fear*		
Level	*High*	*Mod*	*Low*	*High*	*Mod*	*Low*	*High*	*Mod*	*Low*	*High*	*Mod*	*Low*
Number	35	32	4	13	24	8	12	18	3	2	4	1
%age	22.43	20.51	2.56	8.33	15.38	5.12	7.69	11.53	1.92	1.28	2.56	0.64
Total	71(45.50%)			45(28.83%)			33(21.14%)			7(4.48%)		

In the 123 referral materials that provided information, these could be categorized into:

1.	Conservation education	12
2.	Conservation awareness	43
3.	Conservation Education Programs	21
4.	Environmental Awareness Programs	20
5.	Environment Education - Forestry	1
6.	Awareness - general environment	2
7.	General biodiversity	6
8.	Assessment of biodiversity	8
9.	Policy	19
10.	Strategy	18
11.	Implementation	2
12.	Action	11
13.	Legislation	8
14.	Women's issues	2
15.	Sustainable Development	14
16.	Research	15
17.	Taxonomy	1
18.	Interpretation	1
19.	Capacity building	3
20.	Economics related issues	13
21.	Ecotourism	1
	TOTAL	221

Study 22. Local Perceptions on Biodiversity and 'Gaps' in Knowledge

To document the perceptions of local people on the importance of biodiversity conservation from their own perspective, identify 'gaps' in knowledge and understand how they feel these gaps should be addressed. The following aspects were focused on during this study.

1. To understand what aspects of biodiversity are known through traditional knowledge systems.
2. To identify 'gaps' as compared with formal modern systems of knowledge.
3. Discuss with local people if they feel that such knowledge should be provided, and if so how they perceive this information could be disseminated in their community.

Traditional knowledge: This form of knowledge is mainly 'use' based which, according to local people, has trickled down through many generations. When asked about this, nearly all the responders had similar responses - 'we were told this when we were children.' They use this knowledge and are passing it on to the next generation. They are aware of the importance and value of traditional varieties of crops but the need for higher crop yields and cash crops has forced them to switch over to modern varieties of crops.

Where are the gaps?

Many people in these villages are either illiterate or have left school between the 4th and 8th standards. consequently, modern scientific knowledge cannot have greatly influenced their thinking. Whatever knowledge they have is thus mostly traditional. Their inability to classify animals, plants, reptiles into respective groups indicates that for them there is no need to classify them. Their knowledge is oriented towards their daily needs. They say that 'insects are ugly because they destroy crops.' When bees and other pollinating insects were mentioned, they seemed to be convinced that insects are helpful and indicated that they would want more information about such issues. They value the need for conservation but they are unclear about the effects of species extinction. Even though the concept of food chains as a 'link between different plants and animals' is not clear, they know the food of several animals. They are unaware of the importance of apex species such as tiger, eagle, or wolf as indicators of complete ecosystems and feel that their extinction will not harm them. They say if the tiger disappears it would not make any difference. But if cattle disappear, it would certainly affect them. These people have fair level of expertise in field craft and even if they do not know the name of a particular species, they know its behavior, habitat, needs and feeding patterns.

They know the names of all the small plants that their cattle feed on, and even which ones are good for them. They do not have names for the plants which are neither used by them, nor eaten by their cattle, and they call all of them '*jungli jhade*'- wild plants, which though recognized to include, as being of several different species are un-named.

The greatest challenge in conservation education is matching the program with the variety of needs of different groups in society. This is most critical in groups that are directly associated with utilization of biodiversity resources. Forest dwelling tribal people, fisherfolk, pastoralists, farmers etc., whose way of life and occupation are closely linked to wilderness ecosystems, also have highly localized traditional knowledge systems in which biodiversity is a major component.

To establish a relevant conservation oriented educational or awareness program is difficult for two reasons. The biodiversity user groups perceive biodiversity differently from non-user groups, as the former have a higher level of awareness of its use value. On the other hand, they know relatively less about the needs for conserving biodiversity at the genetic, species and ecosystem levels. This is outside the sphere of their experience. However, they show a keen interest in learning about such things.

Findings

The studies designed as apart of this project were aimed at assessing the level of information and degree of awareness of biodiversity among various segments of society. They focus attention on the proportion of concerned individuals in society and their desire and ability to act for conservation.

The studies analyze - information, awareness, concern, and action for biodiversity conservation, in specific target groups.

The different modules of the study broadly include:

The Status of *information* in different target groups and important Sectors.

Analysis of the level of *awareness* on biodiversity issues in different target groups.

Assessment of individual responses on their concern for biodiversity conservation and *actions* they have done or can suggest for its conservation.

Analysis of behavioural features at specific community level.

Documentation of individual and community participation in conservation actions.

*The Status of **Information** in Different Target Groups and Important Sectors*

The information on biodiversity in different groups is not only a question of degree but of totally different patterns which thus cannot be compared to each other. This deals with the information in formal education and different non-formal environment education initiatives.

Conservation consciousness in traditional societies stems from close interactions with nature. Much of the information among these people comes from having to collect resources from the wilderness every day from early childhood into old age. Information is 'learned' by watching elders and peer groups and from memorable episodes that result in an indelible mark on their minds from childhood memories.

As Societies move away from these daily close encounters with nature the information banks in the form of gurus, teachers, books, electronic media, and computerized data banks must take the place of the teacher that is Nature herself. Going back to nature, if she exists in her less disturbed form, thus becomes an enlivening experience that is probably genetically coded deep in the human mind.

Landmarks that led to the modern refashioning of such information came to be known as nature education. This includes environment education, and conservation awareness. Each has a different scope. Environment education is comprehensive and can be said to include natural resources, biological diversity, pollution and energy issues in the broadest sense. Nature education is the field approach through non-formal nature study, observations, and outdoor experiences. Conservation education deals with the preservation of resources and is most frequently associated with different aspects of the biosphere.

Issues and Concerns at the School Level:

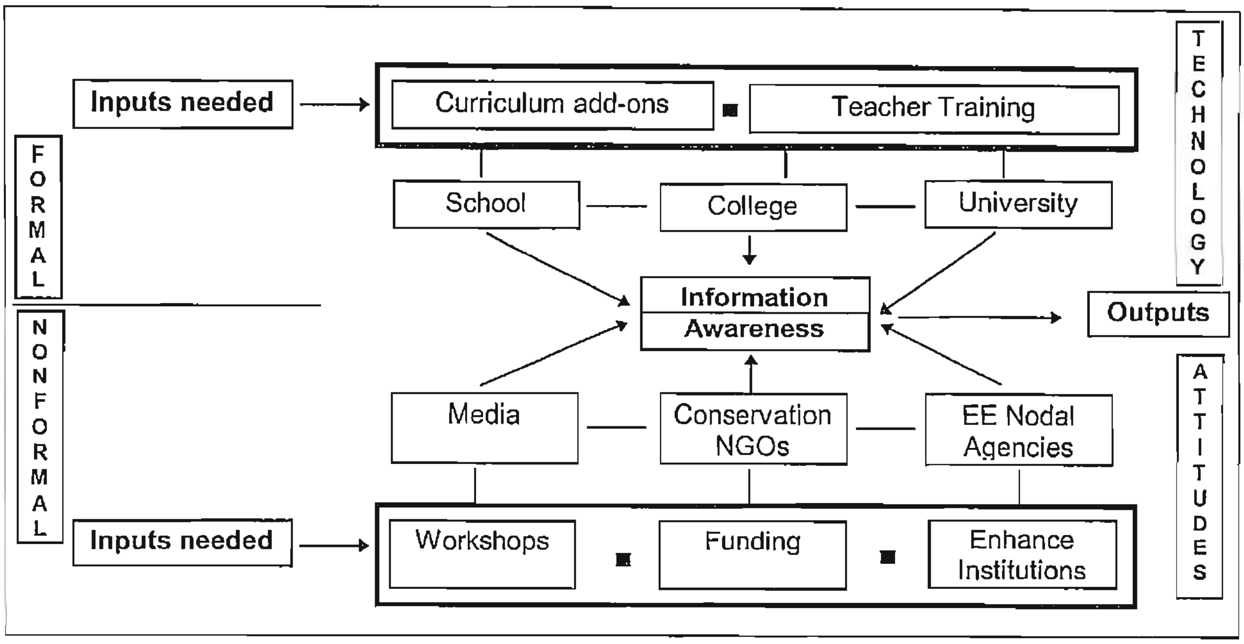
(i) Integrating biodiversity into general science is insufficient as several issues are more closely related with social studies. Conservation issues can also be learned effectively through language classes. These however need to be carefully selected by individuals who have a deep understanding of conservation issues. In the Maharashtra english language text books there are lessons on wildlife that have unfortunately been incorrectly selected. They are related to stories of man eaters and zoo animals rather than these that would stimulate a concern for the immense value of wildlife. The opportunity of the lesson to excite people about nature is thus lost.

(ii) Information level among the teacher community is low and the instructional methodology used by the teachers is inadequate. There is evidence to show that it can be enhanced by teacher training workshops run by NGOs. Short courses of 3 to 5 days organized at WWF, CEE, BVIEER have always included biodiversity. The experience at BVIEER has shown that short courses can provide information that can be used in class-work but are unable to train teachers adequately in field craft and identification of species. This needs both a longer period of training as well as a high degree of motivation among the teachers.

(iii) Status of awareness levels in school children.
Of the 1,161 students who were studied, the vast majority had a low level of information on species.

(iv) Students assessed for level of awareness include both those who attended environment programs and those who had not. The results showed that environment education programs organized by NGOs reach on only a small proportion of students, most of whom are from the urban and upper socio-economic class. Accessing a large number of students is unlikely to occur through the present initiatives used for non-formal environment education.

Input Needs for Biodiversity Education and Awareness



The most critical aspect is using the strengths of the formal and non-formal methods as complementary forces to strengthen each others weaknesses. A review of the strengths and weaknesses of formal and non-formal environment education methodologies at the school and college level has shown that both methods need to be used if conservation is to be achieved.

These findings suggest that information on biodiversity and awareness and the value of its conservation came from a variety of sources. In different sections of society the proportion of information from each of these sources varies considerably. To enhance information, and expect an attitudinal change will require inputs from a variety of sectors. Several inputs are necessary to make this happen through this wide ranging group of institutions. The expected outcome from this integrated approach would lead to the conservation of our wealth of biological diversity.

Issues and Concerns in Different Segments of the Society

During the survey of eight states in the country, individuals from different walks of life were met informally to discuss biodiversity issues out of this sample emerged a picture of the pattern of biodiversity conservation awareness in the country.

The segments that understand the need for preserving local biodiversity are 'Biodiversity User Groups' who have information on their locale specific needs. These ecosystem people however, make little distinction between natural resources and biological diversity.. That currently non-usable life-forms are also to be conserved to keep future options open, is outside their perceptions. While the value for conserving specific usable species or sites exists at the local level and there is an awareness in certain sectors of

Strengths and Weaknesses of Formal and Non-formal Environmental Education

	Strengths	*Weaknesses*
Formal	Large outreach through school and college students	Poor information base and lack of expertise in teachers. Inadequate curricula.
Non-formal	Can reach a variety of target groups. However, in relatively small numbers through local NGO initiatives.	Club-like approach not taken seriously at school level. At times misused for personal agendas.

society for the need for protected areas to preserve wildlife, the broader implications of creating state or national level protected area systems remains unknown.

People view their 'biological endowment' from their own perspectives: use, aesthetics, emotional value, religious sentiments etc. The genera implications of the erosion of biodiversity and of mass extinction of species are essentially unappreciated. The ongoing destruction of biodiversity because of 'development' processes and the forces that are driving changes in land and resource use, are not appreciated even by concerned individuals of the press or administrative functionaries.

The most important issue that emerges out of this analysis is the great disparity of the patterns of biodiversity awareness in urban, rural and wilderness communities. While this was obvious to start with, the pattern of differences that have been identified among these three groups is of great importance in developing a strategy towards achieving biodiversity conservation through a biodiversity awareness program. Some of these are:

1. There is evidence to show that biodiversity conservation and planning for protected areas (Pas) were frequently in conflict with the forest departments working plans for areas around a PA. This is also true for the activities of the fisheries, urban development, small scale industries development, irrigation and hydroelectric departments. All these conflict with the objective biodiversity conservation both at the planning and implementation stages. This indicates a lack of co-ordination and of an all pervasive land use policy at the national level.
2. Regional planners who develop urban plans are oblivious of ESAs or the special safeguards essential for integrating wilderness areas into expanding urban areas. Such areas include landscape elements like surrounding hill forests, wetlands and common grazing lands. As a result, areas which have high biological value get converted to urban or industrial uses.
3. There is a lack of coordination among the various government agencies that are involved directly or indirectly with the conservation of biodiversity. This result in conflicts between territorial wnd wildlife wings of the state forest departments. The management of PA, perceptibly changes when there is a biodiversity conscious PA manager. The absence of biodiversity oriented management planning for reserved forests is another major problem.
4. The fact that relevant information on biodiversity can support conservation efforts in the country has not been appreciated by university, college and school teachers, by the Human Resources Development Ministry or by the state training institutes imparting in-service training to government officials.
   Though education and awareness are usually considered to be a slow means for initiating change in social behavior, experience at the BVIEER-Pune with School environment education programs has shown this to be much faster than usually believed. The trickle of information on biodiversity from school children to the family and even the community occurs frequently in both urban and rural areas.
5. The laws that are essentially aimed at preserving biodiversity are only vaguely known and even NGOs are usually not aware of how they can be used for conservation action. At the local level, these laws remain completely unknown, except in certain sites, for example around Pas, where poaching is actively prevented. The provisions in these laws concerning, for example, the cutting down of trees or trapping of small animals and birds are usually unknown.

Analyses of Behavioral Features at the Community Level

Though there has been a persistent increase in the interest in environment education both through government and NGO activities, the focus specifically on conservation of biodiversity has been lacking in most environment related programs. This has led to a lack of usable information on biodiversity, a poor field orientation and no overt conservation action for preserving sites and species. While a low level of competence has been generated through both formal and non-formal means, this has not led to increasing concern, or action. This indicates that a sufficient amount of attention has not been given to attitude change. There is very little active participation at the people level - urban, rural or wilderness communities, to bring about conservation of sites and species. Thus, outside the membership of conservation, such as WWF, BNHS and a few other NGOs there has been very little interest in conservation.

Urban People

Urban groups know more about what is projected in the media and in books. Several are aware of glamour species —but there is very little taxonomically accurate information.

Rural People

At the rural level, information on the utilitarian value of biodiversity is relatively higher than in the urban groups. This is more evident in older individuals. Traditional agriculturists are highly knowledgeable about crop varieties.

Wilderness People

Among 'ecosystem people' the awareness is focused on useful species of plants and animals that can be locally collected from the wild. It is also related to the dangerous animals that live in the wilderness. The tribal communities are also a great store-house of information on a variety of wild species. Certain segments of the wilderness dwellers know more about fish as they are dependent on fishing. Others know about plant life, especially medicinal plants, which are collected by specific families. Trappers and gatherers understand animal behavior and their habitat preferences.

From Awareness to Action

The mosaic of information patterns in India's highly diverse 'humanscape' if networked through education, could lead to an enhanced level of conservation action. Information on biodiversity is mostly concentrated in a few individuals of specific communities or those having special backgrounds. Their perception and motivation is difficult to measure in quantifiable terms. Their numbers are too small to lead to a mass conservation movement. Multiplying their numbers is an essential prerequisite for the longterm conservation of biological diversity.

A National Strategy for Biodiversity Education and Awareness

This study has not only produced a status report on the level of awareness of biodiversity issues in various sections of society, it has also analysed the information contained in formal and non-formal education on biodiversity. This analysis has been used to develop strategies to enhance a concern for the conservation of biodiversity.

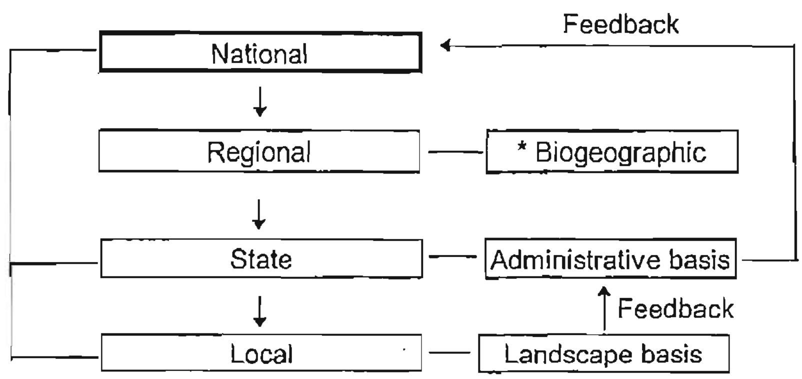
Background

Most conservation programs focus attention on the management of landscapes or on people issues. Few strategies appear to be built around the information needs of the society. The BCPP has recognised that 'education and awareness warrant a detailed study'. In this respect it is unique. It was emphasized ' - that it (education and awareness) is critical and not much work has been done so far', in relation to using education and awareness as a focus for supporting a conservation strategy. The low level of awareness in the society and the gaps in biodiversity information prevent conservation from becoming a reality. Once priority sites and species for conservation of biodiversity in the country have been identified - education, awareness and training are vital for developing 'participatory conservation programs' at the local level.

Appropriate methodologies for enhancing conservation education and biodiversity awareness programs have been identified on the basis of information collected from a variety of key players. Their opinions have been the basis for developing biodiversity conservation education and awareness strategies for the local, state, regional and national levels.

Strategies for Promoting Biodiversity Education and Awareness

There are a large number of traditional uses of plants and animals that people have known for many generations. The majority of species that have names in local languages are those that people use, or those that they fear, or those that have a religious significance. The rest are frequently unnamed plants and considered 'jungli' (wild) or animals that are classified into a large vague group such as 'kitak' for all 'insects'. The known uses of biodiversity at the local level are enormous. But there are also gaps in local knowledge. There is a need to understand the limitations of traditional knowledge rather than romanticize the level of information within these systems. If people's knowledge can be validated and integrated into formal curricula, a locally acceptable method for conserving biodiversity at the local level could emerge from it. What is easy to introduce into curricula is the use of existing local knowledge of biodiversity that is a part the community's perception of its utility. What is not so easy to explain is why all plant and animal species - even those that may cause them bodily or economic harm, need to be preserved. This is outside their sphere of life, - alien to their understanding. Their perceptions are based on the utilitarian value of nature. It is the bringing about the realization that biodiversity must be preserved as intact natural ecosystems, for the future well-being of the mankind, that is a communicators greatest challenge. Can we make this happen by using our own religious and cultural traditions of the sanctity of all forms of life. What are the other strategies that could be used to further conservation. One of the most crucial issues for conservation in India is the absence of a comprehensive and clearly enunciated policy for the conservation of biodiversity. In fact we do not even have a clearly stated National Landuse Policy. Most of the related acts and laws already exist but have not been collated into a special policy statement on biodiversity. This creates a problem in developing a comprehensive strategy as its implementation and action component can only become a reality if it has an umbrella in the form of a policy statement. The National



* There are no institutions at the regional level that can legislate or create institutional structures on a biogeographic bases. This can either be done from the center by involving the relevant State (or) the relevant group of states could integrate activities based on their biogeographic location.

Policy on Biodiversity Conservation could then become a framework for state level policy statements.

Possible methods for enhancing pro-conservation behavior and creating a society which supports conservation will require inputs in the formal education sector and through a non-formal awareness dispersal mechanism using media support, government agencies, environment education institutions and NGOs.

A Macro-Strategy

The macro strategy given provides a concept, design and implementation aspects to develop a Biodiversity Conservation Education and Awareness Action Plan for urban, rural and wilderness people. The analysis at micro-level has been used to design strategies to enhance a concern for the conservation of biodiversity which would create a milieu in which a National Biodiversity Conservation Strategy can be implemented.

To develop a strategy to enhance education and awareness of biodiversity, it is important to understand how information transfer mechanisms produce an awareness of conservation issues in the community. The possible communication strategies applicable for different groups have been identified. It is equally important to address the gaps in information. In reasonably well informed people, awareness changes to a deep 'feeling for nature', and a concern that biodiversity is being lost. This concern grows into a need to 'act' or lobby for preserving biodiversity. The factors that initially motivate people to develop an appreciation for nature have been identified. The minimal role of formal education, and media, the highly specific 'niche' of local knowledge systems, have been addressed. An over romanticized view that there is a high level of information on biodiversity in communities that live around wilderness areas must be dealt with cautiously. These individuals are aware of only species that inhabit their own landscapes. It is difficult to envision a strategy for enhancing pro-conservation sentiments in such groups towards all species. The design of this strategy is aimed at awakening a mass movement that will ultimately lead to the conservation of biological diversity in our country.

Framework for an Education and Awareness Strategy

The macro-strategy for education and awareness of biodiversity has been organized as follows:

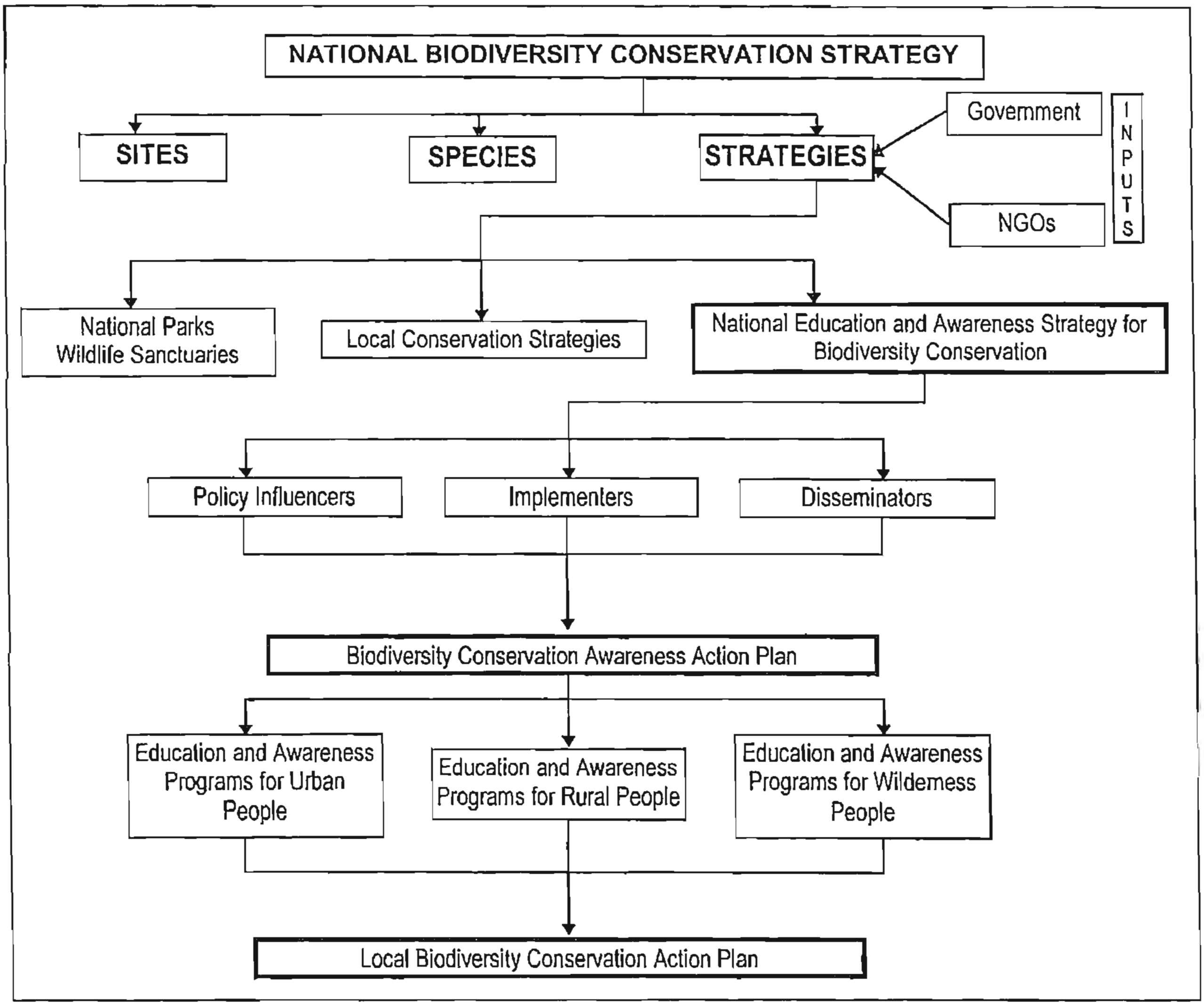
Concept: *Why* an education and awareness strategy is essential?

Design: *What* needs to be done?

Implementation: *Where* and *How* it is to be done.

Action Plan: *Who* is to do it.

There are several linkages between the national, state and local level strategies which need a feedback loop to be able to redirect the strategy as necessary. Top down initiatives and programs at the national level are bound to fail if the basic design cannot be used in the periphery. During this review and study of biodiversity education and awareness a serious attempt has been made to interact with a large number of diverse user groups to make the strategy



as implementable as possible. It is thus a National Framework based on the needs of multiple user groups.

Concept

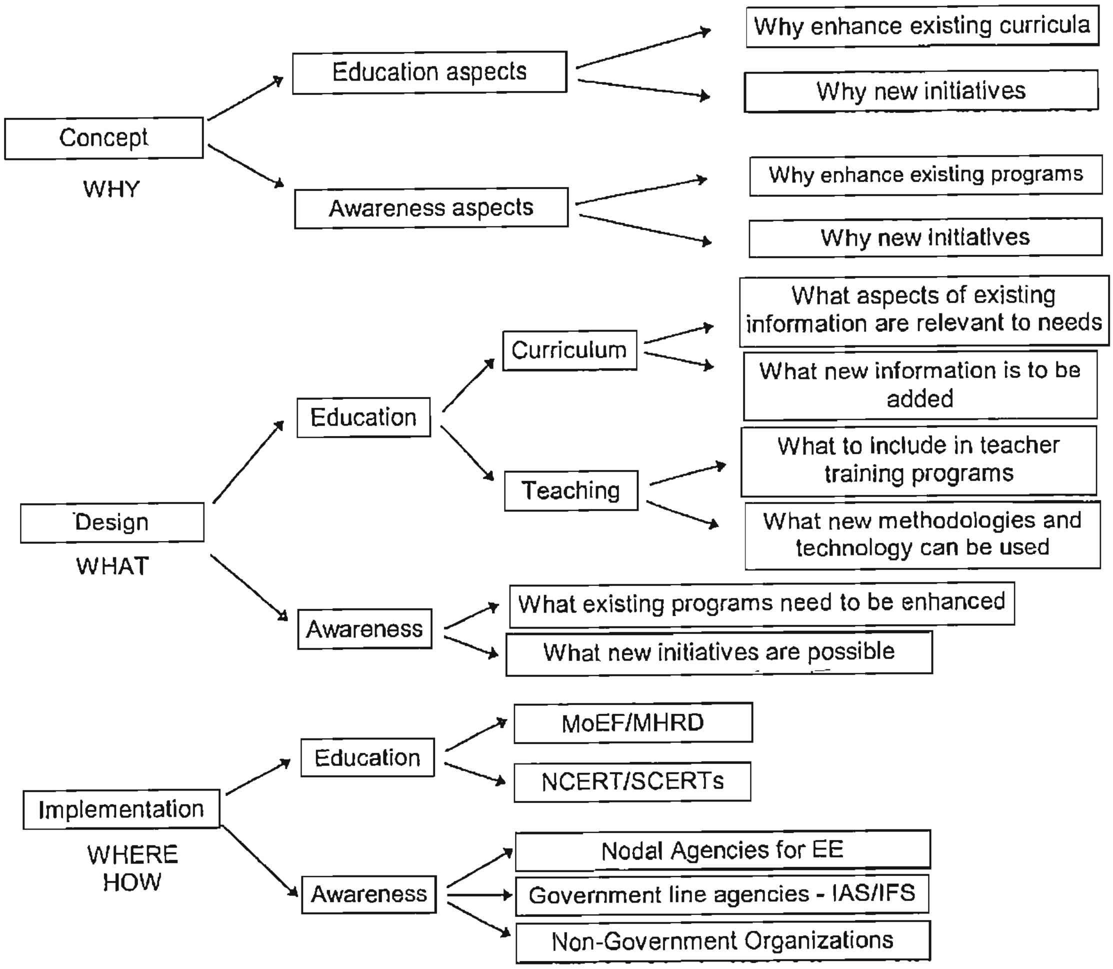
In the absence of a large number of people sensitized to conservation needs, there can be little mass conservation action at the national, state or local levels. This accounts for the existing patterns of conservation action that are triggered by a small number of highly aware individuals.

Most people are unaware of the reasons why biodiversity conservation needs to be included in the National agenda on an urgent basis. People are unaware that the pressures of development affect our biological diversity. That its effect is the loss of wilderness ecosystems, the extinction of species and the disappearance of traditional domesticated varieties of plants and animals, is essentially unknown.

No effective conservation at these three levels can occur without a policy framework. This cannot be developed unless policy makers understand why biodiversity must be conserved.

Within the education system there is a near total absence of information on biodiversity conservation. This is the key sector, as it is sectors that impacts on a large number of people who are at an impressionable age. This is why the strategy places a great deal of emphasis on enhancing existing curricula. Within sectors the other that can enhance a general awakening in society of the values of protecting biodiversity, such as the media, there is a need to rapidly enhance biodiversity related programs.

Enhancing a concern for biodiversity conservation can be approached through the existing educational system as well as through existing information and extension programs of the Government.



Biodiversity extension material essential to create a concern for conservation needs to be site specific. However, what should be included in school curricula and in college programs has so far not been clearly defined.

Enhancing awareness at the community level for urban, rural and wilderness area people requires different approaches as the patterns and levels of existing awareness between these groups and its levels differ widely. It is evident that the mass media could reach the widest number of individuals in society. However, making mass media relevant to the needs of the diverse groups in the community requires a new approache.

The most crucial need for conserving biodiversity in India is that of a conservation movement to support this dwindling resource. This can only be catalysed through extensive education and awareness.

Our survey data indicates that biodiversity information in India is varied, often contradictory and frequently irrelevant. The level of awareness about biodiversity among school students at school and even among science students at the graduate level, is poor. Classroom teaching has been unable to provide the requisite amount of information on biodiversity and has failed to exciten the younger generation a concern for biodiversity leading to action aimed at its conservation.

In contrast, the non-formal environment education sector appears to enhance certain aspects of biodiversity awareness (for instance, for appreciating glamorous and exciting species of wild animals) without considerably enhancing a broader interest in 'nature'. Also, a very small percentage of individuals are accessed by government institutions or NGOs that include biodiversity awareness programmes as part of their mandate. Their extremely localized impact strengthens the case for integrating their techniques into formal educational curricula for better dispersal.

At the macro level it is the micro needs that must influence state and national level initiatives of the government sectors involved in educational planning such as the NCERT, the SCERTs, the education departments at the state and taluka level. They must involve the teacher community in developing need based curricular and co-curricular programs.

Design

The design aspects of the strategy describes what needs to be done to enhance environment education aspects. The type of information and the methods for its dissemination are crucial for creating conditions that would make conservation a national movement. This ranges from macro-strategies at the national level to micro-strategies at even the individual level.

The National Level

Three aspects need consideration for developing a national strategy to increase the efficacy of the educational system and enhance awareness to bring about conservation.

1. Identifying existing successful conservation awareness programs at the national level and including their relevant elements in the formal educational system.
2. Identifing present micro-initiatives that are successful but localized and, basd on these, developing models that can be adapted to become a part of the national and regional strategies.
3. Developing Identify and implementing new innovative methods that could lead to a people oriented awareness strategy for biodiversity conservation at the national, state and local levels.

The State Level

The State level initiatives both in terms of educational inputs and awareness programs vary extensively in both content and intensity. State needs vary due to a wide variety of related issues - economics, politics, basic literacy, social structures, etc. States such as Assam and Nagaland feel that they have been left out of mainstream activities due to their remoteness.

State department Ministries of environment and forest consider forest protection and exploitation as a major mandate - biodiversity preservation 'may be good for the country but not good for state revenue generation', is a sentiment often implied during interactions with state officials.

The District Level

The most crucial aspect at this level is generating enthusiasm in the commissioners, collectors and forest officials. Interactions at this level with local NGOs is also a crucial factor.

The Taluka Level

There is a great need for capacity building within institutions at this level. Development NGOs need inputs on conservation at the working end of programs.

The Village Level

Introducing conservation education into village schools must be initiated through the local panchayats. This is especially important as only then would parents feel this is an important aspect of formal education. It is at this level that a framework for a participatory approach to conservation needs to be urgently developed.

The Individual Level

Most people, when they are initiated by recently acquired information into developing a '*concern*' for environment (resources, energy, or biodiversity), begin to ask - What can I do? This is the first question of the '*action*' stage which educators, disseminators and implementers must be able to address.

Planning for Conservation Education and Awareness

Among the several methods available for increasing awareness levels and widen it throughout the community, it is frequently the most traditional strategy that is implemented. This often leads to failure. New, innovative or alternate, methods have the potential to achieve considerable conservation gains if developed appropriately.

Implementing the educational strategy requires

Analysis of existing curricula and identification of gaps
Identification of the message that fills the gap
Support from Central/State Government
Focused teacher training workshop to generate a participatory program
Evaluation
Modification
Locale specific replication for large scale use

Implementing a mass awareness program requires:

Identifying the specific problem
Identifying the appropriate message
Identifying the most appropriate method - type of mass communication media
Initiating a small scale program to identify effect on the most important target group
Evaluation
Modification for use on a wider group of target audiences

Selecting Methods of Information Dissemination

A **matrix** of possible options that are appropriate for different target groups range from highly effective to useless. Such a matrix could help in designing the appropriate mix of methods to be used to raise educational and awareness levels in different target groups. The level of information provided through formal education and non-formal techniques that raise awareness levels culminate in behavior changes that lead to conservation.

Information Needs for Creating Conservation Consciousness

What individual groups should know:

As different sectors of society already possess knowledge of biodiversity from their own perspectives, there is no need to repeat that which is known to them. It is important to provide information that they do not have and add to what they already know. An average individual, after school, should know that biodiversity is an important and valued national asset, just as any other natural resource such as air, water, soil, oil etc.

Focused information:

(a) Wilderness area people know a large number of local species and understand their own ecosystem, but are unaware of other ecosystems or species not found in their sphere of life. They are the most 'aware' group and are deeply concerned about biodiversity loss but feel it is available elsewhere as they are cut off from the outside world. For wilderness area dwellers, especially tribals are, 'ecosystem people' who already 'know' and use a large number of plant and animal products. A large proportion of drugs have originated from indigenous knowledge of people. However few efforts have been made to explain the principles involved in safeguarding intellectual property rights (IPRs) to local people.

(b) Rural people know domestic diversity and common species that affect their daily lives, either positively or negatively, are aware of losses of wilderness areas such as forests, common grazing lands, non-wood forest products, and of resource scarcity associated with biodiversity loss. Rural people also have knowledge about crop varieties and local livestock types.

(c) Urban educated individuals know about glamour species. There is little knowledge among them of non-glamourous endangered species or of wilderness loss. It is essential to explain to urban populations that wildlife is conserved in PAs and that the cost of such comnservation is often paid by local people whole

Levels	*FEE (FCE)*	*NFEE (NFCE)*	*A-Vs*	*Posters*	*Hand outs*	*Work sheet*	*Lec-tures*	*Work shops*	*Field Trips*		*Print media*	*Radio*	*TV*	*NAA/ IC**
									Short	*Long*				
School	++	++	++	++	+-	+-	+-	--	++	++	+	-	++	++
College	++	++	+	+	+	+	+-	+	++	++	++	-	+	++
Univ.	++	+	+	+	+	+	++	++	++	++	++	-	+	++
IAS	+-	+	+	+-	-	-	+-	++	+	-	++	-	+-	+
IFS	+-	+	+	+-	-	-	+-	++	+	-	+	-	+-	+
LCF	+-	+	+	+-	+	+	--	+-	+	+	-	++	+-	++

LCF = Local community.
FCE = Formal Conservation Education, NFCE = Non-formal Conservation Education
Key:
++ = Works very well,
+ = Works well,
+- = Works sometimes,
- = Works inadequately,
-- = Does not work.
*Nature Awareness Areas/Interpretation Centres.

access to resources that they need for their livelihood is restricted. This must be compensated. They must understand that indirectly, their highly unsustainable lifestyles affect biodiversity more seriously than the needs of the rural and wilderness communities.

The design of an educational profile that is appropriate for (a) different states that have specific landscapes and ecotypes; (b) different perceptions in the urban, rural and wilderness sectors, is a complex task.

The strategy must aim to focus mass media attention on specific pro-conservation messages and to promote appropriate television programs. Orientation of press reporters is also essential.

Implementation

A conscious effort to develop an appreciation for biodiversity conservation with a view towards an action oriented program can only come through developing a variety of locale specific awareness programs. Each must be specific to the needs of the various target groups that need to be sensitized to these issues. These range from officials from diverse levels in government, at the center, the state, and at the local level, such as ministers and MLAs, the elected representatives of the people at the village level; the concerned administrative officials, such as IAS and IFS officers and their field staff; the judiciary; officials of the departments of education, industries, energy, etc. Each of these have specific needs to begin to understand the value of conservation of biodiversity within the sphere of their own functions.

Biodiversity Conservation Action Plan

A National Biodiversity Conservation Action Plan must be designed to suit locale specific needs through a common protocol that can be easily reoriented to make it applicable to a variety of situations.

The program must clearly state its objectives. It must be focused on biodiversity conservation, but cover a wider spectrum of related natural resources and ecosystem services that need to be preserved, with biodiversity as its central theme. The Action Plan should incorporate a wide variety of awareness programs.

Action Plan for Biodiversity Conservation Education and Awareness

The list of possible action modules can be categorized into the following activities:

(i) Programs
(ii) Projects
(iii) Training
(iv) Workshops and Seminars
(v) Instituting committees
(vi) Instructions to line agencies and NGOs from concerned Ministries
(vii) Setting up new agencies
(viii) Media needs
(ix) Material development

These tasks would have to be carried out at national, state and district levels, based on local needs. These deal with educational initiatives and awareness generation actions.

Framework for Activities and Programs for Education and Awareness Generation

Tasks for Central Biodiversity Education and Awareness initiatives

1. *Establish*:
   National Commission on Biodiversity
   National Commission on Species Conservation
   National Commission on Sites Conservation
   Develop:
   National strategy on education and awareness for biodiversity conservation

1. Strengthen Existing Environment Education Nodal Agencies by creating a special Biodiversity Education and Awareness Unit.
2. Establish a specialized National Biodiversity Education and Awareness Center.
3. Establish a National Biodiversity Training Center
4. Constitute a Committee for curriculum development on biodiversity at the national level.
5. Strengthen dissemination of conservation material through a newly established institution on biodiversity awareness enhancement.
6. Provide guidelines from the Ministry of Information and Broadcasting to the mass media.

Tasks for State Biodiversity Education and Awareness initiatives

1. *Establish:*
   State Commission on Biodiversity
   State Commission on Species Conservation
   State Commission on Sites Conservation
   Develop:
   State strategy on education and awareness for biodiversity conservation

1. Strengthen existing Environment Education Nodal Agencies or develop a special Biodiversity Education and Awareness Unit.
2. Establish a specialized State Biodiversity Education and Awareness Center.

3. Establish a State Biodiversity Training Center
4. Constitute a committee for curriculum development on biodiversity at state level.
5. Strengthen dissemination of conservation material through a newly established institution on biodiversity awareness enhancement.
6. Set up Environment Education Nodal Agencies at state level/ Strengthen NGOs

Tasks for District level Biodiversity Education and Awareness initiatives

1. Constitute a committee for curriculum development on biodiversity at district level.
2. Strengthen dissemination of conservation material through a newly established institution on biodiversity awareness enhancement.

Programs to enhance information on biodiversity values and innovative conservation strategies are focused on:

National - Priorities.
State - Priorities.
Relevant to biogeographic zone.
Relevant to ecosystems.
Relevant to important local sites and specific species.
Prioritization of awareness methods for different target groups.
Incorporation into educational processes as a part of formal curriculum. FEE/NFEE.

The program can be divided into sections that deal with (a) education and (b) with the creation of awareness. There is a fair amount of overlap in methodologies and techniques which enhance each others outputs.

I. Education Programs

1. Enhancing existing initiatives at different levels:
   a) HRD/MoEF
   b) NCERT
   c) SCERTs
   d) Universities
   e) Teacher training courses

Identification of Specific Instructional Objectives (SIO)

What should go into the syllabi -

i. School level - Std V to IX
ii. School level - Std X to XII
iii. College Syllabi - B.Sc./M.Sc. in relevant subjects
iv. University syllabus - M.Sc. Botany, Zoology, Environmental Sciences (*new syllabus for NET*)

1. **Possible methodologies to enhance school level teaching:**

a) Ministry of HRD and MoEF
Meetings of representatives of these two concerned ministries to be held along with selected experts to discuss possible initiatives, define the scope of the national level program, suggest methods to put biodiversity into curricula, identify funding sources.

b) NCERT
   i) Workshops at NCERT to include NGOs and other organizations in preparing level based inclusions in Syllabi pertinent to existing General Science/ Geography/Social Sciences/Language.
   ii) Component design for B.Ed. course.

c) SCERTs
Workshops to discuss the NCERT workshop and implement/alter/re-design as necessary along with
   i) NGOs - conservation experts
   ii) Forest Department
   iii) Teachers

d) Universities
Workshops for college teachers - B.Sc.
Workshops for University teachers - M.Sc.
Identified components that should go into existing curricula for Botany, Zoology, Environmental Sciences.
Involvement of UGC.

e) Teacher Training courses
Including biodiversity in curricula cannot become effective unless teachers are trained during their B.Ed. courses.
Components that should go into the course:

2. **Micro initiatives that need expansion**
   i) TTWs at CEE/Madras/ UKSN/ BVIEER

3. **Innovative possibilities**
   i) Use of traditional knowledge by key individuals for field orientation.
   ii) Use of trained Forest Department personnel at school/college level for field orientation.
   iii) Use of distance education

II. Awareness Program

1. Enhancing present programs at National level:
   a) NGO activities
   WWF/ BNHS/ CEE/ BVIEER/ ..
   b) Television - Indian orientation to 'Discovery channel' - Explore India
   c) Open University - Programs through EMRC
   d) Press - Workshops with Press
   e) Govt. officials at Training Institutions,

Administrative Staff College. Inclusion in IAS/ IFS selection exams.

2. Multiplying micro initiatives at National level.
Present NGO programs at school level
MoEF programs need greater financial inputs.

3. Innovative possibilities
Development of Nature Awareness Areas and Interpretation Centers

The Strategy

Possible methods to enhance existing Biodiversity Education and Awareness initiatives that have been identified for the macro-strategy include:

National Education Policy and Programs

(1) *Government initiatives at Central and State level:* MOEF/MHRD to develop a forum for interactions with NCERT, and SCERTs with concerned Nodal Agencies for Environment Education and Conservation NGOs. Interactions are essential to develop a policy statement, redesign curricula and develop teacher training methodologies. MoEF/ MHRD and National Council for Educational Research Technology (NCERT) - workshop for planning curricula. State Council for Environment Research Technology (SCERTs) - workshop in planning state level curricula. Increase the present scope of Ministry of Environment and Forest programs (MoEF) - (NEAC, Eco-clubs, Paryavaran Vahinis etc.). Increase the scope of the Ministry of Human Resources Development (MHRD) programs Environment Orientation to School Education (EOSE).

Action: MoEF/MHRD

Activity: a) Establish Committee/ Forum, b) Workshops - National and State level; c) Meeting at Ministry level.

Output: a) Policy on Conservation Education and Awareness, b) Curricular changes, c) Enhancing scope of Ministry programs.

(2) *Redesigning policy for the Environment Education Nodal Agencies:* (Government aided Nodal agencies: CEE, Ahmedabad/ CPR- EEC, Madras/ UKSN, Almora) - *Workshop for closer interaction to produce a comprehensive Conservation Education Program at the national level.* Interactions between the three Environment Education Nodal Agencies is essential to identify the methodologies to enhance biodiversity education and awareness as a national program through schools and colleges.

Action: MoEF/MHRD

Activity: Establish committees, organize workshops for Nodal Agency networking

Output: National program for biodiversity conservation and education.

(3) *State Level Nodal Agencies:* It is essential to establish and develop state level agencies, rather than expand activities of the three existing Nodal Agencies recognized by the Government at present. It is felt that existing active State level institutions be recognized as nodal units for each State by Government of India that local communities identify as their own organizations.

Action: MoEF/MHRD

Activity: Selection of State Institutions as Nodal Agencies.

Output: Growth and development of State Nodal Agencies for Conservation.

Curricular Modifications in Education

1) *School curricula:* Introduction of Biodiversity Conservation as a part of curriculum at school level.

Action: Through NCERT/SCERTs Nodal Agencies and Conservation NGOs.

Activity: Establish committee for Curricula development.

Output: Curriculum changes at school level.

2) *Graduate curricula in Botany, Zoology, Environmental Science, Geography:* Introduction of biodiversity issues in Science subjects at Graduate level must include its definition, value, threats and conservation measures at the appropriate level.

Action: Through UGC, University Board of Studies, interactions with Environment Education Nodal Agencies and Conservation NGOs.

Activity: Establish committees, organize Workshops with Environment Education Nodal Agencies and Conservation NGOs.

Output: Enhanced College student information and involvement.

3) *Post Graduate curricula:* Enhancing the biodiversity information in curricula at M.Sc. level in Botany, Zoology, Geography, Environmental sciences, Professional courses.

Action: UGC/ MHRD

Activity: Establish Committee with Environment

Education Nodal Agencies and Conservation NGOs at National level.

Output: Enhanced conservation consciousness in future biologists - teachers, researchers, professionals.

4) *Upgrading Curricula for teachers:* Introduction of Biodiversity concerns into the B.Ed. program to enhance school teachers information and attitudes towards Nature conservation.

Action: UGC/MHRD, Environment Education Training Institutions.

Activity: Establish committee at National level.

Output: Enhanced teaching in schools.

5) *Integration of Conservation Action into classroom activities.*

Action: MHRD, NCERT, Conservation NGOs, Environment Education Nodal Agencies. Action through B.Ed. syllabus changes, teacher training workshops, School Conservation Education Programs.

Activity: Organize National and State level Workshops.

Output: Integrating education with action.

Awareness Generation Activities

1) *State Forest Department Awareness Programs: To be enhanced through increased funding for outreach and spread of awareness through activities in urban and rural areas and especially for wilderness communities.*

Action: MoEF/State Forest Department Publicity Wings through NGO support.

Activity: Instruction from MoEF.

Output: Increase in general awareness - Wildlife Week, World Forestry Day, etc. Publications on Protected Areas.

2) *NGO Activities to focus on Formal education:* WWF-I branches/ BNHS (CEC)/ SACON - *to interact with (a) NCERT and SCERTs for planning curricula and (b) orientation of grassroots development oriented NGOs; (c) to evolve and adapt initiatives for local action, (d) attempt Networking.*

Action: WWF-I. Environment Education Institutions, Environment Education Nodal Agencies.

Activity: Through workshops/seminars.

Output: Enhance NGO effectiveness.

3) *Special Publications* - e.g.: Hornbill/ Sanctuary/ PITTA/ CEE - SASEANEE - *to increase circulation and utilization, especially in local languages.*

Action: MoEF/MHRD/Department of Science and Technology/Individual NGOs.

Activity: Support for Material development.

Output: Increasing outreach.

4) *Television programs* - Discovery Channel, Living on the Edge, Heads and Tails - *to be made more Indian oriented and locale specific.*

Action: MoEF.

Activity: Enhance media coverage.

Output: Increase general awareness.

5) *News print* - Environmental issues covered in daily Newspapers - *to include greater coverage of biodiversity issues.*

Action: WWF - regular workshops for news reporters.

Activity: Enhance media coverage.

Output: Increase general awareness.

6) *Materials and teaching aids* - Developing non-formal conservation education material for use in formal education related to local biodiversity such as Booklets on local wild species of animals, insects, birds etc. and local plant life, for use by different target groups. Plant nurseries of local species/ Terrariums/ Green houses/ exhibits of local species of rare, endemic and medicinal plants/ exhibits and Charts on Biodiversity/ painting and essay competitions/ audio-visuals/ handbooks for instructions to teachers/ Worksheets for students.

Action: Forest Department Publicity Wings, Environment Education Nodal Agencies and Conservation NGOs, Environment Education Training Institutions.

Activity: Developing specific school activities.

Output: Enhanced activities, peoples participation at school level.

7) Field activities for students: Visits to Protected Areas, Interpretation Center sites, Nature Awareness Areas during school/ college excursions.

Action: Protected Area Managers/ Schools/ Colleges.

Activity: Initiation through Government/ NGO funding.

Output: People's involvement with Protected Areas.

8) *Supporting Existing potential institutional:* Mechanisms that can be used for Biodiversity Awareness enhancement include; Children's Science

Congress on Biodiversity, Gyan Vigyan Samiti, for Biodiversity information dissemination.

Action: MoEF/ MHRD.

Activity: Programs and Workshops, increase funding.

Output: Increased involvement of school students.

9) *Providing conservation information to existing 'Development' oriented NGOs* - These NGOs can be trained to expand their scope to include biodiversity awareness. This would need training workshops and material developed in the local language.

Action: WWF, CEE

Activity: Programs and Workshops.

Output: Enhancing concepts of conservation and dissemination through a wider range of NGOs.

10) *Linkage of local school education programs with the Forest Department and Wildlife-wings at local and State level:* Utilization of existing knowledge of biodiversity at ACF/ Ranger/ Guard level, by integrating their expertise to support local school programs through visits to natural sites and Protected Areas near the school.

Action: Wildlife wings of Forest Department, Instructions from MoEF to Forest Department/ and MHRD to District level school management.

Activity: Establishing a Committee for and initiation of Workshops at district level.

Output: Use of existing, expertise for disseminating information.

11) *In-service IAS/ IFS training programs* - Administrative Staff Colleges In-service Training Institutes at State level: Inclusion of Biodiversity Awareness into sessions within existing programs, initiating independent capsule courses on biodiversity conservation. Specific content needs for these programs include - the importance of biodiversity conservation; the concept of creating an Integrated Protected Area System; Notification of PAs; conflicts between conservation and development; mitigation of problems, etc. which are key issues at this level.

Action: Indian Institute of Public Administration (IIPA), other Administrative Staff Colleges, State Government Administrative Departments, Training Institutes for Government officials.

Activity: Instructions from MoEF to set up Conservation Awareness modules in State Administrative Training Institutes.

Output: Enhanced conservation action through existing implementing authorities through capacity building at various level in Government.

12) *Domesticated biodiversity preservation:* Understanding the value of local crop varieties and indigenous breeds of domestic animals need to be integrated into existing Government Extension Programs at the local level.

Action: MHRD and CPR Swaminathan Foundation.

Activity: Instruction to extension programs at State level.

Output: Conservation of domestic diversity.

13) *Sustaining traditional values* - Sacred groves; Religion; National/ State animals, birds etc.; needs to be included at the micro level awareness programs to enhance awareness of biodiversity conservation.

Action: MHRD

Activity: Training for NGOs through Environment Education Nodal Agency, Environment Education Training Institutions.

Output: Use of traditions for conservation.

Possible New Initiatives at Various Levels

a) *Nature Awareness Area and Interpretation Centers for Protected Areas program*
The possibility of providing financial assistance and expertise for supporting and developing Nature Awareness Areas (NAAs) and Interpretation Centers (ICs) at various sites at Taluka level to enhance the delivery of biodiversity education and awareness must be initiated by the center, to be implemented at the local levels. These need to be developed both for PAs and in small Nature Awareness Areas at the Taluka level. A framework for developing such centers at the local level has been suggested to the Planning Commission which should be initiated. Methods evolved to integrate these facilities into school/ college teaching programs need to be instituted as developed at the BVIEER, Pune.

Action: Planning Commission, MoEF, State Forest Departments, Conservation NGOs, Conservation Education Training Institutions.

Activity: Training workshops, Identifying sources.

Output: Quantum increase in direct conservation consciousness in all walks of life.

b) *School Biodiversity Conservation Program:*
Teacher Training Workshops for developing locale specific material/audio-visuals/computer programs

etc. need to be assisted through increasing financial inputs. The content and innovative methodologies for enhancing a concern for biodiversity conservation by enlisting the support of teachers through TTWs and handbooks on conservation for an action plan.

Action: MoEF, NCERT, SCERTs, Nodal Agencies for Environment Education, WWF, Conservation Education Training Institutions.

Activity: Initiation through workshops.

Output: Quantum increase in direct conservation consciousness for school students from all ecosystems.

c) *Micro-level Target Specific Training on Biodiversity Education and Awareness.*

Workshops, seminars, training for specific target groups, material development and improving dissemination through *increased funding.*

Target specific programs should reach certain critical and highly specialized groups that affect biological diversity. Whereas local people living around PAs are frequently identified as important target communities, other user groups who act as major impacting factors such as tourists, management's of nearby paper mills or mining concessions etc. may be far more damaging and resistant or difficult targets. The latter are rarely considered as being important targets of conservation awareness programs.

There is much to learn from specific local user groups who have a great deal of knowledge of the species on which their livelihood is dependent. People who collect medicinal plants know their distribution and the micro-habitats in which they occur. Bird and animal trappers understand their behavior patterns. This storehouse of knowledge is rarely explored as they are involved in illegal activities. The program for such groups must focus on providing them alternate livelihoods while understanding from them what they know of the threatened species.

An indicative list of micro-level target groups include:

1) People dependent on PA resources Specific Issue - Local taxonomy; Sustainable use; Ecodevelopment.
2) Forest Department Officials and Front-line staff. Specific issues - Taxonomy, habitat management, population dynamics, species richness, distinctiveness, representativeness, endemicity, rarity, threat and extinction.
3) IAS officers. Specific issues - Notification of PAs.
4) Land use planners - Town Planners. Specific issue - ESAs, bio-rich areas, zoning methodologies, EIA.
5) Tourism Departments. Specific issues - Wildlife biology, impacts of tourism on PAs.
6) Tourists at PAs. Specific issue - Eco-tourism, local threats by tourists
7) Industry dependent on biodiversity resources. Specific issues - effect on bio-resources of extraction, alternate methodologies, extinction.
8) Botanists who collect herbaria. Specific issues - Extinction
9) Medicinal plant collectors. Specific issues - Extinction, ex situ programs.
10) Animal and bird catchers and traders. Specific issues - extinction, legal issues.
11) Traders in Wildlife and its products. Specific issue - 250 bird species (20%) in India are traded, extinction, CITES, legal issues.

The pattern of possible options and methods for disseminating information that can be used for different target groups must be carefully selected. These include both the formal education process and the non-formal components that could ensure a change from information into awareness, concern and develop an action oriented community.

Action: Environment Education Nodal Agencies, WWF branches, and other Conservation NGOs.

Activity: Workshops

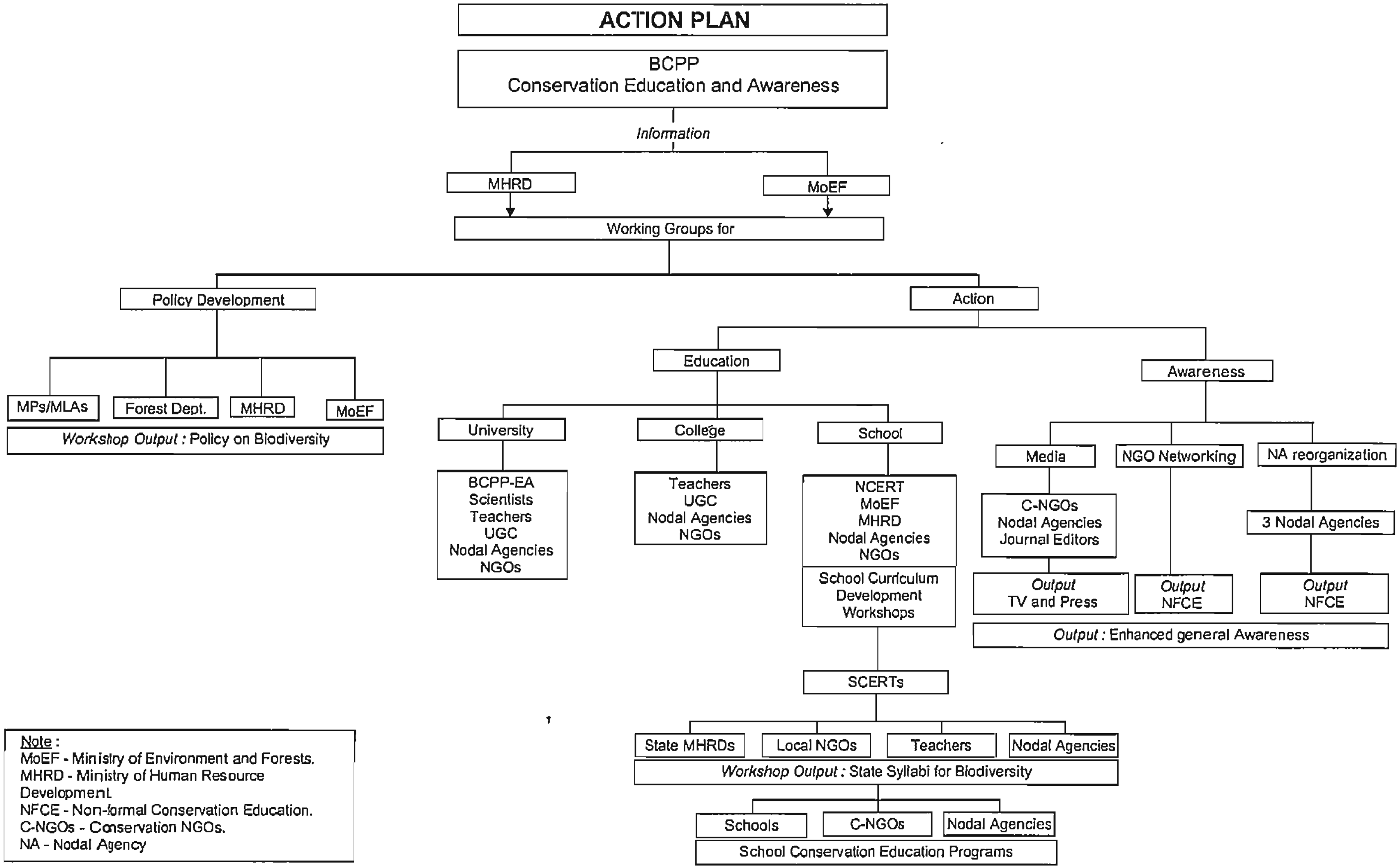
Output: Increasing existing dissemination through specific interactions and material development.

Future Possibilities and Expected Outcome of the Biodiversity Conservation Prioritization Project

Each of the modules have to be initiated through activities generated by the BCPP during its implementation. Adequate funding and institutional support would have to be generated from each Biodiversity oriented project for an education and awareness module.

On the bases of the findings of this report any future projects or programs that are to be funded for supporting biodiversity must budget between 15 to 20% towards supporting conservation Education and Awareness generation. This would create the necessary attitudes to support conservation actions.

The Education and Awareness Output of the BCPP must bring about conservation by (a) Policy framework development; (b) Implementation through Government and NGO support systems; (c) Greater dissemination of information; (d) Changes in peoples perceptions and attitudes towards conservation.



Note :
MoEF - Ministry of Environment and Forests.
MHRD - Ministry of Human Resource Development.
NFCE - Non-formal Conservation Education.
C-NGOs - Conservation NGOs.
NA - Nodal Agency

Conclusions

There is evidence to show that information on biodiversity conservation has been given a low priority in education, media and at administrative and policy making levels. School and college curricula, teacher training and NFEE techniques need to be introduced at the school level. College and University curricula are sadly lacking in conservation biology at all levels. The NGO sector though active has not reached the grass roots level, and reaches a very small segment of society.

The linkages between information, awareness, concern and a readiness to act are difficult to establish and are related to the lack of focused environment education and conservation awareness material in curricula, a poor and mostly global orientation in mass media, an inadequately motivated press, and an erosion of traditional values without adequate recognition of newer concepts on the need for preserving biodiversity as a source of future economic growth.

The Phase I part of BCPP to which this document is related would need to be implemented in a follow up phase. The education and awareness aspects would need to be budgeted into BCPP Phase II. The need to set aside funds for implementing innovative educational initiatives and awareness enhancement are frequently either non-existent or minuscule in the design and implementation of most conservation and development projects. In Phase I Education Awareness and Training has been mentioned as an input for 'determining priority strategies'. This would have to become a major fiscal input into Phase II.

The National Plan for Conservation Education and Awareness will need a financial commitment from both central and state governments and the creation of a separate committed budget head in the Ministry of HRD and Environment and Forest. Funds that can be used in a decentralized manner and are easy to access, are crucial.

The most vital component that would support biodiversity conservation is a 'peoples' conservation movement. This can only emerge from an enhanced information base that creates a concern for preserving sites and species. A major objective should be to focus attention on generating conservation consciousness in clearly defined key groups such as policy makers, implementers and disseminators. This would have to be done through the formal network of educational institutions, through changes in curricula and training of teachers and by influencing mass media to consider biodiversity conservation as one of its flagship mandates. It will also involve awareness generation through modern communication technology.

Unless the country begins to perceive the value of its own biological diversity preservation as a integral part of its development Biodiversity conservation will remain only on paper. This mass biodiversity conservation movement can only be created through education and awareness.

Biodiversity Conservation in India The Legal and Policy Framework

Prabhakar Rao and Archana Prasad

Introduction

Of late conservation of biodiversity has received a lot of global attention and has become a prominent area of discussion and work. Prior to 1970s, however, the loss of biodiversity was not an area of serious debate and concern even though biodiversity loss was no doubt taking place in many explicit as well as many insiduous ways. Consequently the laws enacted during 70's and earlier did not address the issues related to biodiversity conservation in an explicit and holistic way. Today, when the focus of governmental and non-governmental agencies has turned to biodiversity, it would be worthwhile to examine the adequacy of existing laws, policies and schemes in relation to biodiversity conservation. Existing laws may need modifications and even new legislation may be the need of the hour for protecting biodiversity and related issues.

In this report we analyse the laws, and policies from the point of view of biodiversity conservation. The following ecosystems have been dealt with separately for this purpose:

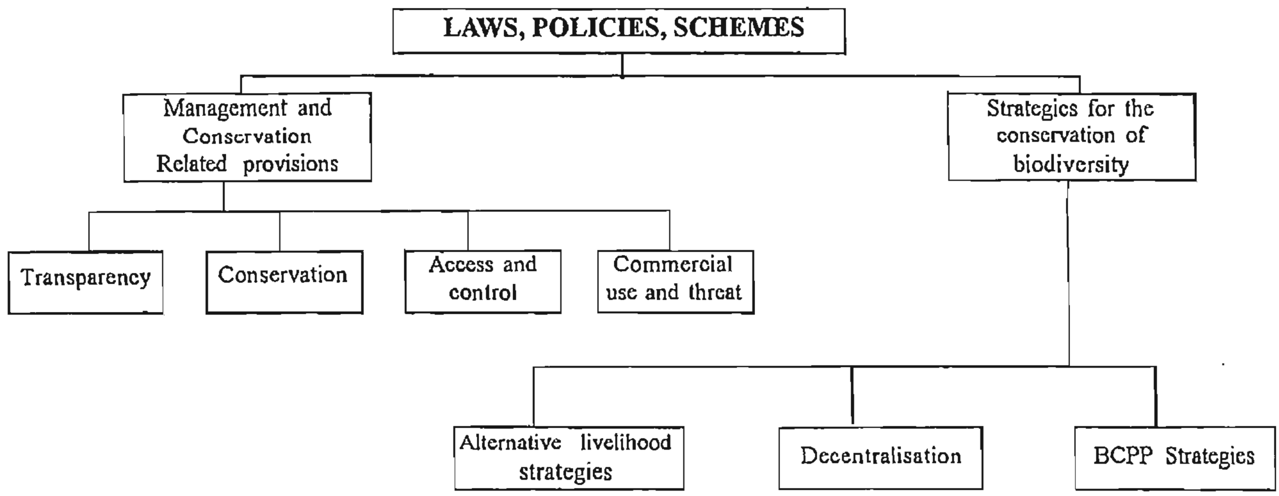
1. Forests
2. Rangelands
3. Hills and Mountains
4. Wetlands
5. Mangroves
6. Coral reefs
7. Coasts

Objectives

The main objectives of this report are to

1. Review and analyse laws, policies and schemes which support the conservation of biodiversity in India.
2. See whether the current policies and laws support or hinder the micro-strategies that have been developed in the sub-group of the BCPP project.
3. Recommend changes in the current legal framework in order to facilitate the operationalisation of these strategies on the field.
4. Recommend changes in the current legal framework in order to facilitate the better conservation of biodiversity in India.

The laws, policies and schemes to be discussed will be classified according the main issues that are relavant for the conservation of biodiversity in India. These issues have been illustrated in the diagram below. The level of depth



and discussion of laws policies, and schemes will be dependent on the kind of data available for each ecosystem. For example it is possible to carry out a detailed discussion of forested tracts because of the availability of significant information for this ecosystem. However as the discussion in this report will show, the same level of detailed analysis is not possible for wetlands, rangelands, mangroves and coral reefs because of paucity of laws, policies and schemes. Hence the structure of the discussion in the case of each ecosystem would depend on the nature and extent of information available. The survey of central and state schemes has been done for 23 states and union territories.

Biodiversity Conservation in Forests

The faunal and floral diversity of forested regions is under severe threat in India even though 4% of the forested area is seemingly under strict protection in National Parks and Sanctuaries. The main causes of degradation have much to do with the dependence of industries on forests as well as the increasing biotic pressures on them. Legal support for the protection of floral and faunal diversity is limited in character, with the emphasis on efficient management of forested areas and produce, rather than the maintenance of diversity. The Acts that have a bearing on the status of biodiversity in forested areas are:

- The Indian Forest Act, 1927.
- The Wildlife (Protection) Act, 1972.
- The Forest (Conservation) Act, 1980.

Apart from these laws, there are also various policies, programmes and schemes that affect the conservation of natural diversity of the forested tracts. Some of these (e.g., the schemes for the regeneration of natural forests) have a positive impact on the conservation of flora and fauna diversity. Others (e.g., the conservation and extension of plantation forests) may have a detrimental effect on biodiversity conservation. Both such types of laws, policies, programmes and schemes will be considered.

Management and Conservation Related Themes

Conservation

Issues related to the conservation of the flora and fauna of the forest can further be sub-divided into the following ways:

Identification of sites, species, and processes

The first act in the conservation of biodiversity is the identification and prioritization of species and sites with a high conservation value. However, since species and sites identified for conservation are dynamic and evolving in character, the ecological processes associated with the development of these sites and species also need to be identified. The process of identification will include surveys, classification and demarcation. There are no policies and laws that make it mandatory upon government departments to carry out a process of such identification before demarcating an area for conservation. The Wildlife (Protection) Act, 1972 and the Indian Forest Act of 1927 make provisions for the demarcation of boundaries and the classification of forests respectively. Though many of the recent forest policies like the National Forest Policy of 1988 and the Conservation Strategy of 1992 emphasise the need for the conservation of natural forests, the question of identification of species, sites and process is never discussed in them. Nor is the process of identification specified in these documents. The law should make it madatory that the demarcation should be the result of a scientific survey. However, there are several institutions that take on the task of identifying, surveying and classifiying the forested areas and the vegetation that grows on these lands. Several state and central schemes also facilitate the process of identification. The details of the allocations for these schemes in the Eighth Plan (1992 to 1997) are provided in table that follows:

Activities Identification surveys and demarcation	*State (and Code)*	*Number of Schemes*	*Allocation [Rs Lakhs]*
	Jammu & Kashmir (J&K)	4	248.00
	Sikkim (SIK)	3	161.45
	Tripura (TRI)	1	14.70
	Andhra Pradesh (AP)	-	-
	Daman and Diu (D&D)	1	30.00
	Himachal Pradesh (HP)	1	550.00
	Tamil Nadu (TN)	-	-
	Kerala (KER)	1	270.00
	Punjab (PUN)	-	-
	Bihar (BIH)	-	-
	Goa (GOA)	-	-
	Assam (ASS)	-	-
	Haryana (HAR)	1	12.00
	Rajasthan (RAJ)	2	207.00
	Andaman & Nicobar Islands (A&N)	-	-
	West Bengal (WB)	-	-
	Pondicherry (PON)	-	-
	Meghalaya (MEG)	2	120.00
	Mizoram (MIZ)	-	-
	Lakshadweep (LAK)	-	-
	Orissa (ORI)	-	-
	Madhya Pradesh (MP)	1	165
	Uttar Pradesh (UP)		

Most of these schemes are state funded and are concerned with the surveying of existing forests and the demarcation of their boundaries. Apart from this the Forest Survey of India has also been given the task of identifying, mapping and surveying forested areas. Its main objectives are to prepare a comprehensive state of the forest report, develop a methodology for vegetation mapping including thematic mapping, prepare an inventory of selected sites and impart training in modern forestry survey techniques. The identification of specific forest types and species is also done by the following institutes:

- Forest Research Institute, Dehradun.
- Institute of Wood Science and Technology, Bangalore.
- Institute of Forest Genetics, Coimbatore.
- Institute of Deciduous Forests, Jabalpur.
- Institute of Rain Forests, Jorhat.
- Institute of Arid Zone Forestry Research, Jodhpur.
- Indian Institute of Forest Management, Bhopal.
- Botanical Survey of India.
- Zoological Survey of India.

In situ Conservation

Laws

Indian Forest Act 1927

It may seem obvious that the purpose of identifying and conserving forested sites as reserved or protected forests would be protect *in situ* the biological diversity therein. But it is ironic that the Indian Forest Act, 1927 is silent on this issue. It empowers the State Government to declare such forests but does not specify the criteria on which these sites may be so declared. It would be better if the law specifies ecological considerations as being of paramount importance in designating forested tracts. Eventhough the Act does not focus directly on the conservation of biodiversity ,there are some sections that lead to the conservation of biodiversity. These provisions are:

- Section 26 dealing with acts prohibited in reserved forests like clearing, setting fire, cattle trespass, hunting, fishing etc.
- Section 30 dealing with the reservation of trees in a protected forest by state governments.
- Under Section 32 state government can make rules to regulate felling in protected forests, clearing land for cultivation and other purposes and other activities like hunting, fishing and cutting of grass and pasturing of cattle.
- State Government may regulate or prohibit in any forest or wasteland clearing land, pasturing of cattle and setting fire when it is necessary for: (1) maintenance of water supply in springs, rivers and tanks (2) slope stabilisation in hilly tracts under section 35.

One glaring ommission is that the biosphere reserves which are meant to conserve representative ecosystems do not find mention in this act.

Wildlife (Protection) Act, 1972

As compared to the Indian Forest Act, 1927, the issues relating to *in situ* conservation are better addressed by the Wildlife (Protection) Act of 1972. Under chapter IV of this Act, the state and the central government can declare any area of "adequate ecological, floral, faunal, geomorphological, natural, and zoological value" value as a national park or sanctuary. The aim of these natural parks and sancturies is to preserve the natural habitat of floral and faunal species. Section 20 &21 of the act make it incumbent upon the collector or the chief wildlife warden to notify the formation of the national park and sanctuary. Under section 19 all access and rights in the national park and sanctuary are extinguished, and any claims to usufruct rights must be considered by the collector under sections 24 and 25 of the Act. Through these provisions, the main aim of Chapter IV is to create conditions favourable for *in situ* conservation of fauna and flora. Section 9 prohibits hunting of wild animals. Section 29 prohibits destruction etc. in a sanctuary without a permit. There is an aspect of *in situ* conservation of wild plants that is taken care of by Chapter IIIA of the Act which deals with the protection of specified plants. Under Section 17H specified plants are considered state proterty and all uprooting, picking and collection of them are prohibited under Section 17A. Notwithstanding these provisions that facilitate the *in situ* conservation of flora and fauna, it would be worthwhile if the law can explicitly mention conservation of biological diversity as the main purpose of declaring any area as national park or sanctuary. Biodiversity being an all encompassing term, the use of the word 'biodiversity' would simplify the law to a great extent. Creation of biosphere reserves also need mention in order to conserve genetic, species and ecosystem diversity.

Policies

There are four policy statements that support the *in situ* conservation of biodiversity in the forested areas.

Wildlife Action Plan, 1983

The following measures recommended in the plan lead to biodiversity conservation:

- Establishment of scientifically managed representative network of PAs.
- Developing appropriate management systems for protected areas.
- Restoring degraded habitats to their natural state.
- Building a professional cadre of personnel fully trained and proper orientation.
- Providing adequate protection to wildlife in multiple use areas such as production forests and pastures.
- Formulation and adoption of a National Conservation Strategy.
- Collaboration with voluntary bodies.

Report of Task Force on Eliciting Public Support Wildlife Conservation, 1983.

Some of the recommendations of the Task Force have positive implications for biodiversity conservation. These are:

- Enforcement of protection rigidly in the core- buffer zone.
- Higher per capita inputs for soil conservation, afforestation, forestry practices compatible with needs of wildlife and local people.
- Motivating decision -makers towards environment and wildlife through camps, workshops etc.
- Efficient mechanism to monitor the implementation of above.

National Forest Policy 1988

The attempt to discuss the relationship between multiple forest use patterns and conservation of forests was reflected in the National Forest Policy of 1988. This policy statement stated that some of its main aims were to:

1. Maintain environmental stability through preservation, and where necessary, the restoration of the ecological balance that has been disturbed by the serious depletion of the forest cover.
2. Conserve the natural heritage of the country by preserving the remaining natural forests with a vast variety of flora and fauna.

At the same time it also suggested afforestation of areas which did not have any natural forest cover with the aim of substantially increasing the forest/tree cover in order to check soil erosion and denudation in catchment areas. Defining the principal purpose of the policy, the Secretary to MOEF wrote that,

> The principal aim of forest policy must be to ensure environmental stability and maintenance of the ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animal and plant. The derivation of the direct economic benefit must be subordinated to this principal aim.

The main operational aspect towards achieving this aim was defined as the strengthening and extension of the network of protected areas for protecting the biological diversity of the country. The strategy for achieving this would be to achieve the national goal of having a minimum of one third of the total land area of the country under forest or tree cover. In the hills and mountainous regions the aim should be to get two thirds of the area under such cover in order to prevent land degradation and soil erosion.

Briefly the main provisions of the 1988 policy that can promote *in situ* conservation are to:

- preserve remaining natural forests in their pristine state.
- provide for extension of network of Protected Areas.
- check soil erosion and denudation in catchment areas.
- check extension of sand dunes.
- promote afforestation and social forestry programmes to decrease pressures on natural forests.
- advocate substitution of wood..

National Conservation Strategy, 1992

The policy of 1988 was supported by the National Conservation Strategy of 1992. This strategy mentioned the conservation of biodiversity in an explicit way for the first time. Its main proposals were the following:

- Intensification of the process of surveying biological resources.
- Extension of the network of protected areas.
- Conservation of micro-flora and fauna was focused upon by this strategy.
- Documentation of local knowledge about biodiversity.
- Rehabilitation of people from PAs.
- Restriction on mono plantations and plantation of exotic species.
- EIA for industries seeking to divert forest land.
- Diversion of biotic pressures from natural forests by creating substitutes for wood products.
- Encourages use of alternative energy sources to reduce pressures from forests.

Schemes

The table in next page shows the schemes that exist for *in situ* conservation.

Activity	*State*	*Number of Schemes*	*Allocations (Rs. Lakhs)*
Formation of National Parks and Sanctuaries.*	J&K	3	280.00
	SIK	5	500.00
	D&N	1	30.00
	HP	6	625.00
	TN	6	600.00
	KER	7	5765.00
	PUN	1	100.00
	BIH	5	1000.00
	GOA	2	4.00
	ASS	7	1337.00
	RAJ	3	1333.60
	MIZ	2	290.00
	HAR	14	720.00
	ORI	1	140.00
	MP	1	3150.00
	WB	8	1446.00
	KAR	10	1300.00
	UP	2	478.00
Formation of Biosphere Reserves	J&K	1	15.00
	SIK	1	17.00
	TN	1	100.00
	KER	1	200.00
	WB	1	165.00
	KAR	1	300.00
	UP	1	315.00
Regeneration of Natural Forests	J&K	-	-
	SIK	3	106.00
	HP**	1	875.00
	PUN	2	1450.00
	BIH	1	200.00
	ASS	2	2510.00
	RAJ	1	152.62
	A&N	2	467.00
	MP	1	1176.00
	WB	1	365.00
	KAR	1	315.00
	UP	1	100.00
Conservation and Regeneration of Medicinal Plants	TRI	1	4.39

* Most of these schemes are funded by the Central Government.
** This is a protective afforestation scheme for the regeneration of natural forests.

Most of the states have schemes for the development of existing national parks and sanctuarie but very few schemes for the *in situ* preservation and regeneration of natural forests in general. A majority of these schemes are funded by the Central Government. Yet, the recent policies that make the intent of the *in situ* conservation of forest resources quite clearcut and explicit still do not have adequate legal backing.

Ex situ Conservation of Flora and Fauna

Laws relating to Fauna

Chapter IVA of the *Wildlife (Protection) Act of 1972* provides some legal provision for the ex situ conservation of forest fauna by authorising the formation of the Central Zoo Authority. The main objective of the authority was to recognize or derecognize zoos and lay down guidelines for captive breeding. For the regulation of breeding the Act also gives the Authority the power to make rules on the following:

- health of animals
- hygiene and feeding
- veterinary care.

The rules on these subjects have been formulated by the Authority in 1995.

Policies

The *Wildlife Action Plan of 1983* supports the *ex situ* conservation of fauna by proposing the:

- rehabilitation of endangered and threatened species.
- captive breeding of animals and reintroduction of threatened species.

Schemes

Schemes facilitating the *ex situ* conservation of fauna in forests are given below:

Activity	*State*	*Number of Schemes*	*Allocations (Rs. Lakhs)*
Captive Breeding	J&K	2	125.00
	HP	1	175.00
	ASS	2	140.00
	HAR	1	30.00
	WB	1	34.00
Creation of Zoological Parks	D&N	3	112.00
	HP	1	50.00
	TN	1	148.97
	MEG	1	5.00
	ASS	4	310.00
	RAJ	1	250.00
	MIZ	1	-
	HAR	3	145
	ORI	1	50.00
	WB	1	26.00
	KAR	2	85.00
	UP	1	408.00

INSTITUTIONS

- Bureau of Animal Genetic Resources.
- Bureau of Fish Genetic Resources.
- Zoological Survey of India.

Ex situ Conservation of Flora

There are practically no laws concerning the *ex situ* conservation of wild flora in forests. Like the Central Zoo Authority and recognition of zoos, there are no laws that govern the setting up of botanical gardens, gene banks, herbaria, and such like institutions. Comprehensive laws are needed in this direction so as to safeguard the genetic diversity in particular and to prevent biopiracy.

SCHEMES

Activity	*State*	*Number of Schemes*	*Allocations (Rs. Lakhs)*
Biological Parks and Botanical Gardens	TRI	1	26.42
	KER	1	500.00
	BIH	2	1195.00
	ASS	1	60.00
Gene Banks	KER	1	100.00
	TN	1	100.00
Nurseries	J&K	1	100.00
	TRI	1	8.69
	AP	1	200.00
	KER	1	100.00
	PUN	1	100.00
	MEG	1	2000.00
	GOA	1	100.00
	ASS	2	110.00
	RAJ	1	100.00
	MIZ	2	405.00
	HAR	1	100.00
	KAR	1	315.00
Seed Development	J&K	2	200.00
	SIK	1	100.00
	AP	2	350.00
	TN	2	200.00
	PUN	1	100.00
	MIZ	1	100.00
	KAR	2	260.00

Note: Some of these schemes like the decentralised nursery and seed development schemes are started by the Wasteland Development Board and National Afforestation and Eco-development Board.

INSTITUTIONS

There are some institutions that can encourage the *ex situ* conservation of forest flora. These are:

1. National Bureau of Plant Genetic Resources.
2. Institute of Forest Genetics, Coimbatore.
3. Botanical Survey of India.

Introduction, Augmentation and Rehabilitation of Forest Flora and Fauna

Introduction, augmentation and rehabilitation of wild flora and fauna are attempted so as to prevent inbreeding, to prevent extinction of species, and to restore disturbed habitats. The results of these trials are however uncertain and many times result in unintended consequeces. The laws should cover such areas of crucial concern by laying down general guidelines and the circumstances under which such options have to be seriously considered. But more than the law, it is specific programmes and schemes that can contribute substancially in this direction. There are few schemes that facilitate the introduction and re-introduction of endangered species:

Activity	*State*	*Number of Schemes*	*Allocations (Rs. Lakhs)*
Rehabilitation of Degraded Forests	J&K	1	2535.00
	SIK	1	197.00
	KAR	1	3560.00
Rehabilitation of Fauna			
Introduction of Exotic Floral Species			
Reintroduction of Fauna	ASS	1	

Note: Most of these schemes are partly funded by the centre.

Movement of Species

There are no laws and policies that govern the migration of species. Neither are there any schemes that are relevant for this purpose. At best we can point towards the agreement on Protection of Migratory Species from destruction in an international convention of 1979. The Convention provides a framework to protect migratory species during their trans boundary migrations and to conserve their habitats.

Conclusions on the Conservation Aspect

The conclusions may be summarised in a tabular form.

Legal Support for Bio-diversity Conservation

Legal Support / *Activity*	*Policies*	*Laws*	*Schemes*
Identification	Specific policies do not exist.	Some exist but others need be enacted. Forest laws need to include this aspect.	Limited in scope and expanse.
Insitu Conservation	Support exists for both flora and fauna.	Forest laws need to focus on this. The forest laws make no explicit mention of this. Wildlife laws make provisions for the existence of national parks and sancturies.	Not sufficient for the regeneration of natural forests.
Exsitu Conservation	Specific policies do not exist.	Needs to be elaborated and expanded in focus. Legal support is insufficient for both though it is relatively better for fauna.	Need more schemes after policy is clarified and formulated.
Introduction, rehabilitation and augmentation	Specific policies do not exist.	Needs legal coverage.	Need more schemes after policy is clarified and formulated.
Movement	Specific policies do not exist.	Needs legal coverage.	Need more schemes after policy is clarified and formulated.

On the basis of the exposition above it is possible to arrive at the conclusion that urgent attention should be paid to revising the existing forest and wildlife laws and policies in order reflect current concerns in biodiversity conservation of flora and fauna

Access and Control over Forested Areas

Conflicts over control and access to forested areas have plagued conservation efforts ever since the colonial times. Ever since the British State acquired monopolistic ownership over forested tracts, local people have encroached upon forest boundaries in order to meet their daily needs. In local perception, the officials perceive these needs wrongly and therefore the conservation targets set by them are unrealistic. Along with commercial exploitation of forests, the increasing biotic pressures have negated the success of conservation efforts. For this reason the issue of access and control over forests must be considered as an important one from the point of view of biodiversity conservation.

Experience has shown that conservation of the biodiversity in forested areas cannot be successful till local needs are satisfied. This can be done through the development of degraded surrounds of natural forests in a way that the local demand for fuel wood, fodder and NTFP is satisfied. In order to be sustainable, conservation efforts and livelihood security concerns should go hand in hand.

Laws

The centralised control and curtailment of access of local people to the bio-resources in Indias' forests is a legacy of the colonial times. The main forest law governing the rights and restrictions of people in the forests is the Indian Forest Act, 1927 formulated by the British. Apart from this the Wildlife (Protection) At of 1972 also focuses on the rights and restrictions of local people in national parks and sancturies. Most laws have advocated a hands-off policy and thus alienated a large section of local people.

Indian Forest Act, 1927

The most striking feature of the law of 1927 is that it does not classify forests according to their biological value. The Act classifies forests into three: reserved, protected and village forests. An analysis of the rights and restricions provisions shows that:

- The.state enjoys absolute ownership and control over bio-resources in the forests.
- The forest settlement officer enjoys arbitrary power to settle the rights in reserved, protected or village forests.
- The rights of local people get severely restricted and their control over the bio-resources of their area become minimal.

Wildlife (Protection) Act, 1972

Under this Act all rights of local people are extinguished in national parks and sanctuaries. The main feature of these provisions is the way in which the law gives absolute power to the collector or the chief wildlife warden and the lack of elaboration of the procedure of the acquisition and determination of rights. Also noticable is the lack of any provision for compensation in case of damage to life and property of local people by wild animals.

Policies

Recent forest policies propose a greater involvement of the local people in forest management. These policies are:

National Forest Policy, 1988

The National Forest Policy of 1988 asserts that a "massive peoples' movement with the involvement of women, for acheiving the objectives pf the policy and to minimise the existing pressures on forests" is one of its main objectives. To this end it lays down the following principles regarding the rights and concessions of the local people in forests:

1. Rights such as grazing should be always related to the capacity of the forests.
2. That those who enjoy customary rights in forests should be involved in its protection.
3. Rights and concessions of poor tribals and backward classes and castes should be fully protected.

At the same time this policy also makes a statement with regard to the type of restrictions that may be imposed on local people namely,

1. Grazing should be controlled.
2. Encroachment and reclamation should be prevented.
3. Fires should be prevented.

Guidelines for Participatory Forest Management

To facilitate the commitment made by the policy of 1988 towards providing greater control of the local people towards their own bio resources, the Government of India Notification of 1990 facilitates the setting up of Joint Forest Management Programmes. Under this scheme, the rights and concessions of only those who qualify as beneficiaries is recognised. Similarly access to forest lands is also confined to beneficiaries.

Schemes

The schemes that facilitate the control and access of people to forested areas are given below:

Activity	*State*	*Number of Schemes*	*Allocation (in Lakhs of Rs)*
Protection against biotic interference	J&K	1	50.00
	TRI	1	34.00
	AP	1	50.00
	TN	1	100.00
	PUN	1	50.00
	ASS	3	300.00
	MIZ	1	100.00
	KAR	1	200.00

Institutions

In the main the authorities of PAs and the forest department enforce restricitions and recognise rights. Under the JFM the forest protection committees are also given some of these powers.

Commercial Threats to Biodiversity in Forests

Promoting sustainable use of forest resources by commercial interests poses a big challange to those who attempt to conserve the floral and faunal diversity of forests. It has been seen that the plantation of fast growing and commercially viable species has led to the destruction of diversity of natural forests. The faunal diversity has also been threatened by the illegal poaching and trade in wildlife products. Similarly tourism which is not environmentally friendly can also lead to the destruction of biodiversity in forests. Of late, there are laws that specifically deal with the control of industrial and commercial activities in forests. At the same time there are also schemes and programmes that promote the commercial exploitation of forests. In this section we consider both these aspects.

Laws

The main acts that control industrial and commercial activities in forests are Forest (Conservation) Act, 1980 and Wildlife (Protection) Act, 1972.

Forest (Conservation) Act, 1980

This act does not make any explicit mention of biodiversity. Yet it prohibits diversion of forest lands for non-forest uses without the prior approval of the central government. Under this Act project proposals need to seek clearance from the environmental angle as per the procedure laid down by the MOEF. The Act provides for:

- Stringent conditions for diversion of forested lands and environment impact assessment proposals so as to safeguard tree cover.
- Compensatory afforestation in case of diversion.
- No diversion of land for rehabilitation unless it involves SC and ST in PAs.

In order to enforce these provisions it provides for an advisory board of the central government to clear proposals comprising of the Inspector General of Forests, Assistant and Deputy Inspector Generals of Forests and three eminent environmentalists.

Wildlife (Protection) Act, 1972

Chapter V and VA of this Act controls the trade or commerce in wild animals, animal articles and trophies in the following way:

- It declares that all hunted wild animals (other than vermin), ivory imported into India, animal article, trophy or meat derived from wild animal and the vessel, weapon, trap or tool used in such hunting shall be the property of the Central Government.
- It prohibits the ownership of all animal articles and trophies without a licence.
- Occupations like, taxidermy, trade in animal articles, dealings in trophy, meat can only be carried out with a licence.

Similar protection is also afforded to wild plants by the 1991 Amendment to the act.

Indian Forest Act, 1927

Apart from these two acts that concentrate on some aspects of commercial activities, the 1927 Act regulates some activiites like felling and transit of timber and other forest produce. But this Act does not make any explicit mention of industrial activity in forests. Nor does it have any provisions that control the use of forests for industrial and commercial purposes.

Policies

National Forest Policy, 1988

Section 4.4 of the policy makes an explicit mention of the diversion of forest lands for non-forest purposes and supports the Forest (Conservation), Act of 1980 by asserting that all projects should go through an evaluation in terms of environmental costs and benefits. As far as mining and quarrying is concerned, policy makers hold that beneficiaries should be prepared to revegetate the land in accordance with forestry practices within the area.

National Conservation Strategy and Policy Statement, 1992

This policy statement is more specific than the policy of 1988 in spelling out control of commercial and industrial activities in forests. The main provisions in its guidelines are:

- Environmental Imapact Assessment prior to selection of sites.
- Incentives for development of environmentally friendly technologies.
- Sale of raw materials to industries at market prices.
- Forest based industries to be allowed access to forests only after potential of the forests to produce such raw materials is established.
- Adequate ecological restoration where mining leases are granted.
- Compensatory afforestation to be done by industries.
- Ensuring environmentally safe disposal of by-products.

Wildlife Action Plan, 1983

The control of illegal poaching is seen as a necessity in this policy.

Report of Task Force on Eliciting Public Support Wildlife Conservation, 1983

Mentions both control of illegal poaching as well as eco-tourism in its report.

Schemes

The schemes dealing with threat from commercial and industrial activities can be divided into two: those that protect the forests from commercial and industrial pressures and those that promote commercial and industrial activity.

Schemes Controlling Commercial and Industrial Pressures in Forests

Activity	*State*	*Number of Schemes*	*Allocation (in Lakhs of Rs)*
Prevention of Poaching	J&K	1	125.00
	HP	1	50.00
	KER	1	50.00
	PUN	1	10.00
	BIH	1	150.00
	ASS	2	40.00
	HAR	3	20.36
	ORI	1	73.00
	WB	1	40.00
Eco-Tourism	KER	1	100.00
	UP	1	10.00
Environmental Assessments	MEG	1	450.00

Schemes Promoting Commercial and Industrial Activities in Forests

Activity	*State*	*Number of Schemes*	*Allocation (in Lakhs of Rs)*
Plantations for Industial and Commercial Uses	TRI	1	8.29
	HAR	1	320.00
	ORI	1	1040.00
	UP	1	3524.00
Development of Tourist Resorts	D&N	1	100.00
Development of Trekking Routes and Safaris	HP	1	50.00
	PUN	1	50.00
Quick Growing Species of Economic Importance	HP	1	500.00
	KER	1	550.00
	HAR	1	225.00
	ORI	1	613,00
Commercial Plantations	RAJ	1	740.00

The tables above show that the central and state governments are following a contradicotry policy towards commercial and industrial activities in forested areas. On the one hand, recent laws and policies show a concerted effort to control these pressures on forests. However, at the same time, we also see that there are sufficient number of programmes in the eighth plan that promote industrial and commercial threats to forests.

Transparency in Administration

A majority of the laws, policies, and schemes till the recent past have not been able to ensure transparancy in administration. With a heavy top down approach, they have tried to address problems from a narrow view. The existing legislation, policy statements and institutional structures need to be reviewed to make, both, the administration and information more accessible to people living in and around forested areas. The proposed Right to Information Bill will go a long way in facilitating transparency.

Strategies for Conservation of Bio-resources

Alternative Livelihood Options

In order to reduce the pressure on protected areas and natural forests, the development of the surrounds is essential. The increase in tree cover and fulfilment of the fuel, fodder and NTFP demands outside forests with high biological value is one of the primary strategies to meet the aim of biodiversity conservation. This has been recognised by the policy makers of the country in the last decade and a half and is reflected in recent forest and wildlife policies.

Laws

There are no laws to ensure that ensure the local people get alternative livelihoods and replacement of income in case of displacement when a natural forest is declared as reserved and as a national park or sanctuary. At best the laws only talk of settlement of rights. One might argue that a law is not supposed to address these issues. But then it must be made mandatory that schemes are in place that address the question of alternative livelihood and rehabilitation of oustees before the actual displacement of people.

Policies

Some of the recent policies provide for income generation activities for the rural poor living in and around forested areas. This is true of both the policies for wildlife as well as other forest conservation. The measures proposed by these policies are:

1. *Eco-development*: Eco-development is proposed by the *Report of the Task Force for Eliciting Public*

Support for Wildlife Conservation, 1983. It aims at developing the surrounds of the Protected Areas. It aims at formulating eco-development committees of local people who can participate in developing strategies for their own local areas. The aim is to formulate strategies that will lead to the betterment of the socio-economic position of the local people as well as reduce the pressure on the PAs.

2. *Development of Minor Forest Produce*: Both, the National Forest Policy, 1988 and the National Conservation Strategy, 1992 recognise that minor forest produce is essential for the survival of tribal communities. These policies propose the promotion of the optimum utilisation and regeneration of minor forest produce. They also propose family oriented schemes for the improvement of the status of tribal beneficiaries. This can also be done by integrated area development planning to meet the needs of tribal economies.
3. *Development of Forest Based Industries*: National Forest Policy, 1988 and the National Conservation Strategy, 1992 propose the development of these industries. Such industries should provide employment to local people and small and marginal farmers who should grow the trees required for these industries on their lands. Natural forests should not be available for this purpose.
4. *Development Alternative Sources of Energy*: The policy of 1988 and 1992 recommends the development of substitutes to wood fuel to meet the needs of energy in local areas in and around forested tracts.
5. *Projects for Rehabilitation of Oustees*: The conservation strategy of 1992 proposes the formulation of the National Rehabilitation Policy in order to meet the local need of the people as well as take measures to ensure that they are better off than before they were shifted out of their abodes.

Schemes

There are many schemes that can support projects that provide alternative livelihoods to local people living in and around protected areas and forests with high biological value.

Institutions

The institutions that promote alternative livelihoods are:

- National Afforestation and Eco-development Board.
- National Wasteland Development Board.

Decentralised Institutions

In the section on Access and Control we have seen that the forest management often attempts to impose restrictions on the forest use of local people with out their consent. Scholars and activists have often argued that greater access to forest resources for the local people would mean a greater stake of local groups in forest protection. For this reason, JFM can be seen as way of loosening control over forest resources and an effort to provide legitimacy to decentralised forest institutions. The sharing of decision making powers with the Village Protection Committees is reflective of the fact that atleast some officials in the forest department are recognising the need for decentralised institutions.

Laws

There are practically no laws that make it obligatory for the government to facilitate the development of decentralised institutions for the management of forests. Infact existing local institutions like the Village and Forest Protection Committees are not recognized by any law. In fact our analysis of the Wildlife (Protection) Act, 1972 and the Indian Forest Act, 1927 show that the these laws impede the process of decentralisation by concentrating powers in the hands of a few officials. With the passing of the Panchayati Raj Act, the process of decentralisation should be carried to its logical extent.

Policies

There are some policy statements that support decentralised institutions.

National Forest Policy, 1988: This statement makes a commitment towards the greater involvement of tribals in conservation efforts but does not specify the the nature of decentralised institutions and their powers.

Guidelines for Participatory Forest Management, 1990: These guidelines form the basis of joint forest management. It is also the only policy document which specifies the nature of some of these protection committees and their benefit-sharing arrangements. Further, it also elaborates upon the role of NGOs in decentralised forest management. These guidelines are different for different states. (See Annexure for details)

National Conservation Strategy, 1992: This policy proposes that NGOs and tribals should play a greater role in forest management.

Micro Strategies and Forest Management

Micro-strategies for biodiversity conservation in forested tracts developed by the BCPP can be divided into two categories:

1. Strategies dealing with degraded forest tracts.
2. Strategies dealing with protected areas for wildlife.

It would be worthwhile to examine to what extent the laws as presently applicable will help or hinder the implementation of these strategies.

Strategies Dealing with Forested Tracts that are Degraded

Support in Law and Policies / *Types of Strategies*	*ACTS*			*POLICY*	
	1927	*1980*	*PANCHAYATI RAJ ACT*	*1988*	*1992*
Legal Protection For VPC					
Restoration of hill tops, ponds and meadows in RF by the people.	Act doesn't allow.				
Curtailment of Commercial Activity and Tourism.		Adequate Provision.			
Stopping Encroachments.		Adequate Provision.			
More Rights For Local People.	Settlement of Rights at Discretion of Forest Officer			Both Talk of Fulfilment of Needs.	
Specification of Role of NGOs.					Specified in this policy.
Linking Conservation with Alternative Livelihood Strategies.				Both Policies Specify Mention This in terms of Family Industries NTFP, etc.	
Panchayats as Key Players in recording biodiversity.			Needs Amendment to include this.		
Panchayats' Maintaining Biodiversity Register			Needs Amendment to include this.		
Education and Awareness					Figures Prominently in this policy.
Access to Information to Local People.					

Strategies Dealing with Protected Areas for Wildlife

Support from Policies and Law / *Type of Strategy*	*ACT* *1972*	*POLICY* *1983 Action Plan*	*REMARKS*
Closing some areas to human interference.	Chapter IV		
Need to compensate for and resolve human wildlife conflict. This is identified as a major problem.			An important area that has not received adequate attention in law and policy.
Empowerment of the VSS or VPC with respect to the curtailment of poacher and management of PAs.	No Provision	Not Mentioned	
Development of the Surrounds through development of buffer zone.			Figures prominently in report of task force.
Role of Panchayats in Management of PAs.			
Ownership of homesteads and agricultural strips in PAs.			
Role of NGOs in buffer zone management.		Figures in terms of education and awareness.	
Awareness and Education		Figures prominently in Policy.	

The analysis above shows that there is very little legal support for the micro-strategies developed in BCPP. In some cases like the human -wildlife conflict the policy is also inadequate.

Biodiversity Conservation in Rangelands

Rangelands are defined as extensive unfenced areas with natural vegetation which are used by animals (wild and domesticated) for grazing. These lands are typically large fields around settlements bearing predominantly grasses which are habitually grazed by herbivorous animals moving from one place to the next. They are either hay plots or free grazing plots. Besides grass, grazing lands of India bear shrubs and trees which grow either in in isolation or scattered in large and small patches with variable density. Rangelands are under the control of the state forest department or the gram panchayat. Here the cattle from nearby settlements can graze during the dry seasons when grasses are not available elsewhere.

The most striking feature about the management of rangelands is that there are no explicit laws, policies and schemes that directly deal with the conservation of bio-resources in these unique ecosystems. At best the rangelands falling within the boundaries of reserved forests and protected areas are covered by the Indian Forest Act, 1927 and the Wildlife (Protection) Act, 1972.

Management and Conservation Related Provisions

Conservation

There are no specific laws for the conservation of rangelands. Rangelands falling under forests and protected areas are covered under the Indian Forest Act, 1927 and Wildlife (Protection) Act, 1972.

Activity	*State*	*Number of Schemes*	*Allocation (in Lakhs of Rs)*
Ecodevelopment and buffer zone development in national parks and sanctuaries.	KER	1	100.00
	MEG	1	150.00
	HAR	2	8.65
	KAR	1	125.00
Integrated Wasteland Development	J&K	6	600.00
	TN	1	100.00
	MEG	1	100.00
	GOA	1	100.00
	ASS	2	970.00
	RAJ	3	617.66
Development of Minor Forest Produce	J&K	7	700.00
	SIK	1	183.50
	TRI	1	400.00
	D&N	1	25.00
	HP	1	100.00
	TN	1	202.91
	PUN	1	262.00
	MEG	1	100.00
	BIH	1	250.00
	GOA	1	100.00
	ASS	1	50.00
	MIZ	2	120.00
	HAR	1	250.00
	KAR	1	250.00
Farm Forestry and Social Forestry	J&K	1	120.00
	TRI	1	502.00
	D&N	2	700.00
	HP	1	1095.00
	TN	1	3779.20
	PUN	1	108.29
	MEG	1	3600.00
	BIH	1	133.19
	GOA	1	103.50

Contd. . . .

Activity	*State*	*Number of Schemes*	*Allocation (in Lakhs of Rs)*
	ASS	3	10108.00
	RAJ	2	27185.00
	MIZ	1	305.00
	ORI	1	4559.00
Beneficiary Oriented Scheme for rehabilitated Tribals	ORI	1	2845.00
	KAR	1	120.00
Fuel and Fodder Projects	J&K	2	800.00
	SIK	2	524.00
	HP	1	500.00
	KER	1	50.00
	PUN	1	1072.30
	BIH	1	2900.00
	ASS	1	1500.00
	RAJ	2	4500.00
	MIZ	1	50.00
	HAR	1	2520.00
	ORI	1	1224.00
	WB	1	1420.00
	MP	1	2596.00
	KAR	3	350.27
	UP	1	1275.00
Agroforestry	SIK	1	100.00
	HAR	1	3000.00
Environmental Assessment Project	MEG	1	600.00

Access and Control of Rangelands

There are no specific laws for the conservation of rangelands. Rangelands falling under forests and protected areas are covered under the Indian Forest Act, 1927 and Wildlife (Protection) Act, 1972. Restrictions on grazing in rangelands are also laid down by the Grazing Policy of the Government of India, 1995. Sponsored by the National Afforestation and Ecodevelopment Board, this policy highlights the need to specify the number of livestock that would be allowed to graze on wastelands.

Commercial use and threats to the diversity in rangelands

There are no laws, policies or schemes covering this aspect.

Transparency of administration

There are no laws policies or schemes covering this aspect.

Strategies for Conservation of Rangelands

Alternative livelihood to reduce biotic pressures on rangelands

There are a few schemes that can facilitate the removal of grazing pressures from wastelands. But then these schemes are neither prevalent nor sanctioned in all the states. Some states, like UP and Jammu and Kashmir have sanctioned state schemes for pasture development and identification. In majority of the other states, fuel and fodder development projects are set up by the state and central governments (the details of which are given in the alternatuve livelihood section on forestry).

Decentralisation of Institutions

The integrated grazing policy published by National Afforestation and Eco-development Board. in 1995 recommends that the management of grazing lands should be done by village level institutions like the gram sabha.

Micro-strategies formulated under BCPP

Under the BCPP, micro-strategies for the preservation of grasslands have identified some ways by which grazing pressures can be reduced on grasslands. These measures will also ensure the better management of rangelands by promoting a better relationship between the authorities and local people. These measures are:

- Annual cutting of grass to increase habitat suitability for endangered species. This grass can be given to the surrounding villages to use for thatching, fodder or other purposes.
- The harvesting of fodder from from forests and rangelands by the forest department to distribute it to the local people in order to prevent undue human interference.

The conservation related measures suggested are:

- Breeding sites for some endangered species.
- The prioritization of some endangered species and sites for conservation.

Policies and laws should be formulated to operationalise these measures. The schedules of the Wildlife (Protection) Act should be amended to include endangered species priotitised in BCPP. Similarly legislation should be enacted to include ecologically fragile sites in the law.

Biodiversity Conservation in Hills and Mountains

Mountain and hill areas are distinctive and fragile ecosystems that need special conservation efforts for maintainence of biodiversity. They face unique problems like erosion, landslides, silting of rivers and loss of soil fertility. They also face threats from extensive quarrying and mining, expansion of network of roads, tourism, expansion of the human population, mono-culture plantations and the expansion of agricultural and animal husbandary practices. Being ecologically fragile zones they need special attention.

Management and Conservation Related Provisions

Conservation

There are no specific laws for the conservation of these ecosystems. Mountain and hill areas declared as forests and protected areas are covered under the Indian Forest Act, 1927 and Wildlife (Protection) Act, 1972. Apart from banning green felling in some part of the Himalayas, there has been little focus on the conservation of these fragile ecosystems. The setting up of the G.B. Pant Institute of Himalyan Ecology near Almora in the U.P hills and the sponsoring of a large number of research studies on the ecology of the Western Ghats, though welcome steps, have limited use as the findings of these studies are hardly acted upon.

The G.B. Pant Institute runs a programmes on *Integrated Action Oriented Research Demonstration and Projects for Himalayan Regions*. It is the focal institution for studying development strategies and technologies for the sustainable development of the Himalayan and Hill ecosystems. In recent times the Planning Commision has sought to focus on the Western Ghats and Eastern Himalayas. The focus on the Eastern Himalayas is also done through grants to the North Eastern Councils which are supposed to run programmes on ecological concerns in the regions. But ecological concerns are rarely evident in the resultant schemes, programmes amd activities.

Fortunately there are a significant number of protected areas in the hills and mountains. These are located in Himachal Pradesh, the North East, Jammu and Kashmir and the U.P Himalayas. There is also the Nanda Devi Biosphere Reserve in the Western Himalayas and the Nilgiri Biosphere Reserve in the Western Ghats. The himalayan and the hill ecosystems receive some amount of protection due to the existence of these national parks and sanctuaries.

Recently the Planning Commision has brought out a report on the National Policy for an Integrated Development in the Mountain areas. On the conservation front, it proposes that the vast genetic diversity that exists in the Himalayan region, both the flora and fauna, needs to be preserved for posterity. *In situ* conservation of the genetic diversity and resources in many situations may be inescapable. However, declaration of any area as biosphere reserve and closing down the area from human interference can have substantial impacts on those living within or in adjoining areas. The Group recommends a time bound programme for inventorisation of genetic resources in the Himalayan region under the aegis of the Botanical Survey of India and Zoological Survey of India for *ex situ* conservation. In this, universities and other academic institutions or agencies, must also be associated to complete this process in a well-defined time framework. A systematic attempt at the conservation of germ plasm and genetic resources must be attempted for which a detailed master plan must be evolved.

In the case of institutions, this policy statement recommends the setting up of a National Himalayan Development Authority for initiating and monitoring sustainable development in the Himalyan and Hill Area ecosystems. They also recommend a special fund called the National Himalyan Environmental and Development Fund for this purpose. In addition to these it envisages an enhanced role for the MOEF.

The Planning Commission is also running two programmes for the development of hill areas and the western ghats. The working group of the ninth plan for these two areas states that the biodiversity of these areas is located in two distinct eco-types: 1) natural ecosystems and 2) agro ecosystem types. It highlights the need for a policy framework for *in situ* conservation of these eco-types through their sustainable management. It recommends that the policy of reservation under the Forest Act be reviewed and revised accordingly. Instead there should be an elaboration and refinement of the JFM programme for the sustainable redevelopment of the hill areas and western ghats.

Commercial use and threats to the diversity in mountain ecosystems

The National Policy for Integrated Development in the Himalayas recommends that the Ministry of Environment and Forests must frame detailed guidelines on various considerations which needs to be kept in view while providing environmental clearances for development projects under the Environment (Protection) and Forest (Protection) Acts, be that by the central or state Governments. It is necessary to make these guidelines transparent and enforced in a fair manner free from arbitrariness.

The Policy also states that one of the major activities in the Himalayas is tourism both in the form of pilgrim tourism and for pleasure and advénture. While infrastructural facilities would need to be created to enable tourism to develop fully in the Himalayan region and become a major economic activity, it is necessary that the impact of the creation of luxury hotels, eating places at the cost of local ecology must be studied in depth. The promotion of tourism may however go against the interests of biodiversity conservation.

Strategies for Conservation of Mountains

Alternative livelihood to reduce biotic pressures on mountains

There are no noticable laws, policy and schemes that deal with this aspect of the management of mountain ecosystems.

Decentralisation of Institutions

There are no laws and schemes specifying this. There are hill area development councils in West Bengal and Assam which are always demanding more powers. Apart from this, the National Policy for Integrated Development in the Himalayas recommends that there should be coordination between scientific institutions, NGOs, government and the Himalayan Development Authority. It also envisages a larger role of the NGOs as facilitators of local participation for the saving the biodiversity in the mountain ecosystems.

The working group on hill area and western ghats development programme recommends that local participation be increased in the JFM in order to bring about in situ conservation of biodiversity in these areas and sustainable development of the region for ensuring its ecological stability.

Micro-strategies formulated under BCPP

The BCPP did three studies under the sites and species sub-group on mountain areas. The main recommendations of these studies included the following recommendations:

- The formation of a uniform policy of the conservation of all hill and mountain regions, for areas outside protected areas also.
- The development of a collaborative common inter-governmental strategy for the conservation of the Himalalyas.
- The control of commercial and developmental activities in hill and mountain regions.
- The eco-restoration of fragile habitats as specified in these reports.
- The creation of ecological landscapes for the preservation of specific sites.
- The management of biotic pressures.
- The control of poaching and unrestricted tourism.

Some of these recommnedations are taken care of in PAs and Reserved Forests located on mountain and hill regions. But there is an urgent need to have policies, schemes and laws covering these aspects. The National Policy on Integrated Development of the Himalayas covers some of these points like the control of tourism, and coordination between different governmental and non-governmental agencies.

Biodiversity Conservation in Wetlands, Mangroves, Coastal Areas

Wetlands

Wetlands may be defined as submerged or water saturated lands, both natural and artificial, permanent or temporary, with water, i.e., static or flowing, fresh, brackish, or saltish, including areas of marine water, the depth of which at low tide does not exceed six metres for the major portion of the year. Wetlands can be described as the water logged wealth of India. They have been seen as transitional ecosystems i.e., transitions between terrestrial and aquatic bodies. They support a variety of valuable flora and fauna.

Wetlands in their unmodified natural form function as bird, fish and wildlife habitat. If managed sustainably they can meet the development needs of the modern society. To manage wetlands, it is imperative to understand the close relationship between these ecosystems and the catchment area as wetlands are dependent on the catchment area for its water requirements, both in terms of, quality and quantity. Any environmental stress on the catchment would have a direct or indirect impact on the wetland and if the complete ecological cycle is considered, the reverse impacts from the wetland on the catchment area also become evident.

Conservation Efforts

In India there is no Central Legislation on wetlands as we have in the case of forests. Some States where wetlands play a crucial role in the social fabric have passed legislations pertaining to fishing and other aspects of wetlands. However some of the major environmental threats faced by wetlands have not received adequate legal protection in India. Siltation, soil erosion and soil and watershed conservation find no mention in current laws. Any activity that changes the hydrology disrupts the whole system. Thus, draining, diversion of water flow, increased flow of silt or nutrient enrichment are responsible for a shift in the structure and function of wetlands. Threats also arise from dredging, construction of all kinds including dykes, dams and seawalls for flood control, solid waste disposal, discharge of pesticides, herbicides, and mining of wetlands soils for peat, coal, sand, gravel, phosphate and other materials, subsidence due to extraction of groundwater, oil, sulphur and other materials. Infact the National Conservation Strategy proposes laws for achieving these objectives. Despite lack of legal protection, wetlands do benefit from Central and State Schemes aimed at watershed and soil conservation. The scheme on conservation and management of wetlands was initiated in 1987 with a view to laying down policy guidelines, taking up priority wetlands for intensive conservation measures and to prepare an inventory of Indian wetlands. A National Wetland Committee had been constituted in the Seventh Five Year Plan for conservation of wetlands.

The National Wetland Programme focuses on the preparation of management action plans like protection, siltation control, pollution control, weed control, afforestation, wildlife conservation and fisheries development. It also proposes research activities like survey and mapping of wetlands, application of GIS, and mathematical modeling in selected wetlands, environmental education, evolving wetland evaluation techniques to judge the health of wetlands, and impact of developmental projects and other human activities on wetlands.

Only when designated wetlands are given a protected area status do they get any affordable protection. However there are many laws that indirectly lead to the conservation of wetlands and deal with the factors that threaten the very existence of these lands.

Several well known wetlands are in a severely degraded state. They imperiled because human pressure has increased dramatically, resulting in unmitigated expansion of habitation and cultivation. An increasing number of poorly conceived, mostly government/international aid agencies sponsored development schemes have ruined wetland areas by drainage and development. There is no legislative control on land speculators who reclaim wetlands fro development activities.

One of the important factors threatening the conservation of wetlands is water pollution brought about by industrial and agricultural wastes that run off into these habitats. To control this phenomena the Water (Prevention and Control) of Pollution Act was enacted in 1974. The statement of objects and reasons of the Act of 1974 stated that in the past, rivers and streams had become polluted because of the run off of affluents due to urbanization. This Act was to be operationalised through Centrally constituted pollution control boards. It opined that though pollution was a subject in the State list, the Centre would legislate for public good.

The other Act which has a major bearing on the conservation of wetlands is the Wildlife (Protection) Act, 1972 which accords some protection to wetlands that have been designated sanctuaries. In wetlands that have not been demarcated as sanctuaries, no such protection is accorded and activities like aqua-culture can be carried out without hindrance.The other notification that has some bearing on the conservation of wetlands is the CRZ notification under the Environment (Protection) Act, 1986. Within the CRZ various activities like construction for human habitation, for example, are regulated.

The role of environmental education is particularly important because in the popular notion wetlands are equated with marshy areas with mosquitoes and dangerous crocodiles. And the only way to deal with them or to put them to some use is by reclaiming them for agriculture or some construction activities like housing or industries. This mindset needs to be changed. Wetland and marine ecosystems are poorly represented and managed through protected areas. Despite attempts to conserve some of the more critical natural wetlands through the use of PAs (93 sites covering 5.5 million hectares), only 28% (1.5 million hectares) are totally protected. 30% (1.6 million hectares), have some form of protection, and the remaining 42% (2.4 million hectares) are totally unprotected.

Micro Strategies for Wetlands

Our analysis has shown that there is an urgent need to legislate for these complex ecosystems. Some of the factors and issues that need to be taken into account have been illustrated above. They show that the law needs to take the following major issues into account:

1. The management of bio-resources by local bodies.
2. The role of different stakeholders in the restoration of degraded ecosystems.
3. How to balance the needs of the people with the natural regeneration of these acquatic ecosystems.

Micro-strategies formulated under BCPP

The micro-strategies for Chilka have attempted to suggest some solutions to these problems. For example in Chilka, the people started fishing co-operatives to protect their interest vis-a-vis the trawlers. Here the group has suggested that a federation of fishing co-operatives should manage local fisheries. Also diversion of land for prawn culture, factories and residential buildings needs to be checked.

In the case of Kaliveli tank, which has so far remained relatively unpolluted, the recommendation is to declare this large brackish water lake as a bird sanctuary. The minimum unmet needs of the people have to be addressed to if the lake is to remain in a good condition.

In the Malvan estuarine complex, water pollution and construction of dykes need to be checked in order to prevent adverse changes in the quality of water and soil. In the case of Pulicat Lake, sustainable catches of prawn and crab have to be determined. Eco-restoration with full involvement of locals needs to be started. The desirability of including Pulicat lake as a Ramsar site has been mentioned.

Though the strategies focus more on local participation in conservation of biodiversity, they also give some clue regarding the types of powers local institutions should be accorded. Some of these are:

1. Pricing of products that go out of the region.
2. Regulating fishing rights in the surrounds.
3. Determining the terms on which commercial activity like tourism should take place.

However one crucial area is ignored by these strategies. They fail to make any suggestions about what conservation goals should be considered a national priority and which should be locally determined. The Chilika report states that the forest and the fisheries department should have a role of providing inputs to local committees. Providing technical inputs is essential to ease the pressures on these ecosystems. But this cannot be the only function of these departments. These departments must lay down conservation goals that are regional in character. It should ensure that the local conservation efforts are not contradictory to these goals. If a conflict occurs, than ways to resolve it should be found through a process of consultation between local and regional representatives. Further monitoring systems for the status of ecosystems should be set up at every level keeping in mind the indicators of sustainability. In short the laws, where they exist, should be specific about the division of powers, responsibilities and duties of institutions which are involved in conservation of these bio-resources.

Mangroves

Mangroves are the salt tolerant forest ecosystems found mainly in the tropical and sub-tropical inter tidal regions of the world. They consist of swamps, forests land within and its water spread areas. They stabilize the shoreline and act as a bulwark against the encroachments by the sea.

Conservation Efforts

Mangroves are a unique ecosystem providing many functions of protecting the shorelines, yet they have no special legal backing. Mangrove forests that have been classified as reserved forests or protected areas enjoy some protection under the Indian Forest Act of 1927 and the Wildlife Protection Act of 1972. In addition to these rules, CRZ regulations described in the case of wetlands also cover a lot of mangroves as they provide protection to coastal regions which are 500 metres above the high tide area. But the CRZ notification does not protect the mangroves from felling and pollution. Comprehensive legislation that address the following problems relating to Indian mangroves are urgently called for:

- Reclamation of mangrove area for agricultural purposes.
- Conversion of large tracts of virgin mangroves into aqua culture, domestic and industrial development, construction of harbours, channels etc..
- Degradation due to fuel and fodder extraction

The Scheme on Conservation and Management of Mangroves was initiated in 1986. The main activities under the programme are survey and demarcation of sites, protection and conservation measures like natural regeneration, afforestation, nursery development, education and awareness programmes and research on various aspects of mangrove ecosystems and coral reefs. Being an ongoing activity review meetings are held to monitor progress. Apart from this scheme a National Mangroves Programme has also been set up in response to the National Committees recommendation. Under this programme nodal academic institutions are given the task of formulating action plans for the conservation of mangroves. So far 15 areas have been identified under this programme.

Intense biotic pressure has reduced mangroves to discontinuous patches along riverine deltas. Even these stand severely degraded. Mangroves have been ruthlessly destroyed for timber, fuel wood charcoal and tannin. Vast areas have been reclaimed for residential flats, industrial estates, harbour extension and docks. Bilge from tankers, sewage, effluents from industries and agricultural pesticides have degraded mangrove flora and fauna.

Micro-strategies formulated under BCPP

The BCPP sites sub-group on mangroves covered Bhitarkanika, Coringa, Kundapur, Sunderbans and the Gulf of Kutch. The main recommendations of these studies included the following:

- Fuelwood to be brought under the public distribution system to reduce pressures on mangroves.
- Reclaiming mangroves for aquaculture should be banned. Locals in any case do not get any benefits. In case banning is not totally possible, methods of prawn farming without destroying mangroves should be demonstrated to locals.
- Fishing may be permitted only when turtle excluding device is made mandatory on all drag nets. In any case, mechanised vessels with drag nets disturb the benthic fauna thereby affecting the food chain
- Fodder banks to be established to prevent ruthless ravaging of mangroves.
- Provide for biogas plants.
- Committee of local people should be allowed to manage the mangroves of the area.
- Encourage planting of fuelwood species in vacant lots
- Education and training of fisherfolk in sustainable fish catch and to release all juveniles back into the waters
- Training locals in alternative income generating activities
- Positioning of industries at a relatively safe distance from mangroves and stringent effluent management
- An effective, ecologically based land use policy in mangrove areas.

Apart from these, certain site specific recommendations based on threats and disturbances have also been spelt out.

Coral Reefs

Coral reefs are shallow waters, tropical marine ecosystems which are characterized by a remarkably high biomass production and a rich faunal and floral diversity. They are formed by the calcareous skeleton that houses corals, a type of soft bodied, radically symmetrical marine invertebrates.

Conservation Efforts

Like mangroves and wetlands, there are no special laws to provide protection to coral reefs which serve as a mechanism for providing shelter to the fish diversity of the region. They are faced with the problems of pollution, degradation and destruction through mining, dredging etc. Along the Gulf of Kutch, prized corals have been so grossly over-exploited that they are facing imminent extinction. They are commercially mined and used in ever increasing quantities to plaster homes of the burgeoning local population. Excessive siltation results in large scale mortality of corals. Though the CRZ regulations provide them with some protection against pollution, they do not take the fragile nature of coral reefs into account. Currently the on going project of the Department of Ocean Development is being implemented through Space Application Centre, Ahmedabad for the mapping and characterization of these reefs.

The National Coral Reefs Programme has identified the main tasks to be accomplished in the conservation of coral reefs. These are survey, classification, control of over exploitation and pollution, identification of sites for marine national parks. Four coral reef areas have been identified for intensive conservation and management : Gulf of Kutch, Gulf of Mannar, A&N and Lakshwadweep. Commercial extraction of corals was banned in 1978, yet direct dredging of corals has been reported. The designation as marine national parks may help the reefs to recover over time.

For all the three ecosystems, wetlands, mangroves and coral reefs, there is a National Advisory Committee that advises the Central Government on conservation methods to be undertaken. Some new measures have been proposed in the 9th plan which contain an ambitious programme in the form of Perspective Plan. During this plan the survey of wetlands, mangroves and coral reefs will be undertaken using remote sensing technology and conventional methods to assess the total wetland area in the country and the loss occurring periodically. Studies in the nature of economic valuation of these unique resources and evaluation techniques for quicker appraisal of their health are some of the highlights of the plan.

Coastal Zones

Conservation Efforts

Prior to the CRZ rules of 1986, the Indian Fisheries Act 1897, had some bearing on the conservation of biodiversity on coastal regions. The Act imposed some restrictions on fishing in coastal areas. It also took some measures for protecting fish in these areas. The use of explosives, fixed engines, construction of weirs and certain types of nets was prohibited in fish habitat. At the same time the states could enjoy exclusive rights to fish in private waters after taking the consent of all the owners. At the same time some states also amended this Act in the post-colonial era to make the attracting of prawns into private waters an offence. Any contravention of these rules was to invite a penalty of Rs. 100 and if the breach is a contiuing breach it would result in a further fine of Rs. 10 per day. Apart from these provisions, the early Game laws as well as the Indian Forest Act of 1927 also had provisions which forbade the hunting, snaring, shooting, trapping or poisoning of water in order to catch fish reserved and protected forests.

The next important legislation for the conservation of coastland diversity was the Coastal Regulations Zone (CRZ) constituted under the Environment (Protection) Act, 1986. These rules were framed under section 3(1) and 3 (2) (v) of this Act and stated that the "Central Government hereby declares the coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action (in landward slide) upto 500 metres from High Tide Line and the land between Low Tide Line as the ciastal zone" it enacted rules to limit industrial expansion in this zone. Under this major objective the following activities were prohibited in the coastal zone:

* Setting up of new industries.
* Handling or storage of hazardous wastes.
* Fish processing units.
* Discharge of wastes and effluents.
* Dumping of city or town wastes.
* Construction activities in ecologically sensative areas and between low and high tide line.
* Harvest of ground water.

Of these, certain activities were permissible with the consent of the MOEF. These activities were: construction activities for which forshore activities are essential; construction of jetties, thermal power plants and all other activities costing over ruppees 5 crores. Apart from this the CRZ rules also stated that state governments would have to classify these zones according to the criteria specified in the CRZ rules. The zone was categoriesed into 4 types:

1. CRZ-1: The zone includes ecologically sensitive and important areas such as national parks, sanctuaries, reserved forests, mangroves and coral reef areas. It also includes places with a diversity of marine life. The second type of areas under this category are areas between the high tide and low tide areas. In this category, new constructions are prohibited within 500 metres of the high tide line.
2. CRZ-2: These are areas that have already been developed close to the shoreline. Here buildings are

not permitted on the seaward side. They are only permitted on the landward side and reconstruction is only allowed according to the FSI/FAR norms. The designs of these buildings should be compatible with the surrounding architecture.

3. CRZ-3: These are areas which are relatively undisturbed and include the rural areas (developed or undeveloped) as well as some areas within designated urban boundaries. They are demarcted as "No Development Zones" within 200 metres of the high tide line. Beach resots and hotels may be established between 200-500 metres if the MOEF permits. Construction and reconstruction of dwelling units shall be allowed between 200-500 metres so long as they are within the ambit of traditional rights and customary uses such as existing fishing villages and goathans. The number of these dwellings shall not be more than twice the existing number. The regulations also specify what height and area these dwellings should cover.
4. CRZ-4: Includes the coastal stretches of Andaman and Nicobar and small islands not covered under the first three categories. For example in the Andamans dredging, and collection of corals and sand dunes is not permitted.

The CRZ rules deal substantially with the conservation of marine ecosystems in that they classified the coasts on the basis of their ecologically sensitivity and threat to the shoreline. However, even while doing this they concentrated mainly on the control of commercial and industrial activities on the coasts. They do not deal with the biotic pressures that threaten the ecology of the coasts. Further they do not deal with hazardous operations like oil drilling in a specific way. Neither do they specify whether the forests, Protected Areas and watersheds in the coastal zone would be subject to the laws under other Acts like the Indian Forest Act 1927, or Wildlife Protection Act 1972. Futher these rules facilitate the centralisation of power in the hands of the MOEF which has the sole authority to grant permission in the case of certain commercial activities. Under these rules there is no scope for the incorporation of local bodies in decision making for the conservation of biodiversity in the coastal areas. The CPCB in collaboration with the Department of Ocean Development has identified 173 monitoring stations all along the Indian Coast to assess the water quality. Four SPCB have also been involved. Data on 25 parameters are being processed to formulate schemes to control and monitor pollution of the coastal waters.

Recommendations

Forests

The following recommendations can be made on the basis of our discussion of laws, policies and schemes for forest ecosystems:

1. Laws and policies are urgently needed for the identification of biodiversity rich forested areas. At present, national surveys of forests are done for only canopy density cover. This does not give an idea of the species diversity of the region. Further the method of canopy cover is also such that it only gives us an idea of the forests with .10, .40 and above .40 canopy density. It does not give us an idea of undisturbed pristine forests. It is also important to identify and preserve these forests.
2. Currently the core and buffer zone boundaries are not recognised by the Wildlife (Protection) Act. The zonation of protected areas must be recognised by law.
3. In order to protect natural forests it is necessary to increase the tree cover so that people can meet their fuel and fodder needs from these man-made forests and the pressure is released from natural forests. Efforts should be made to achieve the target of the 1988 Policy, i.e., 33% tree cover in the plains and 66% tree cover in hilly and mountainous regions. In order to do this the following steps must be under taken:
   - Targets for each state must be specified.
   - Any state falling short of their target should be given a time frame for achieving it on a yearly basis.
   - States, which fail to meet these yearly targets, may not be allowed to divert any forested land for developmental purposes till they fulfil these targets.
4. The Forest (Protection) Act, 1980 should be amended in the following way:
   - The diversion of land for projects should require the concurrence of the Village Protection Committee (VPC) of the area, (where it exists), and the Central Advisory Committee.
   - The power of vetoing a decision with regard to sanction of any commercial activity in the forest area should also vest with the VPC of the area where the project proposed to be started.
   - No project may be cleared without the consent of either the VPC or the Central Advisory Committee.
   - The role of these bodies should also be recognised in buffer zones and multiple use areas of the national parks and sanctuaries.

5. As far as compensatory afforestation is concerned, the following measures should be taken:
    - Quite often, afforestation takes the form of planting 4-5 types of species. Instead the endeavor should be to recreate the natural forest type that existed before the degradation set in. This should be done after consulting old working and management plans, and knowledgeable village elders.
    - Afforestation usually takes only floral species into consideration. It is true that faunal species cannot be introduced simultaneously because of the absence of green cover. But from a long-term point of view, introduction of faunal species must be considered for a healthy ecosystem.
    - Soil microbial functions and the forest litter communities should not be ignored in these areas.
6. In order to ensure the success of natural forest protection it is essential to decentralise forest administration. It is also necessary that the law specify the roles of different agencies in protecting forests. For this the following steps should be taken:
    - Local protection bodies like the VSS and VPC should be given legal recognition. In areas with no VPCs, it must become mandatory for gram panchayats to hold elections for constituting VPC. Women, SC/ST should have representation on the same guidelines as suggested by the 73rd & 74th Amendments.
    - The VPC should be given the power to make rules.
    - The 73rd & 74th Amendment should mention biodiversity conservation as obligation of panchayat and Nagarpalikas.
    - The forest department should ensure that the conservation efforts of local bodies are in tandem with larger conservation goals.
    - The FD should provide inputs of technical, financial and policy nature to local efforts.
7. The law should lay down the principle that alternative forest lands or livelihood are provided to people whose rights are extinguished because of protection of some forested tracts or formation of protected areas.
8. Human-wildlife conflict has been found to be a major problem across groups. Most groups have suggested a more accessible and simplified procedures of compensation. Current laws have paid very little attention to this problem.
9. Special efforts should be made to control poaching and trade of wild animals. The poaching of commercially valuable species should also be stopped by special policing measures.
10. Finally, the budget of the forestry and wildlife sector is less than one percent of the total budget. The allocation of funds to this sector should be substantially increased.
11. A National Forest Genetics Bureau should be set up on the lines of the National Plant Genetics Bureau.

Rangelands

The main recommendations for conserving the diversity of rangelands in a better way are as follows:

1. Rangelands have suffered the most because of their non-recognition as a significant and distrinct ecosystem. A comprehensive legislation and policy is needed to manage and conserve the diversity of rangelands. But before this is done it is essential to identify the extent and the nature of biodiversity on rangelands. Perhaps a separate classification of rangelands also needs to be done in order to prioritise the preservation of important pristine rangelands wherever they exist.
2. The protection of rangelands should be covered under various environmental laws like the Forest (Conservation) Act and the Environmental (Protection) Act in order to prevent their further degredation, reclamation and commercial exploitation of rangelands by imposition of deterrent penalties.
3. The Forest (Conservation) Act needs to be amended to stop the reclamation of rangelands for afforestation.
4. The conservation of rangelands is almost impossible if grazing pressure is not diverted to alternative sites. A 1995 Report on Integrated Grazing policy by the National Afforestation and Eco Development Board suggests that a suitable legislation limiting the number of animals to be kept by families living within and around forests needs to be considered. The problem has to be tackled in a coordinated manner by all concerned departments like agriculture, animal husbandry, forests, soil conservation, rural development, irrigation and revenue without which no policy for restoring the ecological balance, which is the ultimate objective of a rangeland policy, would be successful.

Mountain and Hilly Regions

The discussion of mountain and hill ecosystems highlights the need for taking the following steps:

1. It is important to review the protection being accorded to mountainous and hilly ecosystems. The representative sites of all the different types of ecosystems should be included in the protected area network.

2. For this whole fragile region, development strategies need to be formulated which balance the needs for regional socio-economic development with the imperatives of maintaining the ecological balance. The Planning Commission, along with the Ministry of Environment and Forests and the environment and forest department of states, should get involved in formulating sustainable development plans for these regions and in monitoring their implementation.
3. The relevant provisions of the Environment Protection Act should be used for notifying the fragile mountain ranges so that mining, road construction, building activities, deforestation and other types of environmentally destructive activities can be regulated. This notification could perhaps be along the lines of the coastal regulation zone notification issued in 1991 by the Ministry of Environment and Forests, Government of India.
4. Though there is recognition that hilly areas need special attention in terms of development, and for this purpose the Planning Commission allocates special funds for hill regions and has some focused development programmes there, a corresponding recognition of the ecological fragility of the hills and mountains is not reflected in the finanacial allocations. It is important for the Planning Commission to make special provisions in the State and Central budgets for promoting sustainable development in the hill areas and for ensuring that projects based in, and affecting, the hill and mountain ecosystems have the resources required to be executed in an environmentally friendly manner. In order to facilitate this the recommendations of the Planning Commissions' expert committees on hill areas and the himalayas should be implemented.

The Ministry of Environment and Forests should prepare guidelines covering projects and activities in hill and mountain areas, and set up a special committee, like it has for various types of projects and areas, to assess all proposed projects and activities in hill areas and to ensure that they solicit and get environmental clearance prior to implementation.

Wetlands, Mangroves, Coral Reefs

1. Education and awareness regarding the ecological significance of these unique ecosystems.
2. Studies to determine the bio-indicators of pollution and continuous monitoring to act as early warning signals for initiation of corrective steps
3. Comprehensive legislation directly applicable to these ecosystems to be formulated
4. Giving preference to natural as against engineering solutions to environmental problems in these areas.
5. Promoting the use of non-conventional energy sources or to provide fuel and fodder through the public distribution system.
6. Increasing the economic stake in conservation through value addition to time and natural products.
7. Strict regulation of tourism and control over construction activity of any kind.
8. Propagation of salt resistant agri-biodiversity species
9. Eco-restoration of damaged sites specially mangroves.

Acknowledgements

We would like to thank Gopinath S., Swati Shresht, Rewa Mishra and Lalit Kumar for help with the sources.

Economic Aspects of Biodiversity Conservation: Micro and Macro Strategies for Intervention[1]

Kanchan Chopra

Strategies for Biodiversity Conservation: The Role of Economic Policy Interventions

Economic compulsions, working within the framework of a set of institutions play a major role in the use and conservation of resources. The manner in which they impact present and future use of natural resources depends in a large measure on these institutions, the important ones among them being the market, the state, and sometimes non-market and social institutions. No one institution can be an all pervading one: relative significance of different institutions varies, being determined by the depth of its pervasiveness and reach within the existing structure of the economy. In general, in order to be well articulated, an institution needs to determine,

- — membership criteria which determine inclusion or exclusion in the institution;
- — rules of behaviour to be complied with by those included and
- — a system of rewards and penalties which ensure that they are complied with.

In the case of the market, for instance, possession of purchasing power determines inclusion. A state may treat nationality as the inclusion criteria and a community, residence in a particular area. Compliance to behavioural rules may be ensured by a dictate, by social sanction or duly enforced property rights. In the context of biodiversity conservation, behavioural norms or rules and codes of compliance need to be directed towards a balance between present and future use. In other words, sustainable or wise use is of the essence.

The market does not solve this inter-temporal problem efficiently, mainly due to the absence of a well articulated system of giving weight to future preferences: hence the need for intervention. State intervention in this context often takes the form of exclusion of predetermined areas from extractive use by industry. These areas, declared as protected areas, are "notified" and kept protected from human interference. Such a "protected areas approach" may not always be the appropriate one, in view of costs of ensuring compliance with rising populations and demands. It is somewhat synthetic to think of limiting conservation efforts to a few selected areas. It raises problems with respect to the impact on surrounding regions and interactions with them have often resulted in counter productive impacts. Further, conservation also needs to be achieved outside of protected areas. In other words, the strategy for conservation needs to be built into the pattern of development and perceived development aspirations of the people.

In this paper, economic interventions are viewed from the micro and macro perspectives. In the context of conservation of biodiversity outside of protected areas, micro-strategies based on data obtained from fifteen sites in four states[2] are interpreted to focus on kinds of direction best pursued. In addition, an in-depth study of a national park falling in the region is interpreted to yield strategies for biodiversity conservation within protected areas. Sections II and III discuss strategies from the two viewpoints respectively and Section IV provides pointers towards policy directions.

Integrating Conservation with Development: Evidence from the Field

The sites selected for study of economic aspects extended to a wide range of ecosystems. Four sites each from Himachal Pradesh, Bihar, Rajasthan and Karnataka were selected: some with a view to understand linkages with markets through sale, value addition through processing and the tourism potential. Table 1 summarises the location and characteristics of these sites.

In addition, developmental aspirations as reflected in district plans and the perceptions of government functionaries were also investigated. While the state specific details are given in tables in Annexe I, the policy interventions emerging are examined here.

Table 1: Location and Characteristics of Sites

State	*Sites*	*Remarks Ecosystem/other characteristics*	*Number of sites*
Himachal Pradesh	Gramon Kathog, Kashlog, Uprela, Dhatti-Bairghatta village cluster	Forest ecosystems at different altitudes: One example of local value addition	3 village sites: 1 processing unit
Rajasthan	Bade-Bhilwara, Vrimdoera, Rangpur, Agapur	Degraded forests, Arid, Riverine ecosystems: One site in the vicinity of national park	4 village sites: one near national park
Bihar	Dolma, Hazaribagh, Sahibganj, Ranchi Urban Agglomeration		3 village sites: one urban market
Karnataka	Karkala, Bhadrawati, Kumta, Rannebennur, Gandhlahalli (Kolar)	Forest ecosystem, Coastal zone, a dry zone and a transitional system	5 village sites

Dependence for Subsistence, Evolving Market Linkages and Economic Interventions

Dependence on biological resources continues to exist in a large way in different ecosystems. Its nature varies across ecosystems and this is most important in drawing up strategies for economic development at the regional level. Dependence on collected fruits and other plant products is high in forest based eco-systems, such as in the Western Ghats region of Karnataka and one parts of Himachal Pradesh. Dependence on biological resources may take the form of fishing in a coastal village (as in Kumta) or collection and sale of river bed sand as in the riverine system (Rangpur in Kota, Rajasthan). Trade in live animals and animal parts may also be significant as in the Ranchi Urban agglomeration.

A large part of this dependence arises out of a lack of other options. In such a situation, links with the market either do not exist (as in the case of self consumption) or are of an exploitative nature. Lack of complete information results in the collector's price being much lower than national or international price. While variations exist determined primarily by market conditions, primary collectors do not in general get more than 31 to 74% of the final price. Table A1 in the annex gives hike factors (the ratio of final market price to collector's price) for a few products in study sites from three areas.

Economic interventions in such situations usually focus on removing imperfections in markets. This can be done by creating information networks that disseminate better information or by improving possibilities of alternative employment, through development activity and better skill formation in rural areas. While such strategies may enable rural populations to increase their income levels, they ignore altogether the impact on resource conservation and biodiversity conservation. Providing a better price to the primary collector may sometimes be counter-productive in that it results in higher levels of extraction and decreased availability. Table A2 gives evidence obtained on this with respect to some sites and products studied. All major non-timber forest products seem to show a decline of more than 50% over a three to five year period or availability of the product at greater distances or higher altitudes. Note however, that availability of "wild amla" in Himachal Pradesh seems to have increased due to direct benefits having been received from a local processing venture.

It follows that conservation can be achieved better in the longer run by integrating it with both present and future income earning activities on a more sustainable basis.

Linking with Markets: Local Value Addition

A strategy for local value addition is expected to generate higher incomes, create employment, and lead to sustainable use due to interest in future availability of high value adding raw material. It also creates an incentive for preserving knowledge with respect to plants, animals and biodiversity. Resource availability determines the kind of value addition that is possible. Table 2 gives a listing of the kinds of processing that can be developed in and around the sites studied.

Table 2: Local Value Addition Possibilities

Study area	*State*	*Activity*
Mala	Karnataka	Areca leaf plate making, Self-contained sweet making unit, jackfruit papads
Shettykoppa	Karnataka	Coconut drying, pressing of rubber sheets
Kumta	Karnataka	Cashew processing
Dhati-Bairghatta**	Himachal	Mango/amla* products
Sidhwari**	Himachal	Preparation of Brahmi syrup
Ranchi	Bihar	Lac Bangles

* Wild variety.
** These are not BCPP study areas but situated near the Thaltokhod study area in Mandi. It might be worthwhile to study these examples of local value addition as there is a good possibility of replicating these experiments in adjoining areas. Details are provided in Himachal field report.

While some degree of preliminary value addition was observed in all sites, the two instances found in Himachal Pradesh constitute organised attempts of development interventions that bring together conservation, income generation and development. Both were initiated by NGO groups[3]. These experiments show that local communities if adequately involved can manage an operation that markets commercially viable products. There exists a need to examine these can be replicated with participation of the people.

However, harvest rates of products need to be kept at sustainable levels. this can be done if,

— collectors' income gets augmented by a share in the profit, so that he is able to support a reasonable living standard,
— collectors are assured of long term property rights to resources.

Development Plans and Conservation Goals

Government departments do indeed have their own conservation plans. There does exist awareness of biodiversity conservation but these plans are viewed as distinct from development plans. Agriculture, irrigation and rural development oriented plans are perceived as development plans whereas examples of conservation practices are as follows:

— rewarding people for helping to control forest fires,
— closing certain forest compartments from collection altogether. These controls are based on regeneration cycles of certain species and are parts of forest working plans. However, it is often true that people are not at all aware of these,
— managing large national parks as part of conservation strategy.

Most of these plans assume a kind of patronising or policing role for government agencies. There is a clear hiatus between development and conservation in the mindset and action plan of local level officials. This is often counter productive as some developmental schemes work at cross purposes with conservation. The need for integration clearly exists. In the following section, protected areas management is studied in depth to see how it can be modified to gain from market linkages without compromising on the basics of conservation.

Conservation Strategy within Protected Areas

Protected areas constitute one of the most visible interfaces with the market. The tourism industry, dependent as it is on a market expressed demand for conservation represents this linkage which needs to be used effectively in the interests of conservation. Further, stakeholders in national parks represent a cross section of society with differing incomes. Fiscal interventions based on cross subsidisation can be used to create funds for biodiversity protection.

Protected areas extend to around 5% of the geographical area of India, and consist of both national parks and sanctuaries. They are managed solely for conservation under statute of law. A considerable amount of government effort and investment goes into the conservation plans for these areas.

These protected areas tend to impact closely the livelihoods local communities living in and around the park. In turn, they are affected by the continued existence of rights of the local people, mainly arising out of a continuation of conventional arrangements. It was found in a study covering 32 national parks and 138 sanctuaries[4] in India that

(a) 56% of national parks and 72% of sanctuaries had settlements of human population within the protected area,
(b) 83% of parks and 87% of sanctuaries had population adjacent to the protected area,
(c) 43% of parks and 68% of sanctuaries accorded and accepted rights of local communities such as to grazing by livestock, harvesting of timber and collection of minor forest produce.

Use is therefore never totally irrelevant. In the case of some protected areas such as wetlands, use is an integral part of conservation even as seen by international conventions governing them[5]. Ecological studies have in some cases confirmed the scientific basis of some kinds of traditional use patterns. Finally, of course tourists use these parks for recreation and education and scientists for research. Each of these uses creates a set of stakeholders with limited rights to the protected areas.

Simultaneously, however, the responsibility for conservation rests only with the government and the line department. Large expenditures are incurred on maintenance and upkeep, resulting in implicit subsidies for the users. Biodiversity conservation can be both more effective and less resource consuming if stakeholders are involved in a meaningful way in the management of the park. This is particularly true in cases where stakeholders differ in terms of their access to resources such as money, time and knowledge. There exists the possibility of designing fiscal policies for effective conservation at low cost.

A study of KNP, Rajasthan

This park, originally a bird sanctuary built around the turn of the last century is located in Bharatpur district of Rajasthan, very close to Agapur, one of the study sites. It is therefore appropriate to examine it as a case for studying interactions between stakeholders and possible strategies arising out of them[6].

The stakeholders[7] in the park are identified as:

— the local rural population that derives a use value from the park, mainly through the collection of grasses, fuelwood and fish:
— the local urban population that benefits from incomes generated by the hotel and tourism industries:
— the tourists who derive services of recreation, education and tourism:
— the management which is responsible for the maintenance of the ecological health of the park in a situation such that the economic and ecological benefits continue to accrue;
— the community of scientists and ecologists who put a premium on existence value of the wetland ecosystem:
— non-users in the rest of India and elsewhere who value the existence of national parks and protected areas such as these.

In such a diverse scenario, highly varying perceptions with respect to value are bound to exist. A recent WWF study(1996) brings out clearly the varying positions taken with respect to use value accruing from the park and its actual and likely impact on the park's ecology. Views taken by the village residents and those taken by the park authorities differ substantially[8]. Village people tend to focus on the positive linkages, whereas the park managers continue to point out the negative aspects of human interference in the park. Neither of them however, refers to "levels" of sustainable use.

As part of the surveys carried out to determine the value of the presence and preservation of Keoladeo National Park, Bharatpur, rankings of different aspects of value by stakeholders was generated. The questions were designed in accordance with uses of the park perceived to be important for different sections of the population. Stakeholders include people residing in other parts of the country as they too perceive benefits from the park, and are willing to rank the advantages they receive as nonusers.

The respondents from each group were asked to rank aspects of the park, which benefited them the most. The following aspects cover most of those uses: ecological functions provided, consumption of different goods, Livelihood provided, existence or presence of unique or rare species, aesthetic or recreational value, future use, providing different kinds of services, ritual and cultural value.

The following Table 3 classifies value scores of deferent stakeholders into three categories, in accordance with the significance accorded to them, with category 1 being the one with the highest significance and category 3 the one with the least.

Though a fair degree of conflict is inherent in the above rankings, it is important to note the areas of agreement. Ritual cultural and so called aesthetic values seem to be pretty low down in the preference pattern of three of the four categories of stakeholders. This is probably due to the fact that they have found a reflection in other ways such as in the ecological function and existence values concepts. Alternatively, it may mean that the value system itself has undergone a process of change.

Both classes of non-users, the scientists and the non-users seem to realise the significance of livelihoods generated by KNP. This provides some common ground for

Table 3: Classification of Perceptions of Value

Category	*Scientists*	*Tourists*	*Village residents*	*Non-Users*
I. HIGH VALUE	Rarity, Ecological function, Existence	Aesthetic Curiosity	Livelihood and related services, employment	Ecological function Consumption
II. MEDIUM	Consumption, livelihood, future	Existence	Ecological function	Existence, Future, Livelihood
III. LOW	Services, ritual cultural, aesthetic	Services, others	Others including ritual cultural	Ritual cultural, aesthetic

policy making. Ecological function of the wetland in preserving the water and nutrient flows seems to be given a high value by scientists, villagers and non-users outside the park. Such perceived congruence in value perception is an important point of take-off for policy.

An important issue from the management's point of view and also from the macro economic viewpoint relates to the reduction of these subsidies.

Fiscal Incentives: Towards Joint Management with Stakeholder Participation

It is important to note that the government has been subsidising the park. Table A4 given in the annexe gives an indication of the magnitude of this subsidy. Such subsidies perpetuate the perception that conservation entails an economic cost. Further, they seem to subsidise a leisure activity that supports tourism at a level that may be ecologically harmful and unsustainable.

There exists a case for significant changes in the management of national parks. While some of these changes are concerned with low income users such as villagers in surrounding regions, reduction in subsidies to the park by tapping the spending capability of high income users such as tourists, is a step in the right direction. It is important in this context to examine the nature of demand for tourism services generated by the park. In other words, economic value as expressed in the market needs to be determined in order to take appropriate measures that help to make park management independent of subsidisation. This source of income can be used profitably to protect the ecology of the park as well.

We give below some directions of possible fiscal change, which could comprise building blocks in a macro perspective with respect to most national parks:

1. The demand for Keoladeo National Park tourism services is fairly insensitive to price. If a redistribution of the benefits and costs from Keoladeo National Park were attempted through an increase in entry fee, among other things, the demand would not be affected.
2. Stakeholders other than tourists also value livelihood and ecological functions of the park highly as indicated by the scores obtained from multi-criteria analysis. Aesthetic and ritual value is quite low in their ranking.

Determining sound management practices is helped if the nature of demand for the services of the park is spelt out. National parks may differ in stakeholders market linkages. Some are areas with a large tourist presence. Policies with regard to tourism also need to address the following issues;

1. Impact of the magnitude of tourists and of the manner in which they use the park on its health needs to be determined. The questions to be addressed in each context relate to determining the form of eco-tourism and the limit if any, on tourist numbers in the interests of specific ecosystems.
2. Determining the extent to which cross substitution between different categories of stakeholders can improve the financial management of the wetland. In particular high income tourists, scientists and others with a stake in preservation could pay for it and/or compensate for the loss in income of low income stakeholders incurred by limiting use and extraction to sustainable levels.
3. Where the above is not possible, the magnitude of subsidy required to maintain the park in a healthy state needs to be determined and sources of government or non-government funding found for it. This may be at national or international levels.
4. Conservation enthusiasts, both within and outside the country may be willing to pay for upkeep and maintenance of wetlands, if proper institutions are in place for their management.

While designing fiscal and economic policies, ecological imperatives must always be kept in mind. "Wise Use" needs to be identified at the park level for specific sites. To begin with, this could be done for major national parks. The following policy directions to determine levels of sustainable use can be suggested:

1. Bring together all stakeholders in the park in a local area institution[9]: elicit views on wise use and use it as a forum for raising awareness,
2. Simultaneously, commission studies by specialists to determine the levels of extraction and use that are compatible with maintenance of the ecological health of the ecosystem.
3. Examine the outcome of 1 and 2 and arrive at a policy for use in consultation with stakeholders, which include all local level development agencies.
4. Ensure an environmental impact analysis of all development projects undertaken in the area, defined to include the catchment. Projects with adverse impact on the health of the park would need to be reviewed to include abatement measures.

Policies for Conservation with Development: A Plan for Action

Institutions need to be set up both in the context of conservation within protected areas and outside of them to ensure the integration of plans for conservation with livelihood generation in a meaningful manner. Some methods of doing this are spelt out below:

1. The nodal organisation is the " Committee of Stakeholders" at the local level. This committee could be a subcommittee of the local *panchayat* or urban municipality as the case may be in order to give it a legal standing. It has to be defined for each wetland area to include representatives of
   (a) all persons who have an interest/stake in it: in particular local populations who have traditionally been using the area and the managers, such as the Forest department,
   (b) all plan or project implementing departments in the area whose activities may impinge on the ecological health of the area and
   (c) representatives of any existing or planned units for value addition based on biological resources. These may be in the government, private or the NGO sector.
2. The above Committee work in collaboration with local scientists and universities to determine whether a convergence exists between indigenous perceptions and scientific knowledge. At times, this collaboration may have to be worked out with institutions outside the area.
3. Plans for biodiversity conservation, management and use evolve from the deliberations of these local level institutions and are presented and discussed at the appropriate state and central government ministries. Here they are viewed in the larger context the conservation and development needs of the nation. It is important that at these levels as well, all development implementing agencies of the government are fully represented and involved.
4. It may be useful to aim at setting up these procedures for a few sites initially, possibly those where information or experience exists. A phased plan for all regions could then be drawn up.

ANNEXURE TABLES

Table A1: Price Spread/Hike Factor Between Local And National Market Prices

Karnataka		*Himachal*		*Rajasthan*	
Product	*H.F.*	*Product*	*H.F.*	*Product*	*H.F.*
Muskvala	3.2	Shikakai	1.9	Puwal	1.7
Banafsa	3.0	Rampatre	1.4	Ratanjot	1.6
Patees	2.4	Hotsol	1.3	Arandi	1.6
Koru	1.9	Soapnut	1.2	Aritha	1.4
Dhupa	1.3	Nexomica	1.2	Mohua	1.3

Hike factor (H.F.) = Final market price / collector level price.

Table A2: Availability of Major Non-timber Forest Products

Product	*State*	*Marked decline*	*Decline*	*No change*	*Increase*
Acacia	Karnataka	*			
Garcinia	Karnataka		*		
Rampatre	Karnataka		*		
Soapnut	Karnataka			*	
Mohua	Rajasthan		*		
Karanj	Rajasthan			*	
Tendu	Rajasthan			*	
Khejri	Rajasthan		*		
Singli-mingli	Himachal	*			
Dhupa	Himachal	*			
Wild amla	Himachal				*
Wild anar	Himachal			*	

Table A3: Kinds of Uses Ranked by Stakeholders

S.No.	Uses	Stakeholders asked to Give Ordering
1.	Ecological functions	Scientists, village residents, Non Users
2.	Consumption	Scientists, Villagers and Non Users
3.	Livelihood	Scientists, villagers and Non Users
4.	Rarity	Scientists and Tourists
5.	Aesthetic	Scientists, Tourists and Non Users
6.	Future	Scientists and Non Users
7.	Existence	Scientists, Tourists and Non Users
8.	Services	Scientists, Tourists and Villagers
9.	Ritual	Scientists and Non Users

Stake Holders Survey at Keoladeo National Park

The uses of the park framed in the questionnaire, were of the format given in Table A3. The categories of functions mentioned in the above table are defined as given below:

ECOLOGICAL FUNCTION: The existence of biodiversity helps to keep ecosystems stable and functioning, and wetland ecosystems perform many important ecological functions for humankind, e.g. flood control, regulation of water and nutrient cycles, etc.

CONSUMPTION: Plants and animals provide many goods that satisfy human needs, e.g. timber, wool, medicines, fodder, etc. Also, the use of water in irrigation and for domestic purposes.

LIVELIHOOD : Providing livelihoods for people.

RARITY : The presence of unique or rare species.

AESTHETIC : Aesthetic or recreational value for the respondent.

FUTURE :Possibility of new uses for it in the future, e.g. scientists may find a cure for cancer from a plant variety.

EXISTENCE :The existence of diverse plant and animal species and every living creature have a right to live, regardless of their use to us.

SERVICES :The park provides different kinds of services like tourism, educational value to the visitor, cattle grazing, requirement of permits of longer duration for collection of fodder grass to the villager, etc.

RITUAL : It has ritual and cultural value in the lives of many people.

It may be pointed out that the manner in which each of these questions was canvassed in different schedules varied. This was done to ensure that the respondent was able to respond in a meaningful manner.

For each stakeholder, the aspects of the park are taken as "Alternatives" (along the row) and individual respondents as "Effects" (along the column) while creating an *Effects table*. Each respondent was given equal weight, irrespective of their individual perception of different "Alternative" uses of the park and the ordinal values given by the respondent to the uses were the inputs into the *Effects table*.

The perception of these stakeholders - Scientists, Villagers, Non users (residents of Delhi) and Tourists (Indian and Foreign tourists) as obtained by *Multi Criteria Analysis (MCA)* is detailed below. Alternative techniques can be used for arriving at the scores given to different aspects of value[10]. When the data set is of an ordinal nature, the regime method is one of the preferred techniques. The "effects" are compared in a 'pairwise' fashion in order to arrive at an aggregate score.

Table A4 : Revenue and Expenditures of Keoladeo National Park

Year	Revenue (Rs.)	Expenditure (Rs.)
1990-91	10,97,836	17,48,162
1991-92	17,37,712	14,79,042
1992-93	18,63,630	2,30,339
1993-94	20,27,825	19,79,443
1994-95	19,76,480	22,91,024
1995-96	24,52,000	37,07,400

Notes

1. Data inputs from study sites of the BCPP project were obtained from the group on Micro- Strategies being coordinated by Madhav Gadgil.
2. This data was collected as part of work done in the micro-strategies group. Collection and preliminary collection of data was undertaken by Anirban Ganguly in collaboration with state level investigators.
3. The projects have been set up under the aegis of the Indo-German Changar valley eco-development project and the Chinmoy Tapovan trust.
4. See IIPA (1993) and Kothari(1989).
5. See, for instance the insistence on "wise use" in the Ramsar Convention for wetlands.
6. A number of studies on ecological and economic aspects of this park exist. A detailed study on this park was also conducted as part of a UNDP supported project on Valuation of Biodiversity by the present author. See Chopra and Chauhan (1998).
7. The stakeholders comprise highly disparate sets with average household incomes varying from Rs. 66,944 per annum for the village residents to Rs. 2.64 lakhs approximately for tourists in general, with foreign tourists possessing an average income of Rs. 7.52 lakhs. Further, their average education levels also vary from illiterate or primary to specialisations in specific areas.
8. See Chapter 5 for the details with regard to the different perceptions. Though grazing and extraction feature in the perceptions of both village residents and park managers, the former focus on the positive aspect of the interaction between them and ecological health of the park, while the latter point to the negative linkages.
9. This could be a new institution or an existing legal institution such as a *panchayat* or an urban local body.
10. The software called DEFINITE has been used for this exercise. See Jansen (1994) for details of the technique used.

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Prioritising Micro Strategies

Conserving India's Biodiversity: Let People Speak

Srishti Jigyasa Pariwar*

Environment and Development

One of us, Madhav Gadgil, still vividly recollects a meeting of India's garden city's elite committed to the cause of nature conservation on an evening twenty years ago. The scene was a lawn in one of the poshest localities of the city, and there were two items on the agenda. One was the plight of elephants which move right up to the outskirts of Bangalore and were being killed by farmers when they raided their ragi fields. The group was unanimous that there was no way to help some damage to the crops, and that the farmers must be educated to tolerate the losses. The second item on agenda was the menace of urban monkeys, protected by widespread religious feelings, who were causing so much damage to all the gardens. The group was also unanimous that the monkeys must be trapped and released somewhere far in the countryside, possibly to inflict some damage on crops of some other farmers, who would no doubt also be educated by some other nature lovers to tolerate the losses in the larger interests of wild life.

Consistency, says Oscar Wilde, is the last refuge of the unimaginative. Perhaps, Madhav was the only unimaginative member of this wildlife group troubled by the lack of consistency in this approach to elephants and monkeys, to urban elite and rural poor. These serious internal contradictions are of course a part of the widespread contradictions in our overall approach to problems of environment and development. This approach is characterized by fragmented sectoral thinking, by a wholly inappropriate disjunction of conservation and development. It aims to pursue conservation on 4% of the country's landmass set aside as protected areas, i.e., wildlife sanctuaries and national parks, completely ignoring the development aspirations of millions of people who have for generations been tied to these lands. And on the remaining 96% of the country's lands it pursues development at all costs, totally oblivious of the vital role that the natural resources of these tracts play in the well being of the vast majority of our people. The story of Sone Beel in the Barak Valley of Assam, is one such example of inappropriate development brought out by our studies (Box 1).

Box 1

Damming blindly

Sone beel, with a water spread of 35 sq. km. in the Karimganj district is the biggest wetland of Assam. The principal water source for the beel is river Singla originating in Mizo hills; its major outflow is river Kachua, a tributary of the river Kushiyara. Sone beel harbours 70 species of fish yielding over 300 tonnes of harvest per year. This is the principal source of livelihood for people of 19 villages flanking the beel. Good management of this diversity of fish and their habitat therefore ought to be a very significant objective of all development efforts around Sone beel.

This has not been the case. Floods are a part of the natural water cycle of Assam and the damage they cause has to be contained through careful action. Instead the region has seen a series of inappropriate measures, probably more geared to create business for the civil contractors than to help the people or the nature. First of such interventions was the blockade of the major outlet of Sone beel, the river Kachua by a blind dam in 1950s, with the water being diverted by a canal to the river Longai. This resulted in tremendous siltation of the beel, and serious disruption of migratory paths of fishes. It also adversely affected water transport. So the local people took matters into their own hands and blasted the blind dam. In 1964 the authorities responded to the navigational difficulties by replacing the blind dam by a lockgate, the first of its kind in Assam. But this has never operated properly, nor is there any provision for fish ladders and fish passes, so that the siltation goes on unabated as fish populations continue to decline, both in variety and in abundance.

The approach we have adopted for nature conservation in independent India is modelled on the National Parks movement of the United States. This movement was a response to the wholesale destruction of the natural world unleashed by the Europeans across the American continent spanning over three centuries. It arose in a new society that

*For list of members see Annex.

had crystallized by the end of 19th century, a society that was largely equitable, provided we ignore blacks and Amerindians. National Parks came to be constituted in this society on vast tracts of lands that had little human presence with the decimation and displacement of the indigenous people that once occupied them. They catered to the broad based demand for outdoor recreation, and were administered by a bureaucracy answerable to the wilderness enthusiasts. This is not a system that can be easily transplanted in our highly inequitable society dominated by rural people deriving a subsistence by drawing on resources of the natural world, and governed by a bureaucracy that refuses to accept any accountability to the masses of Indian people. Yet this is what we have attempted to do, blindly borrowing from the West, dismissing our own indigenous traditions, and belittling the strengths of our masses to sustain life under great adversities. Our approach to development too is equally flawed, driven by an obsession to catch up with the industrial nations. But we have ignored the fact that in the west the benefits of industrial production reach out to the vast majority of the people, through employment, and through a social welfare system. Quite to the contrary, in India dams and mines have rendered millions homeless, while the benefits of the minerals, the irrigation water or power produced are cornered by a tiny minority. Box 2 recounts one such experience from Darlaghat in Himachal Pradesh.

Box 2
Bypassing People

Darlaghat is a growing township about 50km from Shimla, the capital of Himachal Pradesh. Darlaghat was notified as a wildlife sanctuary in the early 60's. However, its status as a wildlife sanctuary could not protect the woods from the forest department. In Pammad village, there is a sacred grove called Baadidhar that is venerated over a large area. The local villagers believe that they are prohibited from using most of the resources of the grove by divine sanction. Only leaf fodder is allowed to be extracted but without using any tools. These sanctions had protected the thick oak forest for centuries. In 1967, the forest department clearfelled one third of the sacred grove. This has been a major cause of the breakdown of the customary regulation and in the ensuing years, the sacred grove has become an open access resource for fuelwood and fodder. As if the logging was not enough, the clearing of natural forest was followed by monocultural plantation of chir pine in the grove leading to further erosion of local taboos.

In 1992, Darlaghat WLS was denotified to make way for a mega cement plant. The mining for limestone for this factory has in a short span of three years not only wiped out a forest area, tira ri jan, held in common by five hamlets, but has also seriously affected the water cycle. Villagers report that traditional water sources such as springs and rivulets are drying up and there is heavy siltation in the rivers. Local medicine men lament the reduced availability of medicinal plants. In just three years, the mining has destroyed biodiversity as well as common lands of five hamlets. In the next phase, it will expand to three neighbouring panchayats, helplessly awaiting their destruction.

A Grassroots Perspective

Inevitably, our conservation programmes have run into manifold difficulties. They have tended to create islands of diversity surrounded by oceans of devastation. This is a double tragedy, for the diversity that lies outside the protected areas and plays a vital role in the well being of the people; and for the diversity within the islands of protected areas, now under assault on many fronts. It is time then to dispassionately assess what we have been doing and what we have achieved. Often the best way to get at the truth is to view it from a different perspective - and in this case this different perspective would most appropriately be that of the masses of Indian people, of people who are constantly in touch with the natural world in their day-to-day efforts to derive a subsistence. So a group of us involved with the Biodiversity Conservation Prioritization Project of World Wide Fund for Nature- India decided to try and approach a cross- section of rural Indians from all over the country and let them speak of what they know of, how they related to, and how they would like to protect the rich heritage of our country's living diversity. This has been a co-operative effort of a number of us working in eight states - Himachal Pradesh, Rajasthan, Bihar, Assam, Orissa, Maharashtra, Tamilnadu and Karnataka, and the Union territory of Andaman and Nicobar islands. We are a group of people mostly drawn from colleges, universities and research institutions and from development and environment oriented NGOs, as also some officials, especially from the Forest Departments. We call ourselves an alliance (pariwar) of people driven by curiosity (jigyasa) about the natural and the social world (srishti). Young women and men, either students or NGO activists have constituted the backbone of our investigatory teams. They have found this opportunity of interacting with the real world, instead of merely learning by rote from books, a most valuable educational experience. Together we have covered over fifty village clusters representing a wide spectrum of environmental regimes and social organization in our complex society. The study sites have ranged form the seacoast to the peaks of Himalaya, from humid islands of Andamans to the arid desert of western Rajasthan, from floodplains of Brahmaputra to the salt lake of Chilika. They have spanned forest villages deep inside the Palamau Tiger Reserve and tribal hamlets being engulfed by the city of Ranchi. The investigating teams have often included members of local communities, they have all through worked closely with all segments of people from the study sites.

The study has been an almost year long process of talking to people, individually and in groups, in their houses, in public places in the villages and while walking with them all over the landscape. It has involved ten modules : (1) Identification of different groups of people in terms of their relationship with the living resources of the region from over which they meet the bulk of their resource requirements such as fuelwood or grazing for their livestock; (2) Mapping the mosaic of ecological habitats of the study site; (3) Recording the different species of plants and animals and their uses known to local people; (4) Recording the abundance and distribution of these living organisms in the different habitats of the study site; (5) Documenting the ecological history of the study site, especially for the last two decades for which people have excellent recall; (6) Recording the ongoing patterns of utilization of the living resources of the study site, to meet subsistence as well as commercial demands and the extent to which different groups of local people as well as outsiders benefit or lose from these uses; (7) Documenting ongoing attempts at regulation of uses of living resources, or their conservation, both on part of Government agencies, and in form of efforts by local communities;(8) Recording the development aspirations of local people and how these relate to the diversity of living resources of the region;(9) Documenting the agreements as well as differences in the approaches of the different sections of the local communities in their prescriptions for the management of living resources of the study sites; (10) Documenting the various emerging options for managing the natural resources of the study site, with a particular focus on conservation of biodiversity. We owe a debt of gratitude to Anil Gupta, Kailash Malhotra, M.K. Prasad, Madhu Sarin, Darshan Shankar and Shekhar Singh for their contributions to the development of the concept and the methodology. All this information has been recorded in a document called "People's Biodiversity Register"(PBR). Many of these documents in the states of H.P. and Rajasthan were prepared in Hindi; others have been or are being translated in local languages. Copies of the PBRs have been presented to the local communities in special functions and are being maintained in local Panchayats, schools and colleges. Throughout the study, an attempt has been made to faithfully record what people say, not to put words in their mouth, certainly not to preach to them.

The response to this initiative from all over the country has surpassed our expectations. We often have prejudices, for instance, that nothing works in Bihar. Contrary to this stereotype, our programme has done exceedingly well in that state, with active involvement not only of teachers, students and workers of NGOs, but also of officials of Forest Department (see Box 3). The local people too have responded well everywhere. Their enthusiasm has grown as they have come to realize that for the first time they are working with people who genuinely respect their knowledge and perceptions and are seeking their suggestions and eventual involvement in taking good care of the natural resources of their localities.

Box 3
Voluntary Efforts

All over India there exist highly motivated groups dedicated to nature conservation working at the grassroots. These could come to play a valuable role in organizing decentralized, people-oriented conservation efforts throughout the countryside. One such group is Nature Conservation Society (NCS) in Bihar.

NCS is based in Daltonganj, the commission headquarters of the Chhota Nagpur area of south Bihar. It was founded in 1976 by a group of college and university teachers and forest department officials. Later on more members from other cross sections of society were added. Its primary purpose was to help the newly created Palamau Tiger Reserve in the field of awareness building among general masses, in anti-poaching activities and in interaction with local communities. It works in full collaboration with the forest department. It has organized college and school students in the form of Nature Clubs in urban as well rural areas. The Nature clubs have surveyed tribal villages, run competitions on wildlife and forests, and sponsored camps in forest areas. The documentation by these clubs since 1978 is now the basis of monitoring the biodiversity of Palamau Tiger Reserve. NCS has encouraged college teachers to undertake wildlife research and has helped eight of them to complete their doctoral degrees.

NCS has been associated with the World Bank in eco-development activities in the Palamau Tiger Reserve, with the Bihar state government in watershed development programme, and with WWF in the Tiger Conservation programme. NCS served as the co-ordinating agency for the PBR project for the state of Bihar.

Biomass Based Civilization

What then are the main points that emerge from the wealth of material that this exercise has generated ? It very much confirms that India remains a biomass based civilization. Across the length and breadth of our country, a large proportion of the people subsist as ecosystem people, greatly dependent on local natural living resources to fulfill their manifold requirements. Many cook with fuelwood gathered from forests or scrublands, graze their cattle, sheep or goat on natural vegetation, collect tree leaves to manure their fields, employ herbal medicines to heal themselves or their livestock. Many tribal families of Central India live on Mahua flowers for several months of the year. Yet others earn a substantial proportion of their small income by collecting forest produce such as canes, beedi leaves, sal seeds or wild mango fruit for sale on markets. Many landless, and therefore the weakest of rural populace supplement their incomes by weaving baskets or mats in the months when there is no employment as farm labourers. Yet others depend entirely on fishing. There is thus a substantial dependence on natural living resources. This relationship is especially strong in case of women who often assume the major responsibility for collection of water and fuelwood, dung and fodder. Cultivation and animal husbandry is even more significant to the livelihoods of a majority of Indians. These husbanded plants and animals in turn interact with a number of species of pollinators, pests, parasites, weeds and fodder plants. The farmers and the farm labourers, the shepherds and cowherds therefore not only relate to a whole spectrum of varieties or land races of husbanded plants and animals, but a large number of other plants and animals affecting them as well. This relationship between the human and the natural world is reflected in the diversity of livelihoods present across the country. This diversity in turn has supported the continued protection of biological diversity and the various habitats where it occurs. Box 4 narrates the story of one such biomass based community from the state of Bihar.

Development efforts over the past 50 years have been pursued in total disregard of this vital relationship between different livelihoods and the nature. In Upraila village in Himachal Pradesh, for instance, displacement of traditional multiple crop agriculture by commercial vegetable seed production has had profound implications for nature as well as the people. The consequent complete absence of green fodder collected as weeds and dry fodder from crop residues has led to severe fodder shortages. People have responded to these shortages by cutting down on livestock. There has in turn been a decline in manure supply leading to growing dependence on chemical fertilizers. Heavy pesticide use is severely affecting traditional bee-keeping reducing the household production of honey. In other areas, it has wiped out important pollinating agents affecting the production of apples. Farmers are now completely dependent on an uncertain and fluctuating market not only for sale of their produce but also for food grains. As a result the ability of the community to absorb shocks has drastically declined. This, of course, is why the current disjunction between environment and development is such a mistake. Indeed insensitive development has led almost everywhere to a decline in the quality of life especially of the weaker segments of the society.

Box 4
Ecosystem People

In West Champaran district of Bihar lies Sariyaman, a horse shoe shaped lake with a spread of 9 sq. km. formed by a shift in the course of the river Narayani. Manjharia is on the bank of the lake, harbouring 250 families of refugees from East Pakistan, primarily of Das and Namasudra communities that were resettled in what was scrubland with scattered paddy fields. They remain totally dependent on locally produced biomass for all of their requirements; the one school shed in the village being the only brick, cement and asbestos structure. The village is surrounded on three sides by the lake, and on the fourth by the forest. This permits them to raise three crops of paddy, that is supplemented by fish from the lake for their food. The naturally growing bamboo is excellent construction material, and the elephant grass serves to thatch the roofs. They stall feed the cattle on grass collected from the lake shore and use the dung and straw as fuel. So they have no need of fuelwood. They neither poach on the wild animals in the forest, nor encroach on it for cultivation. As a result large flocks of waterfowl take refuge in the lake adjoining Manjharia. Their only problem is the damage that wild pigs and cheetal inflict on their crops. They are also concerned at the overfishing and poaching of wildlife by other villagers on the bank of Sariyaman.

Poverty Amidst Plenty

A significant majority of the Indians are then intimately tied to their natural setting in the pursuit of their livelihoods. But Indians not only relate to plants and animals of immediate utility or nuisance value. In almost every one of the study sites people venerate and protect plants like peepal or banyan and animals like peafowl or hanuman langur. In several sites the protection extends to whole patches of forests or grasslands, or pools along streams as well. However, the number of species thus related to in religious or cultural contexts is relatively small. A vast majority of the one to five hundred species of plants and animals recorded as known to people from the various sites are species of practical significance in the lives of people. So are almost all of the species listed as being of conservation interest to the people (see Box 5).

Box 5

Losing Touch with Life

As markets penetrate and nature retreats Indians are increasingly losing interest in and knowledge of the living diversity in their vicinity. In village Kaihad in Mandi district of Himachal all people put together know of around 450 species of plants and animals. But there is a clear pattern of decline in this knowledge amongst the youth. Thus those older then 50 years can identify about 70% of the flowering plants, characterize 40% and mention uses of 5%. In the age range of 30 to 50 years, the ability to identify is down to 25%, to characterize to 4% and knowledge of uses to 1% of the flowering plants. The youth below 25 years of age are almost totally ignorant.

This erosion of knowledge seems related to loss of application of the knowledge, as, for instance, allopathic medicine overwhelms the use of herbal medicines. Indeed one of our study sites, that of Devli Machan in Kota district of Rajasthan used to be called Vaidyo ki Devli. But with extensive deforestation it has lost both the medicinal plant resources and practitioners of herbal medicine, so that the very name of the village has been changed by dropping the epithet "Vaidyo ki". In yet another study site, that of Neralkoppa in Chikmagalur district in Karnataka the local medicineman decided to pass on his knowledge, earlier transmitted along male line, to his daughters because his sons were not interested.

However this decline of knowledge and use is not universal. In Mala village in Dakshina Kannada district of Karnataka, herbal medicines are still in vogue. The knowledge of living resources is also much better retained amongst fisherfolk. Thus many young fishermen around Chilika lake are well educated, yet continue fishing and retain traditional knowledge of fish and their behaviour.

Our studies emphasize that the roots of the ongoing tragedy of the Indian environment lie in the inverse relationship between economic and biological wealth. Per capita incomes are amongst the lowest in the biologically rich districts of the Chhota Nagpur plateau; they are amongst the highest in the districts of Punjab and Haryana that support the lowest levels of natural as well as husbanded biological diversity. Tribals of Chhota Nagpur plateau maintain a rich variety of crops in their small holdings; they have to migrate to the monocultures of Punjab to eke out a living for half the year. Universally, the more dependent and along with that the more knowledgeable a person is about biodiversity, the poorer he or she is. The bigger landholders, the traders, the public servants are everywhere better off than the small holders and the landless. These marginal farmers and farm labourers subsist on farm produce or wages for only four to eight months of the year. They have either to migrate to cities or to tracts of green revolution, or to turn to natural living resources to keep them going for the rest of the year. The latter may take the form of collection and sale of fuelwood or other forest produce such as bamboos, bark of cinnamom trees or seeds of sal, supply of medicinal herbs to agents of pharmaceutical companies, weaving mats from reeds or grasses, or fishing. Occasionally some of these produce may fetch very high values, such as morrel mushrooms of Himachal Pradesh. A significant proportion of people at every one of the study sites is engaged in such activities. Without exception they are poor, often illiterate, unorganized and without any control over the living resources they depend on. What others are willing to pay for the produce they have collected or mats they have woven is governed by the level of wages they earn through labour during the agricultural season; and this is what they receive regardless of the eventual market value of the biological produce (Box 6). The few attempts at getting them a better deal by organizing societies such as forest labour co-operatives have by and large been unsuccessful. Even highly knowledgeable dispensers of herbal medicines are often very poor. This complete disjunction of the level of earnings of people intimately tied to biodiversity resources from the market value of those resources has important implications. It means that these people have nothing to gain from sustaining the stocks of these resources.

The situation is worsened by the fact that neither do they have any rights over these resources. In almost no study site do members of local community have any control over resources of public lands and waters. Traditionally they often did have such control, as in the case of Orans of Rajasthan. These Orans are large tracts - often as much as several hundreds or thousands of hectares of vegetation dedicated to some local deity. The rights of use of the vegetation of the orans were historically limited to members of the local community, who resorted to regulated

Box 6

Tribals and Traders

Nestled amongst the hills of Maharashtra Western Ghats in Pune district is the village of Shilimb. It lies in a tract of heavy rains near the origin of Pavana, whose waters eventually drain into river Krishna. People of Shilimb depend on cultivation of paddy in the valley, of millets on the hill slope, husbanding livestock and collection and sale of a variety of forest produce. Its inhabitants belong to 13 different communities, including Katkaris who are a tribe traditionally dependent on hunting-gathering, Dhangars who herd buffaloes, and now some cattle and sheep as well, and Brahmins, traditionally priests, but also landowners and traders. Put together members of these 13 communities have narrated 226 distinct uses of 173 plant species. Listed below are uses in 10 major categories known to all or most of the 13 communities, and more specifically to Katkaris, Dhangars and Brahmins. Katkaris clearly know much more than the other two. They are aware of very many medicinal uses not known to most other communities. Brahmins on the other hand have no special knowledge, they merely share in what members of most other communities know.

Usage of 173 Species of Plants in Shilimb

Use	*All 13 Communities*	*Most Communities*	*Kat-karis*	*Dhangars*	*Brahmins*
Human medicine	2	9	57	16	9
Veterinary medicine	1	1	1	3	1
Food	45	46	56	49	45
Fodder (cattle)	0	0	0	5	0
Fodder (sheep)	0	0	0	4	0
Agricultural implements	2	13	8	13	13
Ropes	3	4	4	4	4
Fuel wood	4	4	4	4	4
Fish poison	0	0	4	0	0
Other commercial uses	0	1	7	1	1

But it is the Brahmins who share formal learning and have market savvy. So it is a Brahmin from this village who has organized the trade in medicinal plants. He has set up a shop in the city of Pune after obtaining information on the identity of medicinal plants in demand in the urban market by practitioners of Ayurveda. He also manufactures in the village one of the commonest Ayurvedic medicines, triphala churna. Katkaris collect these plants in lieu of very low wages; all the value added goes to the Brahmin entrepreneur.

use, monitored by other community members. But these orans are today taken over as Government property converting them into no-man's land since the Government merely takes away the authority of exercising any control from the locals, without its own agencies assuming this role. As a consequence, traders, graziers, fuelwood collectors from all over have had a field day ruining the orans. In other tracts of public lands constituted as reserve forests, the Government agencies do in theory maintain strict control over the harvests. But in practice this does not work. The Government agencies are at once under pressure from the rich and powerful who can profit from excessive exploitation and from landless poor who often have no way to earn a living other than, say, by selling fuelwood. People from each and every study site contend that the Government machinery is unable to withstand the vested interests of the powerful, as well as incapable of resisting the temptations of collecting bribes from the powerless. In consequence, a great deal of utilization of a diversity of living resources goes on all over the country as illegal activity, conducted in a thoroughly indisciplined fashion.

Not only is the diversity of natural biological communities on retreat all over, so is that of crops and livestock. This loss of crop and livestock diversity is in part driven by economic forces, with modern high yielding varieties fetching better returns and attracting farmers to switch over. But such a switchover is also prompted by Government subsidies for irrigation, fertilizers and pesticides. The higher economic returns from monocultures of modern varieties often turn out to be non-sustainable, as soils deteriorate under chemicalized agriculture, as pests explode with extensive areas coming under single varieties, or as subsidies are withdrawn. Such problems are now facing farmers of Dhikonia from Baran district of Rajashtan. This is a dry tract where a traditional variety of wheat, called "Katya" was being cultivated. Farmers now find the yields from hybrid wheats that replaced katya to be lower than what katya produced. But they cannot now bring back katya cultivation on soils degraded by chemicalised agriculture.

Replacement of the diversity of traditional crops has other implications. Thus in and around Bhitar Kanika Wildlife Sanctuary in Orissa, the replacement of traditional tall varieties by dwarf hybrid rice has led to a reduction in availability of thatching material. In turn this had led to an overharvest of leaves of a wild ground palm. But while traditional crop and livestock diversity has indeed been eroded in many places, this is not without exception. In Kolar district of Karnataka farmers continue to grow traditional rice varieties on a small scale as they consider them more nourishing for their children. In the village of Rani Garbhanga in the floodplains of Brahmaputra in Assam a large number of traditional rice varieties continue to be cultivated as the hybrids failed to do better in local soils with problems of silt and low chemical inputs. At the same time, the Agricultural and Animal Husbandry experts have completely ignored on-farm conservation, solely concentrating on maintenance of germ plasm in ex-situ collections.

The ongoing erosion of India's biological diversity is also promoted by the narrow focus of the official management as well as conservation efforts on a handful of plant and animal species; teak and pine, tiger and Siberian cranes. Thus only a handful of the fifty odd species of medicinal plants and other non-timber forest produce collected from the study site of Mala in Karnataka are subject to forest department regulation in the form of auctions for contractors. The vast majority are collected by locals, and sold to agents who ultimately deliver them through unorganized markets to the pharmaceutical or biocosmetics industry, or to the individual consumers (see Box 7). At the same time, the official conservation efforts such as National Parks pay attention to only a few charismatic animals, be they rhinoceros or crocodile with almost total neglect of the great variety of other living organisms, even of considerable immediate economic significance such as medicinal plants.

Box 7
Rewarding Folk Knowledge

The village Mala, adjoining the great forest of Kudremukh National Park in Dakshina Kannada district of Karnataka is notable for continuing extensive use of herbal medicine. The most knowledgeable of the dispensers of herbal medicines is Shri Kunjeera Moolya, who does not charge for his services, but makes a living as a farm labourer. His talents were recognized by our study team, and as a result he was felicitated, along with Shri Kadari Srinivas Prabhu, a knowledgeable healer of livestock in a special function during the wild life week of October 1996. This felicitation brought to fore many others from the village who were encouraged to talk of their knowledge.

Shri Kunjeera Moolya was approached in March 1995 by an agent of some pharmaceutical firm to disclose his knowledge of local medicinal plants. He went around the forest for two days and shared this information, for which he was paid a sum of Rs.200/-, equivalent to his normal earnings over 4-5 days. This agent evidently represented some pharmaceutical company involved in screening Indian plant resources for possible commercial products.

The best organised of such programmes is run by Hoecht Marion Roussel India, a subsidiary of a multinational company of German origin. Hoechst runs in Mumbai a research unit established in 1972 and described as a "target oriented lead discovery centre from natural origin". It employs some 70 Ph.D. holding scientists; all but the Director being Indian citizens. Indigenous information, obtained from people like Shri Kunjeera Moolya, as well as from published literature including that of Ayurveda and ethnobotany which has no tradition of giving credit to folk healers and other knowledgeable individuals, and electronic data bases is used to provide clues to rationalize the search for plants with interesting bio activities. Only 3 of the scientists employed by the research centre are engaged in collecting samples of plants, fungi and micro-organisms, others are busy with screening, toxicology and investigations of chemical mode of action.

Obviously Hoechst would pay very many people like Shri Kunjeera Moolya small sums like two hundred rupees, and then pool together all the information generated with other public knowledge such as of Ayurveda, and inputs from many scientific disciplines to eventually develop a small number of products. The process may take many years, perhaps decades, and of course particular pieces of information provided by a specific individual may or may not yield any product; and in any case every product will use many other inputs in its development. It is therefore difficult to design a system of either regulating collection and use of such knowledge or ensuring payment of royalty to a particular individual in case his/her knowledge had provided an important clue. The only solution may be in the form of documentation such as these "People's Biodiversity Registers". We believe that the PBRs may then one day come to play a useful role in organizing effective systems of sharing of benefits with holders of folk knowledge. This would of course depend on the Government of India as well as state governments enacting suitable pieces of legislation bearing on conservation and sustainable use of biodiversity and related knowledge.

No One's Concern

As may then be expected, our studies highlight that no segment of the Indian society seems to be motivated today to prudently manage, or conserve biodiversity resources. The rural populace relating with these resources on a day to day basis perceive material welfare flowing not from living in a biodiversity rich milieu, but from access to man-made capital: roads, bridges and telephones, hospitals, schools and colleges, markets and factories. Our investigations show that everywhere, all segments of rural people mention enhanced access to such man-made capital as their basic aspirations for development. None of them put better conservation of biodiversity resources high on the priorities for what they would like to see happen in coming days. There is a contradiction here. For all the studies also report a steady deterioration of natural habitats and of natural living resources especially over the last two decades for which people have excellent recall (see Box 8). These developments include steady privatisation of erstwhile public grazing lands and woodlands, incursion of outside commercial interests resulting in massive fellings of trees or dynamiting of rivers, continuous unsustainable levels of harvests for fuelwood or grazing of cattle by local people leading to steady degradation of living resources. These are also everywhere reported to imply a deterioration in the quality of life of the people, and when discussing these facts all segments of rural people, especially the poor do concur that it would be most desirable to put a halt to this degradation. When asked which species and which habitats should be protected on a high priority, their response invariably focusses on species of utility to them, for instance, mahua and cane, as well as on habitat elements of utility such as forests or even paddy fields which are now being converted to arecanut plantations or shrimp farms on the Western Ghats.

Box 8
Medicinal Plants in Decline

There is a long tradition of use and trade of medicinal plants from western Himalaya. However, commercial extraction began to adversely affect the distribution and abundance of various medicinal plans only in the 20th century. Heavy extraction and local processing by traders of berberis roots from the Mandi district led to local scarcity in some areas. Similarly, unregulated harvest of *Taxus baccata* leaves and bark in the Sainj valley of Kullu in the 60's led to disappearance of the tree in some pockets. Both berberis and taxus extractions were a result of increased market demand. While a number of species were known and used locally in Himachal Pradesh, escalating consumer demand in the 70's for medicinal and cosmetic products in urban India and outside, has led to commoditising of many species in the last 25 years. Shinglmingli (*Dioscorea deltoidea*) has been the worst affected by this onslaught. While parts of Chamba report local extinction of this herb following heavy extraction, it has also become rare throughout the rest of the state. In the last 4 years, berberis and *Taxus baccata* have faced heavy extraction once again. The collection of the plants is carried out by local villagers on the basis of rights over forest produce, whereas the ownership of lands over which these occur rests with the government. Traders are also involved in illicit collection through migrant labour resulting in conflicts with local collectors. Lack of security of tenure for the local collectors is a major reason for breaking down of customary regulations for sustainable harvests. While earlier, gram panchayats had the powers to levy collection fees for harvesting medicinal plants, the power was discontinued with the constitution of Himachal Pradesh as a full state in 1971. As of now, neither the local collectors and local bodies, nor the traders have any say in ensuring sustainable harvest. The government machinery, on the other hand, has failed to rise to the occasion.

However the entire cross section of people from all the study sites stretching across the length and breadth of India are at a loss on how to address this complex problem. The American writer, H.L. Mencken remarks that "for every complex problem there is a simple solution—and it is invariably wrong". In India, we have decided that the simple solution to all the complex problems of the country is—to give more money or more power to the bureaucracy. In case of nature conservation, this is equated to establishment of protected areas brought under the control of the forest department, and managed on the principle that the most important step to be taken is the exclusion of subsistence uses of living resources by local communities. Our studies amply bring out how wrongheaded this unthinkingly accepted simple solution is to the truly complex problems on the ground.

False Premises

This simplistic solution is based on six propositions into which our studies provide many insights. These six propositions are that: (a) Only state machinery can protect biodiversity; (b) Conservation of biodiversity is no concern of development agencies; but is a monopoly of Forest Departments (c) Creation of new protected areas will enhance prospects of protecting biodiversity; (d) Existing protected areas do effectively conserve biodiversity; (e) Exclusion of subsistence demands is essential to biodiversity conservation; and (f) Bureaucratic and technical experts know best how to conserve biodiversity.

Contradicting the notion that only state machinery can protect biodiversity are many examples of traditional and often still living community based conservation practices such as Orans of Rajasthan. Indeed these constituted an extensive network of well maintained natural vegetation subject to regulated grazing through much of the state. The decline of orans in recent decades can in large measure be attributed to the state takeover of these lands. In the same state of Rajasthan the highest antelope densities are to be found not in the wilderness but in villages dominated by Bishnoi community, thanks to their religious sentiments. And in every part of the country fresh water biota is best conserved in sacred ponds and sacred stretches of rivers.

The notion that conservation is the sole prerogative of the Forest Departments springs from the narrow, sectoral approach of the Government apparatus. True, forests are amongst the richest repositories of biodiversity. But coral reefs are equally rich, and the alienation of Fisheries Departments form conservation concerns has meant endless difficulties in management for areas such as the Gulf of Manaar Biosphere Reserve. Moreover biological diversity elements of great value such as wild relatives of cultivated plants occur in a whole variety of habitats often outside forest areas. Thus wild relatives of paddy are to be encountered in village irrigation ponds and as weeds in paddy fields with low levels of management inputs. Many green leafy vegetables that serve as excellent suppliers of leaf protein, especially for farm labourers also occur as weeds along with many other crops. Wild relatives of yams frequent highly disturbed habitats such as road verges. A number of medicinal plants also occur outside forests. Furthermore, modern scientific advances imply that even seemingly insignificant life forms may turn out to be of great economic value. Thus spiders posses poisons affecting nervous systems. Pharmaceutical companies are now screening them for potential applications in nervous disorders. So one day an important therapeutic product could come out of a creature lurking in the cobwebs that we regularly sweep out with our brooms. Given this scenario, protection of biological diversity ought to be a far broader concern than that of national parks, or even of reserve forests.

The experience of the Kigga village near Sringeri in Karnataka is pertinent to the third proposition, namely that constitution of a new protected area helps in biodiversity conservation. A forest area called Narasimhaparvata, traditionally used very lightly by people of Kigga and neighbouring villages, was incorporated a few years ago in the Kudremukh National Park. The villagers' immediate reaction to this move was to greatly step up their rate of exploitation of the forest, to stockpile large quantities of timber before their access was abridged . In effect this probably meant greater degradation than might have happened if the area was left out of the National Park. The experience of Keoladev Ghana National Park near Bharatpur in Rajasthan also calls into question the belief that National Parks actually help protect biodiversity. This is one of our study sites and it is the contention of local people that their exclusion from the area on constitution of the National Park has meant more destructive exploitation of the vegetation by outside commercial interests working in collusion with some of the corrupt officials. The experience of this National Park is also pertinent to the proposition that exclusion of local subsistence uses such as grazing is the key measure required to conserve biodiversity. The locals reinforce what scientists have also documented, namely, that banning of buffalo grazing from Keoladev Ghana has led to the rampant growth of a grass, Paspalum, and consequent deterioration of the wetland habitat for waterfowl, the main focus of this protected area.

These insights suggest that the whole institutional set up directed towards biodiversity conservation in India is grounded in assumptions that are inappropriate. At the heart of these is the assumption that bureaucratic and technical experts always know best. But the systems that need to be managed for conserving biodiversity are incredibly complex natural and social systems, highly variable in space and time. The science of ecology has, to this day, failed to come up with any universal laws that help us arrive at practical management decisions. These management decisions need therefore to be taken on a case by case basis, with an overall systems view and making use of all the available location specific information.

The so-called experts have little competence to do this, because of their lack of familiarity with most particular, inherently complex situations. It is now well known that Salim Ali, a most respected scientist and Kailash Sankhala, an equally respected wild life manager were both wrong in assuming that banning buffalo grazing would benefit the wetlands of Keoladev Ghana. Our studies throw up further examples. Thus on the B.R.T. hills near Mysore in Karnataka the researchers were primarily concerned with the impact on regeneration of the harvesting practices of amla or gooseberry *Phyllanthus emblica*, an important constituent of Ayurvedic medicines. The local Solliga tribals contend that this focus is misplaced; that the regeneration of amla principally depends on forest fire and not on the harvesting of the fruit. The technocratic experts have an even weaker understanding of the social context in which conservation has to be implemented. Thus the managers of Nandadevi National Park have banned summer grazing of sheep in the alpine pastures. Residents of the nearby Lata village contend that this has had twofold negative impacts. Firstly it has led to spread of weeds like *Rumex* resulting in a decline of medicinal herbs. Furthermore it has permitted incursions of musk deer poachers from Nepal who have a field day now that there is nobody around to report on their activities.

Indeed, the dominant tradition of government departments has been one of devaluing and destroying the diversity of life in favour of artifacts such as dams or buildings, or of a small number of economically important species such as eucalyptus or wattle or tiger prawns. In our study site of Holanagadde at the mouth of Aghanashini

Box 9
Judicial Activism

Citizens of India are increasingly turning to the courts to force the state apparatus to act in a responsible fashion. But neither those who file Public Interest Litigations, nor the judges can be familiar with the many nuisances that operate on ground in our complex society. Very well intentioned court judgements could therefore turn out to be counter-productive. One such possibility became evident during the course of our studies in the Palamau Tiger Reserve area. This concerns a Supreme Court judgement ordering the Government Authorities to settle all claims as to rights and privileges of local people living within the protected areas within a period of one year. Given that hundreds of thousands of families are involved, and that most of these are illiterate, settlement of such claims cannot simply be finished in a short time. Moreover there are serious issues as to what the settlement of such claims entails. For there have been grave injustices to the forest dwellers, especially tribals right from the time of land settlements by the British in the 19th and early 20th century. Many of their hamlets were converted into forest villages where the people were forced to contribute free labour to the Forest Departments. Today the only compensations that may be offered for these people is for land taken over by the Forest Department, none will be offered for all other resources, such as grazing or mahua flowers or bamboo that they will lose. Now, the Supreme Court directive to settle all claims in a year has been interpreted by Government authorities as a directive to move all the tribals and others out of wild life sanctuaries and national parks. This is an incorrect interpretation. The directive merely asks for all rights and privileges to be examined and formalized as required, instead of kept hanging fire for years as is the case in many places today. But the Government machinery is not willing to do this justly and properly as it would involve too much effort. It is easier to kick people out. This is bound to further alienate people from conservation concerns. Our study suggests that we should be moving in exactly the opposite direction. We should indeed be engaged in creating institutions for involving all the forest dwellers positively in conservation efforts.

river in coastal Karnataka for instance, the local herbal medicineman, as well as forest produce collectors complain that the local medicinal plant resources were decimated when the natural scrubby vegetation of the rocky hills was replaced by *Casuarina* and *Acacia auriculiformis* plantations. In the same village the Marine Products Export Promotion Council has promoted conversion of traditional brackish water paddy cum prawn farms into single species tiger prawn aquaculture. This prawn culture did in the short run bring high economic returns to the farmer, but the regular, intense applications of chemicals depletes the fertility of the fields. The prawn farmers are also in difficulty because of the outbreak of a viral disease and a court ban on prawn farming. It then appears quite inappropriate to hand over the entire responsibility of managing the country's biodiversity to the by and large insensitive Government apparatus. Nor are the local people happy with the intervention of the court (see Box 9). They agree that the prawn aquaculture practices ought to be changed in ways more friendly to the environment; but believe that the blanket ban is counterproductive. Indeed it is likely to lead to new legislation that would greatly hurt the cause of conservation.

A Divided Society

In study site after study site the people not only contend that the experts and managers have little understanding of the natural and social systems, but that they are not neutral agents pursuing broader national interests. Instead they believe that the bureaucracy and technocracy is intent on pursuing its own vested interests, often against those of biodiversity conservation. Universally, then, in all the study sites people feel that the present state sponsored system of management of biodiversity resources does not and will not deliver the goods. People are however equally skeptical of themselves taking on this responsibility. They perceive and report numerous divergences of interests amongst themselves, rendering it difficult for local communities to act cohesively in long term group interests. Table 1 attempts to summarise the whole series of such conflicts reported from the state of Himachal Pradesh.

The difficulties due to internal divisions are rampant even in a village like Doli of Barmer district so notable for its conservation ethos (see Box 10). It is because of these conflicts that many of the local people are also doubtful of the capabilities of Panchayat Raj institutions which are expected to provide the machinery for decentralized development planning and natural resource management to take on the responsibility of conservation of biodiversity.

That seems to leave us with votes of no confidence in the formal machinery at both the centralized and decentralized levels. What can then take their place ? There are reports of encouraging experiences from a few sites, such as Dhani in Nayagarh district of Orissa. At this site the local people have successfully organized themselves to protect the forest and wildlife. This self-organized system of resource management emerged spontaneously in 1987 in response to severe degradation of the local forest resources on which

Table 1: The variety of Conflicts Recorded in Himachal Pradesh

Context	*Benefit Sharing*	*Usage*	*Control and access*
Within village	Distribution of existing scarce resources	Between different uses like fodder, grazing, fuel, implements, herb collection	Non-inclusion of minority groups in decision making
	Distribution of increased resources due to regulation and plantations	Future use of landscape especially choice of plant species	
With outsiders	With neighbouring villages	With government departments for use of landscape – roads, choice of plant species	Exclusion of neighbouring villages or migrant graziers
	With FD over forest produce such as Khair	With migrant graziers	Exclusion by National Parks, Sanctuaries or plantations
		With industry for mining etc.	Control over unauthorized access to contractors– medicinal plants, slate quarrying etc.

Box 10
Guardians of Nature

The Bishnoi community, distributed over the Barmer, Jodhpur and Jaisalmer districts of Rajasthan is enjoined by tradition to abide by a set of twentynine principles, one amongst them being the duty to protect some elements of nature. Among the species, which the Bishnois consider sacred are the Khejri trees, the peafowl and certain mammals like the chinkara, nilgai and the black buck.

Our studies of the Doli village cluster in the Barmer district bring out the many dimensions of this conservation practice. The early settlers of this cluster were Rajpurohits who had received the land from the princely ruler of Marwar as a Jagir. The jagirdar had effective control over common village land, including sacred patches of pastureland called Oran, usually dedicated to a temple or a deity, where a socio-religious taboo on felling of green trees prevailed. The Bishnois started settling in the village around the beginning of this century but enjoyed little political and economic power at that time. Soon after independence, the jagirdari system was revoked and the control of the common land shifted to the State Revenue Department. With population rapidly increasing and people clearing land for cultivation and habitation, a sharp decline in the area of protected patches followed.

This trend showed a marked change - indeed a reversal - since the 1970s as the Bishnois gained in political and economic power and were in a position to insist on their conservation practices. They now fiercely protect the oran against any kind of commercial activity. Specifically, they accord total protection to the species they consider sacred; for example, they do not collect even leaf fodder from Khejri trees in the oran nor allow others to do so. A section of the other communities, notably the sheep-rearing Meghawals and Raikas did want access to the oran, as in neighbouring villages, but were not strong enough to stand against the dominant Bishnois. Over the years, these communities too have come to accept such restrictions as a way of life. In fact, they now allow nilgai and black bucks, which are sacred to the Bishnois, to freely graze in their fields, even though they may cause considerable crop damage.

Thus, while orans in many neighbouring areas dominated by Rajputs, Rajpurohits and other castes have been degraded due to the erosion of the religious ethic, those in the Doli cluster have remained largely intact. The Doli landscape thus presents a picture of biodiversity spread over fields and patches of the sacred areas and indeed, over the village as a whole. The Doli case is a unique example of a situation where conservation practices are enforced by the dominant community in a stratified society.

this predominantly tribal community depended for a variety of resources and services. The community managers have delineated the boundaries of the resource patch being protected and the people who should have access to the patch. They have also worked out an effective set of rules for permissible levels of harvests from the protected forest patch, a monitoring machinery to ensure implementation of these regulations and a series of flexible sanctions to promote adherence to these regulations. Over and above protection and regulated harvests of forest resources of utility, the community is also promoting protection to the wildlife. In fact the Dhani Forest Committee was planning to propose to the Orissa Government that their area be declared as a wildlife sanctuary. They are however having second thoughts on this proposal on realizing that this may merely mean their losing their current, carefully self regulated access to the area.

These still surviving as well as newly emergent cultural traditions of conservation reported from many of our study sites suggest a complementary model to that of protection of a small number of relatively large protected areas. This is a model of conservation at all scales, from individual banyan and peepal trees and small sacred ponds and groves to larger protected areas dispersed throughout the countryside. Not only banyan (*Ficus bengalensis*) and peepal (*Ficus religiosa*), but many other species of the fig genus *Ficus* are venerated and protected over much of India. Ecologists now recognize *Ficus* as a keystone resource; i.e. a living resource that supports the continued persistence of a large number of other species. These range from highly specialized species of fig wasps whose entire lives centre around fruit of particular species of figs to many species of fruit eating birds, monkeys, squirrels and bats. Many large *Ficus* trees also shelter day time roosts of thousands of giant fruit bats, *Pteropus giganteus*. While these bats may be trapped for consumption at a distance from the roosts, they are left unmolested where they are most vulnerable at their daytime congregations. India's countryside remains dotted with hundreds and thousands of *Ficus* trees and associated insects, birds, mammals entirely thanks to our cultural traditions. In many Indian towns and cities too, the only surviving large sized trees are such *Ficus* trees.

At the next larger scale are traditions of protecting a clump of a few trees as a sacred grove, or a small temple tank as a sacred pond (see Box 11). Some of these sacred groves and ponds may be as large as tens, or even hundreds of hectares; one of the largest and most famous being the sacred forest of Ayyappa at Sabarimala in Kerala. In fact it was a traditional practice in Kerala to leave 1/7th of the area totally protected as groves dedicated to serpent deities when bringing new lands under cultivation. Such traditions must once have covered the entire landscape of India with patches of natural biological communities, accessible to each and every human settlement. This is an attractive alternative of creating a biologically rich matrix dispersed throughout the country to embed the few larger islands of diversity protected as wildlife sanctuaries and national parks.

Box 11
Sacred Groves

Mundas, Oraons and Santhals are tribal groups spread over many forested districts of Madhya Pradesh, Bihar, Orissa and West Bengal. Several of our study sites in Bihar and Orissa fall in their tract. Here the tribals still display many traditional conservation practices. These include protection to sacred groves from which no plant material is removed. These sacred groves are called Saranas, and harbour their deities in natural forms such as stones. These Saranas fulfill a variety of functions - welcoming entrants to the village, favouring good harvest of crops, protection against wild animals, protection against epidemics, guarding against evil spirits. Many tribal festivals are linked to plants; sal (*Shorea robusta*) with sarhul, karam (*Adina cordifolia*) with Karama, semal (*Bombax malabarica*) and seedha (*Lagerstroemia parviflora*) with weddings. They traditionally practise an annual ritual hunt after worshipping the forest god; in this hunt they spare pregnant females and all immature animals. The herbal medicine men belonging to these communities promote protection of medicinal plants from overharvest, fire and grazing.

These traditions are now being eroded due to two forces—organized religions like Hinduism and Christianity and harvests by outside commercial interests, often helped by the Forest Department. Our investigations suggest that about 90% of the total harvests of plant and animal material from the area are for export; and that those engaged in such export have little concern for sustainability.

Involving People

Admittedly, today there are only a few cases of successful community based systems of conservation and sustainable utilization of biodiversity resources. But they point to significant possibilities, endorsed by people in every one of our study sites. However, the inputs from the people suggest that the alternative should not be designed as a system exclusively dependent on any one kind of agency. The self-organized systems for forest protection from Orissa such as that of Dhani described above today exclusively depend on the local community. But this has its distinct limitations. As the protected forest patch at Dhani has regenerated, people from neighbouring villages whose own forest patches are degraded want to access it, leading to conflicts. Managers of the protected patch are therefore seeking assistance of Government authorities to help neighbouring villages organize protection in their own areas, as well as to keep out others from encroaching on their own patch. Indeed discussions in all study sites suggested that people favour a broad based system of joint management involving local people; along with the Forest Department, Panchayat Raj Institutions as well as NGOs and educational institutions.

The involvement of state machinery is also essential to solve problems that may arise far away. Thus part of the problem of siltation of the Sone beel wetland of Assam arises from deforestation in its catchment in the neighbouring state of Manipur. Similarly siltation and flood problems at two other study sites of Assam, Majuli island and Dibru Saikhowa wild life sanctuary arise from deforestation in Arunachal Pradesh. Human migrations are another problem that needs to be tackled at a larger scale with the involvement of appropriate government structures. Thus the influence of migrants from Bangladesh has been a key factor driving environmental change at several study sites in Assam.

The clear consensus emerging from our studies is that it is the local people who have a real stake in the health of local environment (see box 12). Therefore in any broad based alternative system, people want members of local communities to play a major role in management of local biodiversity resources They suggest that the community groups involved as units of management be relatively small in numbers and fairly homogeneous, and that such groups be given a substantial measure of control over a resource patch with clearly defined boundaries. They would like the help of agencies such as Forest Department, Panchayat Raj institutions, NGOs and educational institutions to monitor that the resources are being managed properly, to coordinate with neighbouring villagers and to help in enforcing regulations. They would also like technical inputs from such outside agencies, especially in form of information on opportunities of local level value addition and marketing. They do, however, want the outside groups to pass on much of the authority for day to day resource management to local communities.

Recent years have witnessed more and more space opening up for the development of such systems of participatory management in India. The Constitution of India in its article 40, enjoins the state to enable the gram panchayats to function as village republics. However, precious little was done in that direction till the 73rd amendment to the constitution in 1993. This amendment asks for the setting up of State Finance Commissions to allocate resources to the panchayat bodies, makes it mandatory for the states to conduct panchayat elections every 5 years and provides for the constitution of a State Election Commission to oversee them. More importantly, one-third of the seats are reserved for women and panchayat bodies are given powers of planning (see Box 13). In a parallel development, the forest policy in 1988 encouraged the involvement of local communities in forest management. Subsequently, this was operationalized throughout the country under the Joint Forest Management Programme, wherein village committees in collaboration with the forest department have begun protecting and regulating the use of nearby forests. The provisions of the Panchayats (extension to Scheduled Areas) Act 1996 goes even further. Based on the recommendation of the Bhuria Committee, the Act is presently applicable only to selected tribal areas notified under the fifth schedule of the Constitution, in the states of Madhya Pradesh, Bihar, Orissa, Andhra Pradesh, Maharashtra, Rajasthan and Himachal Pradesh.

Box 12
In Defence of Nature

The story of Andaman and Nicobar islands brings out starkly the total disjunction between development and conservation. At the same time it brings home the lesson that it is the local communities intimately dependent on natural resources and not Forest Departments that are likely to be the real champions of conservation. The British attempts at colonization of these islands were staunchly resisted by the indigenous tribals, especially of Central Andamans, till they were finally overwhelmed in 1859. This colonization was followed by near extermination of the Great Andamanese tribe and subjugation of Onges. But the Jarwas still hold on to their territory. It is notable that the finest surviving examples of the natural biological communities of the rain forests of Andamans are in the areas maintained as Jarwa Reserves, defended with bows and arrows by the tribals who resist all incursions of the officials, as well as of local and Myanmarese timber smugglers. The Forest Department, on the other hand, seems to be intent on promoting utterly unsustainable levels of exploitation of forest resources. A device to accomplish this involves converting areas of Jarwa Reserve into Reserve Forest. Another important device to break down Jarwa resistance and open up their territory for exploitation of biological resources is the Andamans Trunk Road which has prompted liquidation of some of the finest rain forest. Today Jarwas are struggling to prevent this road overrunning their territory.

Box 13
Women to the Fore

In rural India, women are primarily responsible for collection of resources from nature. Consequently, they also have proportionately greater knowledge on the status of such resources and are affected more by scarcity. In Himachal Pradesh, women have been at the forefront of local conservation initiatives. Responding to the scarcity of fodder, women's groups or Mahila Mandals have successfully protected patches of forest all over Karsog in Mandi district. Similarly, Mahila Mandals are protecting forests in Chuhar valley of Mandi from timber smugglers and sometimes from their own men. When the tubewell dug by a cement company led to the drying up of the traditional water source in Darlaghat, women of the village got together to shift the tubewell elsewhere. In neighbouring Kashlog panchayat, the woman panchayat pradhan has been steadfast in her opposition to limestone mining in her panchayat, in the face of threats from vested interests. At the same time, in Kangra district, women have come together to process wild fruit into pickles and chutney for value-addition, increasing their stake in the conservation of those species in the wild. The women in panchayati raj institutions, elected for the first time due to reservations, are also slowly gearing up to the challenge of leadership.

The Scheduled Areas Act has made significant advances in terms of opening up space for greater participation of local people in processes and decisions affecting their lives. It marks a shift towards direct participatory democracy at the village level by defining the grama sabha at the hamlet or village level and empowering it to take decisions instead of the elected representatives. Moreover, the Act reinstates the concept of community property by transferring the ownership of minor forest produce to the grama sabha. The provisions of the Act, even though restricted to seven states, provide the necessary space for trying out new mechanisms of harmonizing environmental concerns and development aspirations.

Share and Inform

Today local communities pay most of the costs of conservation efforts, either directly as when they have to tolerate crop destruction by elephants or killing of livestock or even people by tigers. Uniformly people complain that the compensation offered by Forest Department to offset such losses in inadequate, and even such inadequate compensation fails to reach them fully or in time. Instead people would like to see installed a system, not only of adequate compensations for losses, but of positive rewards for effective participation in conservation efforts. It is suggested that such a system of rewards could involve several elements. The rewards could be funds to local communities or their institutions such as Panchayats to adopt measures to cut down on costs of conservation such as electrical fences to halt elephant movements into crop fields or to enhance resource use efficiencies, such as more fuel efficient cooking stoves. They could be additional untied development grants. They may take the form of either social recognition or cash rewards for small groups or for individuals, for instance, for maintaining a sacred grove, or a large variety of cultivars of fruit trees on their private lands. People suggest that such positive incentives should be made available in a transparent fashion on the basis of monitoring by independent agencies such as NGOs or educational institutions to ensure that there is no misappropriation.

Publicly accessible documents prepared in a participatory fashion such as the People's Biodiversity Registers may be an appropriate tool for such monitoring. The PBRs document the status of local biodiversity resources, they also record knowledge of uses of these resources. They could form the basis of local level management of these resources, on lines of Forest Working Plans or Watershed Development Microplans. They could serve as records of individual or community level contributions to conservation of biodiversity such as protection of sacred groves, maintenance of cultivars of fruit trees, or sustainable use of medicinal plant resources. They may serve as evidence of people's knowledge of uses of biodiversity resources, as therapeutics, as cosmetics, as pesticides and so on in relation to benefit sharing in the context of intellectual property rights issues. To realize these potentialities, India needs to put in place an effective piece of Biodiversity Legislation. A draft of such an act was released in late 1997 for public debate by Shri Saifuddin Soz, the then Union Minister for Environment and Forests. This draft is clearly deficient in many ways. Dr. M.S. Swaminathan, Chairman of the committee established to draw up this legislation outlined in a talk at the International Conference on Medicinal Plants at Bangalore on February 19, 1998 his vision of what a more complete piece of legislation should incorporate (see Box 14). The picture that has emerged from what people have suggested throughout the country is happily in agreement with Dr. Swaminathan's vision.

There thus emerge from our grass-root studies excellent suggestions for the kinds of institutions that may be established to create a broad-based, people friendly programme of biodiversity conservation and management in the country. That such a programme would greatly benefit from the wealth of location specific understanding

Box 14
Draft National Biodiversity Act as presented by Dr. M.S. Swaminathan on 19 February 1998 at the International Conference on Medicinal Plants, Bangalore

Goals

Conservation, sustainable use, equity and ethics in benefit sharing.

Institutional Structures

Village/Block: Biodiversity Council of village bodies
State: State Biodiversity Board
National: National Biodiversity Authority

Responsibilities

Village/Block level Biodiversity Council: People's Biodiversity Register, prior informed consent, community benefit sharing, conservation and revitalization of herbalists' traditions, heritage trees and sites, integrate agriculture and forestry in health care system, mobilization of local resources.

State Biodiversity Board: Conservation - participatory habitat and forest management, trust for the management of biosphere reserves and national parks with stakeholder involvement, saving endangered plant and animal species.
Sustainable use - wood based industries, non-wood forest products, sourcing of medicinal plants, domestication of threatened species.

National Biodiversity Authority: Standing committees on access, benefit sharing, conservation and sustainable use, commercial use of biodiversity including agrobiodiversity—guidelines and regulations, revitalization of the in-situ on-farm conservation traditions of tribal and rural families, CBD, WTO-TRIPS, trans-national corporations, collaboration with foreign universities/institutions/agencies/companies, state of India's biodiversity reports, monitoring and evaluation, early warning and timely action, information empowerment—information villages and internet kiosks, research on new chemicals and cures, national biodiversity fund - royalty and cess(national and international), case by case agreements, bilateral and multilateral donors, tax incentives for local contributions.

of the ecosystems available with people is underscored by the many concrete suggestions and experiments for natural resource management coming from our study sites (see Box 15). One such happy experience comes from Himachal Pradesh. Situated on the banks of river Sutlej, village Nanj has witnessed a novel community initiative during the course of our study. The village was an active participant in the literacy movement during 1992-93 and the people had been exposed to a variety of issues related to natural resource management. As a consequence, a heavily degraded patch of forest was enclosed by consensus. The regeneration has been extremely good and promising. During the literacy campaign, a blackboard had been painted on a wall at a public place in the village for open classes and dissemination of information. Over the last few years, the black board had fallen into disuse. It was revived again during the PBR documentation to display the gist of the information collected. It resulted in public debates on the issues raised by the information and in turn to conservation actions.

Box 15
Plight of Chilika

Chilika, the largest brackish water lagoon of south and southeast Asia is today under manifold threats. These arise because of the escalation of the pressures on natural resources, be they forests in the catchment that have been felled; surrounding fields that are sprayed with pesticides; or fish stocks that are caught in increasing numbers with mechanized boats and fine meshed nylon nets. Obviously, it is impractical to think of going back to the old days when most resources were used far less intensively. But it is essential to manage the resources far more carefully. In this the sons and daughters of the soil, such as the fisherfolk of Chilika can provide valuable inputs, for they are the people with a serious long-term stake in the health of their environment. The ecosystem people of Chilika identify the following issues and suggest the measures listed opposite to tackle them.

One such debate centered on the species Kambal. Kambal is a multipurpose tree found upto the mid-Himalaya. It is considered to be a good fuelwood and its leaves are used as green manure in ginger cultivation. It was pointed out on the black borad that due to excessive pressure of both fuelwood and manure collection, Kambal has been reduced to a bush in the forest, leading to declining availability of both fuelwood and manure. After many days of discussion in front of the black board, it was decided that leaf manure for ginger was a higher priority. Since other fuelwood species were available in the forest, the extraction of Kambal would be restricted to leaves for green leaf manure and the bushes would be pruned in such a way that one or two shoots would be permitted to grow. At the same time, a few progressive farmers decided to experiment with agricultural crop residues as a substitute for Kambal leaves

Conservation Issues and Suggested Protection Measures

Issues	*Measures*
Siltation	Dredging of inner and outer link channels. Soil conservation involving plantation and embankment.
Weeds	Increase in the salinity level of Chilika by opening the mouth and link channels. Biological control by introducing carps.
Water Pollution	Limited use of motor boats. Ban on chemical food mainly used in prawn culture. Embankment around Chilika. Checking industrial pollution – Jayashree Chemicals etc.
Prawn Culture	Banning of spawn collection. Involvement of Coast Guards. Ecological training to the prawn culturists.
Increased fishing intensity	Alternative income sources to the locals. Revitalizing/involvement of existing cooperative institutions. Check on the immigration of refugees. Check on the use of fine mesh nets.
Encroachment	Survey and resettlement. Eviction of the encroachers. Restoring the traditional rights of the locals.

for manure. Over one year, it was demonstrated that there was no difference in the yields from the two kinds of manure and subsequently more farmers turned to crop residues as it meant far less labour inputs. As a consequence, Kambal is now flourishing in the forest and due to careful pruning and good rootstock, would grow back to trees in a few years time. This experience underscores the great value of access to and exchange of good information. It suggests that enacting a progressive piece of legislation on right to information may in the long run be one of the most useful contributions to conserving India's natural resources.

Nature conservation is not new to India, being integral to our folk cultures. It was a part of the Mughal culture; with nobles maintaining huge areas under hunting preserves. It is a significant component of the Sanskritic tradition as well. Indeed a verse in Mahabharata anticipates the philosophy of the modern Project Tiger:

Nirwano wadhyate wyaghro,
Nirwayghram chindyate wanam
Tasmat wyaghro wanam rakshet,
Wanam wyaghram ca palayet.

(Without a forest cover the tiger is slain, without the tigers the forest is felled. Hence a tiger should protect a forest and the forest nurture tigers.)

Time has surely come to advance beyond this age-old vision and organize systems of mutualism not only between the forest and wildlife, but amongst people and the whole spectrum of biodiversity. For such an approach, too, we have old traditions. Along many rivers of India are maintained sacred pools which harbour high densities of fish. Downstream of these pools, people get excellent fish harvests. This is a system of sustainable use and conservation, good for the river, the fish and the people. We must now take clues from the perspectives made available by this study and work towards devising such win-win systems throughout the country, to replace what are today's lose-lose systems that only benefit in short term a narrow cross-section of the Indian society with vested interests served by misappropriation and liquidation of the country's rich heritage of biodiversity. Such new systems would be decentralized, participatory, pro-people systems primarily relying on positive incentives awarded in a transparent fashion. They would include state interventions, but in ways that ensure that the state machinery is rendered accountable to the people. These new systems would replace the culture of control and command appropriate to a bygone colonial age, by a culture of share and inform that would allow our country to prosper in the new information age. They would be systems appropriate to a more humane, more equitable, more democratic society that we would hopefully usher in in the coming decades.

Srishti Jigyasa Pariwar would like to promote People's Biodiversity Register activities in all parts of India. Readers who would like to associate themselves in such a programme are welcome to write to Madhav Gadgil at Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560012, or send an email message to utkarsh@ces.iisc.ernet.in

ANNEX

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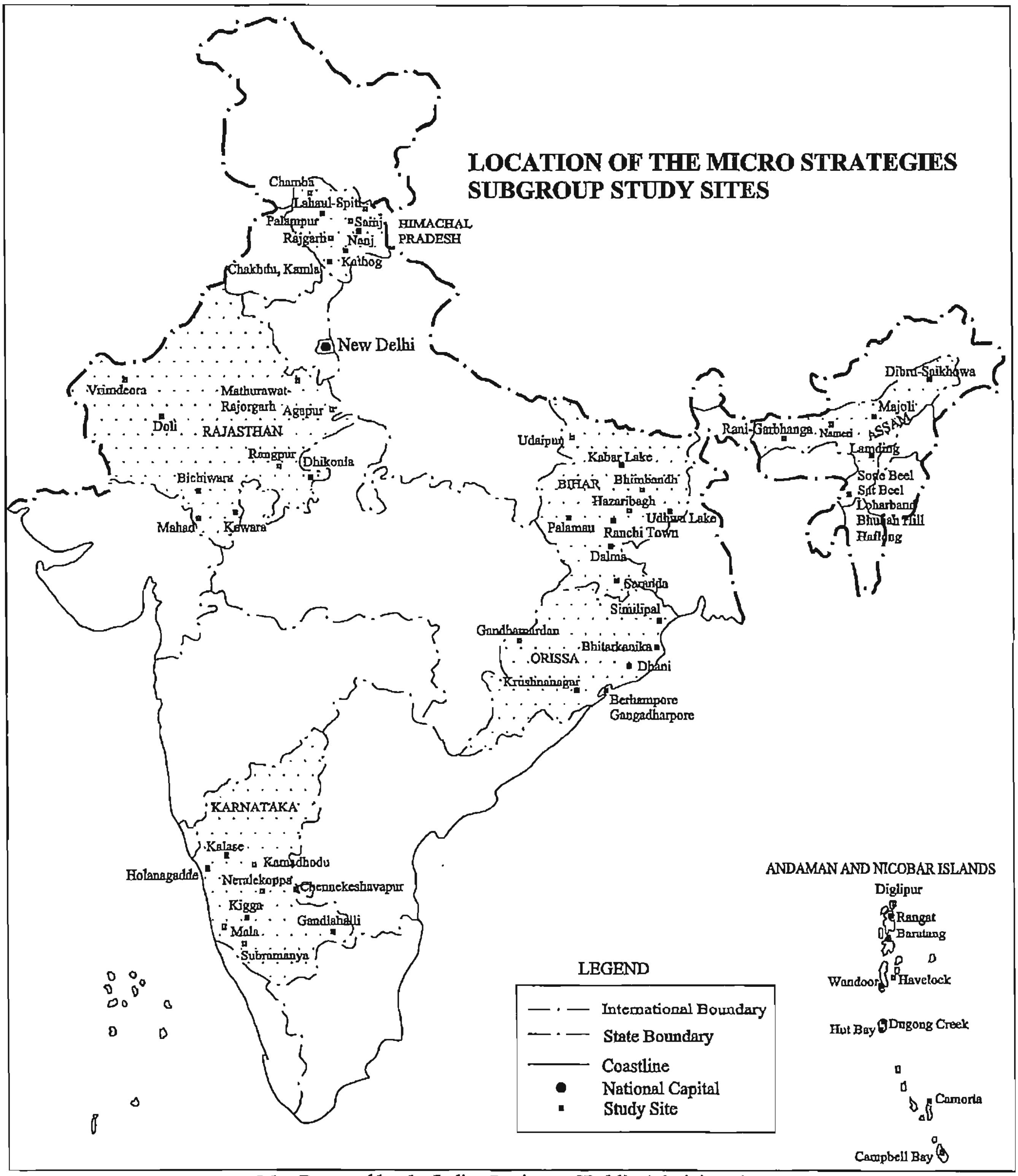


Map Prepared by the Indian Institute of Public Administration

BCPP Microstrategies: A Compilation of Findings

Monica V. Ogra

PREFACE

This document represents an attempt to compile the findings of the BCPP Microstrategies Subgroup into an easily accessible, albeit abridged, form[1]*. The categories listed below have been used to organize the microstrategies which were generated during the BCPP exercise:*

- *Ongoing conservation efforts:* This refers to documentation of conservation initiatives that were present in the field when the BCPP team arrived, or remembered and described by the locals as the recent past.
- *Microstrategies relating to Policy and Law:* This category encompasses strategies that refer to efforts, through governmental laws and policies, to regulate behavior or activity, across all levels.
- *Microstrategies relating to Economics:* These are strategies that deal with sources of necessary financial inputs, economic incentives, the market, etc.
- *Microstrategies relating to Education and Awareness:* This category includes those strategies which point to needs for specified types of information, studies which should be undertaken, changes in the educational curricula, raising of general awareness levels, interventions which could be made by teachers and students, and involvement with youth clubs, NGOs, and local activist groups.
- *Microstrategies relating to Gender Issues:* Where any strategies are in response to prevalent gender issues, they are noted here. In cases where no strategy has been given, but attention has been called to a particular issue, it has been indicated.

Macro-Level Implications of the Microstrategies: Some Perspectives

Introduction

In addition to prioritizing sites and species for conservation across India, one of the main objectives of the BCPP was to identify feasible microstrategies for biodiversity conservation. The strength of these strategies was to lie in their indigenous roots; that instead of creating a set of outsider, "expert" opinions and recommendations for policy changes and management options, action plans could be generated from the ground-up, using local investigators, and with people's participation and knowledge of their own limitations and strengths feeding into the process. The purpose of this paper is to highlight the emerging micro-level strategies and their possible implications at the macro-level.

Methodological Considerations

Before presenting information relating to the strategies, it is important to reflect upon the process which created the data set. As the BCPP microstrategy generation exercise was the first of its kind, a unique and flexible methodology was needed. This was envisioned and crafted over a period of two years, and presented to the teams as the manual known as *Srustigyaan*.

The innovation of the conceptual framework that characterized *Srustigyaan* lies in the construction of landscape element (LSE) and user group (UG) categories. Participatory mapping exercises undertaken in the initial phase of fieldwork provided opportunities for rapport building as well as for demonstration of the important geophysical elements and boundaries of the resource catchment, and identification of the key species and locations within. This allows for the inclusion of many ecosystems into easily referenced units in group discussions and strategizing exercises. Thus the mental prioritization process begins quite naturally, as elements of biodiversity are considered for incorporation into a pictorial representation of the local ecosystems, and data sheets for key species and LSEs are prepared.

Interactions between members of various user groups and their often overlapping interests in different LSEs becomes the object of study from phase 2. UGs are created by identifying all the uses of nature that people carry out, both for subsistence and for income-generating purposes, then listing them and grouping together the related activities to form an understanding of the diversity of bioresource use as well as of livelihood strategies. Theoretically, by identifying the interests in biodiversity conservation from this point of view, caste, class, and gender biases that might otherwise invalidate data sets are reduced. (However, the data actually collected indicates that this was not always the case.[2]) Often individuals may belong to more than one UG, given the seasonality of agricultural and monsoon-related activities, for example. By focusing on the activity instead of the individual, the interests of the UG as a collective body can better be represented. Sub-user groups are also identified, and this provides a way to look at areas of conflicting or mutual interests relating to the conservation of particular species of LSEs.

The 12-15 months of fieldwork, consisting of largely anthropological techniques of household interviews, small (UG) discussions, questionnaires, surveys, etc. was punctuated most notably by two *gram sabhas* (village community meetings), at which discussions took place for sharing and validating information already collected. Throughout, however, information was also sought specifically from "knowledgeable individuals" of the community (the number varied anywhere from 5 to 60 per site), such as *vaids* (medicine-men), village elders, members of nature clubs, etc. -- in other words, persons with a developed interest and knowledge relating to biodiversity were sought for information to augment the data collected through interaction with the user groups. With the help of these people, the teams were able to construct an ecological history for each site, identifying critical events and periods, the major forces for change, and past conservation efforts, all of which have resulted in the current environmental scenario. This, then, was validated in a *gram sabha* meeting with the whole village.

Phase 3 was aimed at producing management options, development aspirations, and understanding of the areas of conflict and consensus among the villagers. In other words, this period of fieldwork was focused on arriving at the nature of the constraints to conservation efforts and the generation of ideas to work within and around them. Another issue to consider was the prevailing access and ownership "regimes". Raising these important subjects provided a space for reflection and focused discussion on ways that the community could, together, try to regain a sense of dignity with regard to the loss of control over local resources that was perceived in most sites. Phase 4, actually the last gram sabha itself, was aimed at prioritizing the management options previously generated and discussed. What resulted were termed "Action Plans."

Microstrategies, then, were realized only after a period of long and sustained interaction with the user group populations. The strength of the strategies lies in their grassroots character, with consideration of local historical, political, and social constraints, issues raised throughout the study, with only the guidance of the investigating team as facilitator of such activities. Biodiversity management options were brainstormed, discussed, reformulated, and prioritized, to arrive at the Feasible Conservation Strategy / Action Plan.

Thus, the initial stages of fieldwork, marked by the mapping exercise and formulation of the data sheets, subsequent discussions and feedback taking place between the villagers and investigating team, and among the villagers themselves, facilitated the process of generating and prioritizing actual strategies for biodiversity conservation. As the people became increasingly sensitized about new environmental issues and taught "outsiders" about old ones —more confident about the value of their opinions and experiences—ideas took root over time, flowering into microstrategies, the number and caliber of which were directly proportional to the level of confidence. Aside from the strategies themselves, this confidence, resulting from recognition of a previously ignored voice and a revived sense of empowerment, can be viewed as a major output of the microstrategy exercise.

The Findings

Policy and Law

The strategies resulting from the BCPP exercise provide a great deal of scope for changes to existing policies and laws. As can be seen from the village-level data, in an overwhelming majority of sites villagers indicated a desire for some form of local control over the natural resource base (e.g., a resource management committee), and changes in the **State Panchayati Raj Acts** to enable these bodies to carry out their duties. The following recommendations for specific additions to the Panchayati Raj Act came from the field, to empower the panchayats or their subcommittees with the rights to:

- A system of checks and balances between government departments and the local community, to ensure accountability and responsibility
- Channelize development funds for biodiversity conservation and people's biodiversity register (PBR) exercises[3]
- Choose between official Joint - Management Programs and informal Community-Based Conservation (CBC)

- Create by-laws appropriate to the local context, to regulate bioresource use and punish offenders
- Demand the closure/modification of polluting industries in their areas
- Empower local committees to manage and protect bioresources, through *self-defined* village units
- Levy taxes, collect use fees, and control the trade of bioresources locally
- Manage local LSEs/WSEs[4], including the right to ban certain activities, or close them altogether or for some time
- Security of local knowledge and resources through recognition of the PBR as an account of village physical and intellectual property, the regular undertaking of which should be the responsibility of every panchayat
- Security of village common property resources (common ownership)

The second major piece of legislation which requires amendment is the Wild Life Protection Act (WLPA). This law is held in contempt by many villagers, who see it as "anti-people" and the work of environmentalists, who despite their love for plants and animals, have lost all regard for the needs of the human inhabitants affected by an imposed proteced area (PA) network. Conservation policies must be locally sensitive and give people a stake in the benefits, they say. In this spirit the following modifications to the WLPA were suggested in the field:

- Additions/Subtractions to the list of protected species (e.g., sharks should be added, abundant plant species subtracted where and when their population becomes viable)
- Locally threatened plant/animal species should also be protected by laws
- Formal protection of traditionally protected/managed areas (e.g., sacred groves, orans)
- Creation of core conservation areas outside of the existing PA network
- Empowerment of local communities to fully participate in biodiversity conservation
- Site-specific legalization of certain hunting practices (e.g., hunting of chital, which is protected on the mainland, but is an exotic nuisance species in the Andaman and Nicobar Islands)
- Permission to collect dead corals, shells, etc., an activity which is presently banned
- Permission to collect NTFPs in some National Parks
- Prohibition of forced displacement of villagers in the name of conservation
- Protection/compensation for crop and livestock losses due to wild animals must be provided by law and awarded without harassment
- Some adjustment of PA borders must be made to allow for people's bonafide subsistence needs, at the minimum (this might include denotification of National Parks to Sanctuary, for example)

Many of the other microstrategies pointed to locally specific issues, yet whose solutions could only be enacted at the macro level; for example, in the UP Hills, one such conflict involves outsiders buying up large tracts of land, even entire ridges, for development as tourist hotels. The suggestion was made for some legal protection to prevent this from continuing unabated. On a macro-level, one possible implication lies in the expansion of the **Land Alienation Act** to empower regions within a state, in this case the Uttarkhand area of the UP Hills, to keep non-locals out. Another possibility is to invoke the **Land Ceilings Act** and/or **Land Acquisition Act**, to slow the conversion of noncommercial property to commercial properties.

Strategies relating to this concept of "outsider" threat are widespread. In addition to curbing the privileges granted to vested, private interests, the strategies reinforce the urgent need to empower the citizen, the community, and the village -- the "insiders". A major obstacle in this regard is the lack of information easily available to people about their options and existing rights. For example, the option to return to a **Common Property Rights** regime was sought at a number of the sites. However, many people don't know how to assert their rights and lay claims to them.[5] The process through which interested persons or agencies are able to acquire information about asserting their legal rights must be simplified. Further, the proposed **Right to Information Act** has important implications for local communities, members of voluntary agencies, and concerned citizens interested in pursuing complete information about exisiting and future development projects, which often have disastrous effects on biodiversity and people's ability to conserve or even maintain the bioresource base.[6] This type of information, specifically cost-benefit analysis of development projects, was requested by villagers in a number of sites.

Another important piece of legislation to push through is the proposed **Biological Diversity Act**, a part of which could address the need expressed in several sites for a way to assert legitimate claims over village physical and intellectual property. Continued use of the PBR exercise and formal recognition of the registers as accounts of such property is an idea that emerged from the study, and an option that should be considered.

Policies and laws should also aim to **protect cultural diversity**. It was seen in Himachal Pradesh that homogenization of occupational activity has led to destruction of biodiversity. Examples of this include the giving up of traditional occupations for wage labour or converting into fruit orchards lands traditionally used for cultivating a variety of plants. This is because humans, like other organisms, fill open niches through creative, adaptive strategies. For example, landlessness was a strategy deliberately employed by nomadic pastoralists in HP, adopted in spite of holding the right to break new land.[7] They did not want and as it was economically and socially more practical for them to remain pastoral nomads. Legislation needs to be supportive of traditional "niche-livelihoods" by providing assistance that is sensitive to the site-specific variations in practices.

It has been said that the problem with India's conservation policies lies not in a shortage of good laws, but in a failure to implement them in the spirit in which they were written. Several policies "desired" by villagers already exist, unbeknownst to them. It is worth indicating here, these laws that warrant "remembering":

- **Forest Conservation Act, 1980**: Prohibits forest conversion for non-forest use
- **Indian Forest Act, 1927**: Contains a provision for village forests/common property
- **Tribal Land Alienation Act**: Allows communities to prevent 'outsiders' from buying land
- **Various state acts dealing with monopolies**: Can be used to restructure LAMPS', perceived by many to hold an unfair monopoly over the trade of NTFPs.

Economic Aspects

The challenge of identifying appropriate economic "incentives" continues to appear. What then, constitute economic incentives, in the villagers' minds? The following list provides some ideas that came from the BCPP exercise:

- Cash compensation for physical or property damage due to wild animal attacks
- Crop insurance scheme to include losses incurred by wildlife raids[8]
- Subsidies or donations for alternatives to fuelwood biomass (e.g., LPG, kerosene) and energy-saving technologies (e.g., solar cells, astra ovens, biogas plants, smokeless chullas)
- Working capital to launch bioresource based enterprise (e.g. cottage industry, cooperative societies, small scale plantations, etc.) in the form of financial assistance (grants-in-aid or loans), machinery, and/or training. Capital could come from governenment or banks, with subsequent profits deposited in a Panchayat fund.
- Development assistance for raising of plantations, civic amenities, irrigation inputs, alternative sources of income, marketing assistance, training, etc.
- Compensation for conservation efforts

While it is obvious that people are not likely to be motivated to conserve biodiversity at "their own cost," the question remains: How can development aspirations be reconciled with conservation initiatives? The micro-strategies that emerge indicate that one way may be to ally income generation with renewable resources, to shift dependence away from dwindling natural resources, while restorative efforts are taken up. Subsequently, increasing the flow of financial assistance for such efforts is felt to be essential, suggested largely through the allocation of additional government subsidies and funding. The logic expressed by many villagers seems to be, "Only when the basic needs are guaranteed, can we consider sacrificing time and resources for the sake of conservation." However, investigators realized and reported that *only by linking economic incentives to conservation would biodiversity be positively affected.* One can see that funding needs to be generated and specifically allocated to conservation efforts. Additionally, strategies need to be further prioritized so that whatever funding becomes available is used to the maximum benefit.

Some ideas for bioresource-based income generation schemes that came from the field include:

- Cash rewards for outstanding efforts toward biodiversity conservation
- Collection of taxes, fees, fines related to the use of biodiversity
- Eco-tourism / Cultural Tourism, where locals are employed as guides and accommodation is created by and under the supervision of the local community; sale of hand-crafted NTFP souvenirs to tourists
- Elimination of LAMPS (though ostensibly designed to benefit the local people, they are widely perceived to be a monopoly of the State[9])
- Elimination of lease auctions (which would allow less powerful interests to gain lease rights)
- Grants-in-aid
- Expansion of JFM (and JFM-style) programs, which would provide a share of the profits to the community
- Medicinal plant cultivation
- Small-scale cottage industry, run through cooperative societies (e.g. around bioresources such as *pan*, fruits, herbs, and various NTFP craft items)

Education and Awareness

A major finding in this section has already been mentioned with respect to Policy and Law—the **low level of awareness** about existing rules, regulations, options, and programs available to them. People specifically asked to be given this information, and to be made aware of the rights and responsibilities of the Panchayat as well.

There is a great potential for **NGOs** to become more involved with the cause of biodiversity conservation through education. Though members of the site communities often exhibited a detailed and vast body of knowledge about bioresources, many lack the management tools and skills needed for popularizing sustainable use. They *want* to conserve, but don't know how to in today's world. On the other hand, others—particularly the youth—have already lost their connection with the forests and are usually not motivated to conserve. Many of the elders lament that traditional uses of bioresources, for example for herbal medicines, are increasingly fading into village histories, as the knowledge of their applications is no longer being passed down to the younger generations.

A significant finding is that, in a number of sites, **social recognition** in the form of public felicitations and/or awards was perceived to have great potential for motivating biodiversity conservation efforts. Outreach programs designed to informally educate, motivate, organize, and support efforts for biodiversity conservation were also sought by many of the communities who participated in the BCPP.

Formal educational institutions are also encouraged to play a large role in this effort. Local schoolteachers are envisioned as leaders and can design coursework and other learning experiences which focus on environmental issues. They can help create societal awareness about the environment through education of the youth. First hand observation of biodiversity as part of the biology, geography, and social science curricula may be achieved through regular PBR and mapping exercises, such as occurred during BCPP. At the next level, local and regional issues may be taken up more vigorously by students of higher learning; a suggestion which came from Assam was that research on local fish diseases should be undertaken by university students.

A final element related to Education and Awareness, but which had no microstrategy generated to remedy the issue, was that of the need for greater **sensitization within the bureaucracy**. Again and again, the sentiment was echoed that poor relationships between local communities and government officials (particularly FD officials) are characterized by mistrust, fear, hostility, and general animosity, and that something must be done about it. A change needs to occur within the ranks of the Administration, where the people once again become a priority. In order for this to happen, attitudes need to shift, from government-as-master to government-as-servant. A viable starting point would be to incorporate local issues and gender issues into FD training, to make a sincere effort to sensitize those individuals about the local realities in the places where they will be posted. Only in such an atmosphere of respect can a relationship between all concerned parties flourish.

Gender-related Issues

Regrettably, the BCPP was largely unsuccessful in its attempt to seriously incorporate gender issues into the fieldwork, as many investigators themselves were not sensitized enough to understand the methodological considerations that such an inquiry demands. The result is a perceptibly male-biased body of data in most cases, questioning the assumption that the strategies, suggested largely by the menfolk, do accurately represent the interests of "the people." In other cases, women were considered a "minority" group, as with scheduled castes and tribal communities, and at times the value of their subsistence-oriented productive activity was underemphasized in comparison to the income-generating activity of the menfolk.

However, in those sites where gender was made a mediating variable in understanding experience and perception, a difference can be observed, and a few clear strategies and relevant perspectives were elicited from some of the villagers, who reported that:

- Owing to the intimate nature of village women's relationship with natural resources, their participation in the decision-making process of resource use and management needs to be increased[10]
- Sensitization about gender issues needs to be incorporated into the Administration and with regard to policy-making, as well as within the village committees on resource management and use
- The role of women vis-à-vis resource use should be better understood and explored
- Women need to be specifically targeted for programs designed to organize and mobilize them around environmental issues and bioresource-based income generation

Summary

In conclusion, we may view the BCPP-generated microstrategies to have the following general implications at the macro-level[11]:

1. People need to have a stake in and control over the local resources if they are to be motivated to make conservation efforts. "Participatory management" is a concept that must be further developed and actualized, with attention given to include women and minority interests.
2. People need access to information, especially about their rights, and a demystification of the nature of constraints and freedoms that are already in place.
3. Many policies and laws exist to meet people's needs, but there is no system of accountability to ensure that

officials are fulfilling their responsibilities. Such an intervention is essential.

4. Economic incentives are reported to be a strong motivation to conserve, but must have a clear and direct link to conservation in the minds of the beneficiaries, in order to have a positive effect on biodiversity.
5. Economic and development policies must be "pro-people," gender-sensitive, and locally appropriate; otherwise, the current state of alienation from the resource base and subsequent degradation will continue unabated.
6. People need help in popularizing sustainable use habits and biodiversity conservation efforts within the villages.
7. The BCPP (PBR) exercise has generated many ideas from the ground about how to empower local communities; however, outside help is needed. NGOs and educational institutions can play a leading role in facilitating conservation and management efforts.
8. The spirit of the National Forest Policy (1988) must be extended to all bioresource-dependent people, and operationalized not just in forests, but in all the ecological regimes:

The principal aim of the Forest Policy must be to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium, which are vital for sustenance of all lifeforms, human, animal, and plant. The derivation of direct economic benefit must be subordinated to this principal aim....

The life of tribals and other poor living within and near forests revolves around forests. The rights and concessions enjoyed by them should be fully protected. Their domestic requirements of fuelwood, fodder, minor forest produce, and construction timber should be the first charge on forest produce....Similar consideration should be given to scheduled castes and other poor living near forests...[to be] determined by the carrying capacity of the forests.[12]

Notes

1. While this report focuses only on the actual strategies which were generated, information was gathered on many subjects, such as "Ecological History" and "Development Aspirations". The reader is encouraged to consult the bibliographic sources for further details.
   As subsequent versions of the field reports were submitted at varying times, some errors of omission may have occurred. Any such errors reflected in this report are the sole responsiblity of the author.
2. For example, at the Neil Island site, evidence was present of a UG bias in favor of income-generation activity. This has implications on gender issues as the traditional division of labor places subistence activity in the domain of women, while income-generation is largely the domain of men.
3. One site in Rajasthan mentioned that funds would be better channeled through FD or NGOs, as there was some mistrust in the integrity of the Panachayat to deliver such funds. This raises the important question of how to create an accountability between the Panchayat and the individual villages, which was not addressed by the microstrategies.
4. "Landscape Element" and "Waterscape Element", respectively
5. Unbeknowsnt to many, "village forests" are legally eligible for common holding as per the provisions of the Indian Forest Act of 1927.
6. For example, the Official Secrets Act is an effective impediment to concerned citizens wishing to legally acquire documents such as cost-benefit analysis of major development projects, as when several Narmada Bachao Andolan activists were jailed for posession of these surreptitiously obtained Ministry documents.
7. From *Nature in Retreat*, page 7.
8. This strategy was related orally by one of the site investigators during workshop proceedings.
9. The issue revolves around the question of whether higher prices of NTFPs would result from the operation of the free market.
10. A few sites in HP suggested that the VFCs should include a male and female from each household. Generally speaking, however, very little regarding the issue of representation – either by gender, caste, or class – within local committees is recorded. See Table 1 and the individual site summaries for more details.
11. See also Annexure 2: *Guiding Principles for Biodiversity Conservation in Himachal Pradesh.*
12. *Sections 2.2, 4.3.4.3, and 4.3.4.4 of National Forest Policy, 1988*

Annexure 1

Guiding Principles for Biodiversity Conservation Strategies in Himachal Pradesh*

The following "guiding principles" were outlined by the Executive Committee of the Himachal Pradesh team for the BCPP. Though they are given with reference to H.P., their applicability and relevance for the rest of the country merit consideration here.

1. **Biological diversity must be protected over the entire landscape.** Instead on focusing on a few "hotspot" areas only, state efforts must change towards sustainable management of bio-resources over the entire state, and reorient development programmes and policy towards such an end.
2. **The socio-ecological unit for a conservation-oriented natural resource management should be the village (or a group of contiguous hamlets), variously and flexibly defined to suit the diverse socio-ecological communities across the state.** The present administrative divisions of the natural landscape clearly reflect revenue considerations above all else.
3. **The diversity of livelihood strategies also needs protection for effective conservation.** As livelihoods are linked to the state of the local ecosystems in a positive manner, the interest of local communities in protecting and regenerating the same will be renewed. To date, the fact that livelihood requirements are being met at all is accidental, as the management objectives of the government departments have never encompassed subsistence requirements of local communities, leave alone new livelihood opportunities. Linking the continuing good health of local ecosystems to new livelihoods calls for a radical redefinition of the management priorities regarding public lands and waters, from being suppliers of industrial or commercial produce for distant users, to the production of resources for local livelihoods.
4. **The prevailing "rights" regime, which recognizes only individual rights devoid of responsibility of sustainable use, needs to be changed in favour of a community right.** New institutions will have to be created to undertake the responsibility of judicious management of natural resources, in the interest of the present and future generations -- the most important of which would be at the local level, a group of users with common interest in a particular patch of forest. Suitable measures would need to be undertaken to ensure democratic functioning in order to address issues of class and gender equity. The role of the forest department will have to be suitably redefined to facilitate enforcement of the management priorities of the local units.
5. **Clear mechanisms to compensate direct and indirect costs incurred in conservation efforts need to be evolved.** If the state's natural resources are to be sustainable managed, it is absolutely essential that ecological limits to extraction be fixed and appropriately divided amongst the various users, the first charge remaining with those local communities who are protecting and managing the resources. The mechanisms for the above purpose should also ensure that appropriate costs are passed onto those users of forest produce who are not protecting the forest.
6. **Positive incentives, economic as well as extra-economic, need to be constituted to promote local conservation efforts and to protect existing systems of sustainable use.** The use of policing and penalties is inadequate to promote and encourage individuals and communities in conservation efforts. While regulation and associated structure of penalties should be under the supervision of the local management units, assisted by the state's organs, public policy should be geared towards constituting positive incentives to individuals and communities designed to promote conservation-oriented development.
7. **Efforts must be made at the societal level to encourage positive changes in people's attitudes towards biological diversity and its conservation.** Concern regarding conservation is usually restricted to those elements that are being used. Even the traditional religious protection which provided sanctuary to the entire spectrum of biodiversity is progressively declining in extent and influence. Legal changes without a social base and an enabling environment lead to distortions that can completely subvert the objectives envisaged in the legislation. The involvement of the teaching community and the students in conservation efforts would inculcate the ecological ethic in the next and future generations. Deployment of students in monitoring local biodiversity and assisting local management units in resource planning would raise the level of interest of the students in local ecology and conservation issues. This would require a redesigning of the school and college syllabi as well as a reorientation of the teaching community.

Table 1 (below), **Common Elements of BCPP Microstrategies**, illustrates the village-wise distribution of major microstrategy elements, accompanied by explanatory notations and examples chosen to point to the wide range and diversity of the voices from the field. This table is merely an aid to provide an overview of the microstrategies actually generated at each site. Absence of a cross should not be taken to necessarily indicate a rejection of or lack of interest in a particular idea; rather, it simply indicates that the microstrategy element in question was not specifically mentioned as a part of that site's conservation strategy.

*Based on *Nature in Retreat* pp. 40-42 (Chhatre, Kothiyal, Sharma)

Table 1: Common Elements of BCPP Microstrategies

				Policy and Law								Economics					
S.No.	State	BCPP SITE (*complete data for these sites, as indicated, was not available as the source document was an abridged, oral English translation from the original Hindi report. Some additional details were provided by the investigators.)	Presence of ongoing conservation efforts	Want recognition of local body for resource mgmt.	amend WLPA	amend Panchayat Act	punish / stop poaching, smuggling, etc.	modify NTFP / LAMPS laws	public land reform/change in prop. rights regime	expand Joint-Mgmt pgms	more govt. subsidies	open to alternative energy sources/ tech	econ. incentives for BD cons./ outside financing for efforts	better crop damage/ livestock predation compensations	desire alt. sources of income/employment	cultural or eco-tourism / ecodevelopment desired
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	A&N	Middle Andaman	x	x	x	x	x								x	
2		Neil Island	x	x	x	x	x			x	x		x			
3	ASM	Bhuban Hill		x			x		x			x			x	
4		Dibru-Saikhowa WLS	x	x											x	
5		Haflong and Jatinga		x					x		x	x			x	
6		Loharbond		x					x			x			x	
7		Lumding		x					x		x				x	
8		Majuli Island		x		x					x				x	x
9		Nameri National Park				x	x			x	x	x		x	x	x
10		Rani-Garbanga	x	x				x	x		x	x			x	
11		Sat Beel	x	x												
12		Sone Beel	x	x	x				x		x	x			x	x
13	BIH	Bimbandh WLS	x	x		x	x	x		x		x		x		x
14		Dalma Hills	x	x		x		x					x	x	x	x
15		Hazirabagh	x	x		x	x				x	x	x	x	x	
16		Kanwar Lake & WLS				x			x	x	x		x		x	x
17		Palamu Tiger Reserve	x	x		x			x					x	x	
18		Saranda Forest	x					x		x		x		x	x	x
19		Udaipur WLS		x	x	x			x	x			x	x	x	x
20	H.P.	Banet		x	x	x			x				x			
21		Graman-Panjaund*	x	x	x		x	x	x	x				x	x	
22		Kamla*	x	x		x			x				x			
23		Kathog*	x	x		x							x	x		
24		Nanj*		x		x		x	x				x	x		
25		Pammad*		x	x	x		12	x				x	x		
26		Rajain*	x	x		x				x	x		x	x		
27		Sagnam*	x	x		x							x	x		
28		Shanshar*			x								x	x		
29		Thalli*	x	x	x	x			x					x		

Contd. . . .

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
30		Upraila*		x	x	x			x				x	x		
31	KAR	Holanagadde	x	x	x	x	x		x	x	x	x	x	x	x	x
32		Mala	x	x		x	x			x			16	x		
33		Merkal	x	x	x	x	x	x	x		x	x	16	x		
34		Neralkoppa	x	x	x	x	x	x	x	x	x	x	16	x		
35		Sirsi		x				x	x			x	x			
36		Subrahmanya	x	x		x	x				x		x	x	x	
37	ORI	Bhitarkanika WLS			x					x				x	x	x
38		Krushnanagar	x	x		x	x			x		x			x	
39		Chilika Lake	x	x	x		x		x							x
40		Dhani Reserve Forest	x	x		x									x	
41		Similipal Tiger Reserve		x	20		x	x	x	x				x	x	
42	RAJ	Baran*		x		x		x				x			x	
43		Bichiwara		x		x	x	x	x	x	x	x	16			
44		Doli*	x	x		x			x	x			x	x	x	
45		Kewara	x	x	23	x	x	x	x	24	x	x	x	x		
46		Mathurawat-Rajor-Garh	x	x	x	x	x	x		x						
47		Phulwari Ki Nal WLS	x	x	x		x	x		x						
48	UPH	Dun Valley	x	x		x						x			x	
49		Kumaon-Garhwal	x				x		x	x	x	x	x			x
		TOTALS (out of 49 sites)	31	43	19	32	20	16	26	20	17	19	24	25	26	12

Notes for Table 1

1. *Middle Andaman:* Quarterly mass communication of the common people, to raise aware about BD and to inspire them to conserve bioresources. A cultural program/video on different ecological consequences in the world could be arranged by the Gram Sabha.
2. *Neil Island:* Much of the responsibility for conservation is to be borne by the Mahila Mandal, but there is no indication that the womenfolk were part of the discussion leading to this.
3. *Bhuban Hill:* The Church is envisioned to play a major role in resource management, together with a Village Development Council (VDC) consisting of elected members from among the villages. Individual landholders would be expected to pay additional taxes in exchange for a share of resource partitioning, which would entrust them with the responisibility of sustainable forest use.
4. *Halflong and Jatinga:* Introduction of prizes and incentives in the form of kind (not cash) to popularize nature conservation efforts.
5. *Lumding:* Farmers are interested in entrusting a committee of FD officials, traders, and saw mill owners with the responsibility of sustainable-use forest management.
6. *Rani-Garbanga:* Diversion of the Guwahati Refinery effluents away from the beel.
7. *Sat Beel:* Prevent the proposed conversion of the beel area into a bus terminus.
8. *Sone Beel:* Temple / mosque ponds should be stocked with fish, to conserve gene pools.
9. *Saranda Forest:* Eco-theological schemes should be prepared.
10. *Udaipur WLS:* "A group of young men" will form the committee to plan and execute BD conservation activities.
11. *Banel:* Government should employ a watchman to control the harmful activities of nusiance species, provide for their foods in the forests, or make efforts to annhilate species that are destroying crops and pastures (including monkeys).
12. *Pammad:* Changes must be made in FD policy which allows contractors to exploit forests but prohibits villagers from taking even leaf fodder.
13. *Holangadde:* Some part of the paddy fields should be reserved for growing traditional varieties; those who participate should be honored and rewarded. Other "eco-friendly" efforts should be noticed and rewarded with public feliciations, cash awards, prizes, etc.

Contd. . . .

Table 1 *(Contd.)*

Economics			*Education and Awareness*							*Gender*			*Other*	
impose a tax on "outsider" use of bioresources	*impose a fine on offenders of BD conservation efforts*	*organize cooperatives (e.g., cottage industry)*	*awareness programs/camps*	*outside training/help (eg. NGO)*	*more info on govt policies*	*changes in educ. curricula*	*more studies on local issues*	*continue monitoring of BD / PBR-style exercises*	*improve communications with govt officials*	*women should be on VFCs*	*increase role of women in decision-making*	*special targeting of women's organizations*	*see accompanying notations*	*BCPP SITE*
18	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*3*
		x	x					x					1	Middle Andaman
						x	x		x			2		Neil Island
x						x							3	Bhuban Hill
		x		x	x			x						Dibru-Saikhowa WLS
x				x			x						4	Haflong and Jatinga
x						x								Loharbond
x				x		x							5	Lumding
	x			x			x	x	x			x		Majuli Island
				x				x	x					Nameri N.P.
				x	x	x		x	x				6	Rani-Garbanga
x													7	Sat Beel
x	x		x	x		x	x	x					8	Sone Beel
		x		x		x	x	x						Bimbandh WLS
		x	x				x							Dalma Hills
								x						Hazirabagh
x		x	x					x						Kanwar Lake & WLS
x			x					x						Palamu Tiger Reserve
			x			x							9	Saranda Forest
		x						x					10	Udaipur WLS
	x		x							x	x		11	Banet
														Graman-Panjaud*
x	x									x				Kamla*
	x								x					Kathog*
x	x													Nanj*
														Pammad*
x	x		x											Rajain*
									x					Sagnam*
														Shanshar*
														Thalli*
														Upraila*
x	x		x	x	x	x	x		x				13	Holanagadde
x	x	x	x	x	14	x		x					15	Mala

Contd. . . .

18	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*3*
x			x			x		x					17	Merkal
x			x	x	x	x							18	Neralkoppa
		x		x										Sirsi
x			x	x	x	x	x	x	x				18	Subrahmanya
			x	x										Bhitarkanika WLS
														Krushnanagar
		x	x			x				x				Chilika Lake
				x					x		x	19		Dhani
		x	x	x										Similipal
x			x	x		x		x					21	Baran*
x	x	x	x	x		x		x	x				22	Bichiwara
x		x	x	x		x								Doli*
		x	x	x		x		x	x				18	Kewara
x		x	x	x	x	x			x					Mathurawat-Rajor-Garh
			x						x				25	Phulwari Ki Nal WLS
x			x										26	Dun Valley
		x	x	x			x	x	x			x	18	Kumaon-Garhwal
21	10	15	24	22	7	19	9	18	14	3	2	4	x	TOTALS

14. *Mala*: More information regarding patents and IPRs (intellectual property rights), especially*Mala:* There should be a public evaluation of development projects. In this case, the Cogentrix project is causing anxiety as environmentalists are perceived as "anti-development" and "grassroots people" who might play a decisive role are confused.
15. *Mala, Merkal, Neralkoppa, Bichiwara:* Link annual development grants with conservation.
16. *Merkal:* Corruption among the FD officials is a major issue needing attention.
17. *Neralkoppa, Subramanya, Kewara, Kumaon-Garhwal:* The PBR should be used as documentation for use in commercial application issues and have legal recognition as accounts of village intellectual and physical property.
18. *Dhani:* Target tribal women for alternate livelihoods linked to NTFPs.
19. *Similipal Tiger Reserve:* Tigers should be bred and released in the wild, to increase their population and allow them to resume their role of forest protection.
20. *Baran:* Membership in the VFC would be restricted to one member per family.
21. *Bichiwara:* Frequent interactions with the neighboring villages dependent on the same resource catchment would help the cause of conservation; neighboring villagers should be called to attend meetings of the VPC. A network or federatino of various village level institutions is also an option.
22. *Kewara:* People want the right to kill the panther. Wolf, monkey and squirrel populations should be controlled.
23. *Kewara:* People feel that JFM hasn't been very successful, but want assistance from the FD in implementing forest works designed by their own VFC. They feel that the bioresources are village property and should be managed without FD interference.
24. *Phulwari Ki Nal WLS:* Solutions must take into account the close relationships of kin and trade between Rajasthani and Gujarati villagers, who will both be affected by any initiatives.
25. *Dun Valley:* Many strategies have been suggested and are already being implemented, most of which do not rely on external inputs.

A People's Plan for Biodiversity Conservation in the Dehradun Himalayas

Ajay Mahajan, Bhupal Singh, Prabhakar Rao and Jaya Iyer

Area and Coverage

As the monsoon meets the ultimate mountain, it pours in gladness.

On the first ranges of the Himalayas, overlooking the Duns, nestling in and atop a water rich valley called Sinsyarukhala, lies the Nahi-Barkot area, in the Malkot region of Dehradun district. Spread over an area of approximately forty square kilometres, it comprises three villages and two hamlets.

A decade ago, the people of this area had rallied together and fought, in valley and apex court, to save their biodiversity and water source rich, ecologically and geologically fragile, hills from reckless limestone mining. In the first environmental PIL (Public Interest Litigation) before it, the Supreme Court had ordered the mine closed.

A coming together of exceptional locational, topographical and precipitational factors, makes this area a meeting point of biodiversity from different ecological zones, the doon valley, the lesser Himalayas, and the upper ranges of the Shivaliks, with some unique diversity of its own.

These hills are also a critical catchment and birth place for a host of perennial springs, and the source (often the only one) of drinking water for twelve neighboring and downstream villages.

Agriculture and pastoralism, equally important and interlinked, are the mainstay occupations of the local people. The locational and climatic factors, mentioned above, have also enabled an agriculture of diverse, indigenous Himalayan crops and varieties, completely rainfed and organically grown.

Realising well the advantages of traditional seeds, the farmers of the area are active participants in the **Beej Bachao Andolan**, a movement to save indigenous seeds from the onslaught of new hybrid varieties, in the Garhwal Himalayas. The movement is sucessfully conserving, *in-situ*; 130 varieties of rice, 150 of rajma (kidney beans) and severak varieties of amaranthus, pulses, millets, vegetables, spices and herbs.

Forty different crops of indigenous himalayan cultivars, some with multiple varieties, are grown in this area, every year.

Cereals such as red wheat, oats, rices, mandua, amaranthus, buckwheat, corn; millets like jhingora and koni, beans and pulses like various rajma (kidney beans) varieties, urad, kulat, bhatt, chana, masoor and tor; oilseeds like mustard varieties, sesame seed and tilphara, medicinal varieties of turmeric and ginger, arbi and red chillies. Vegetables as cucumbers, bitter gourd, a sweet bitter gourd, ridge gourd, bottle gourd, jimikand, kadoo, raddish, fenugreek, garlic, tomatoes, peas, potatoes and coriander.

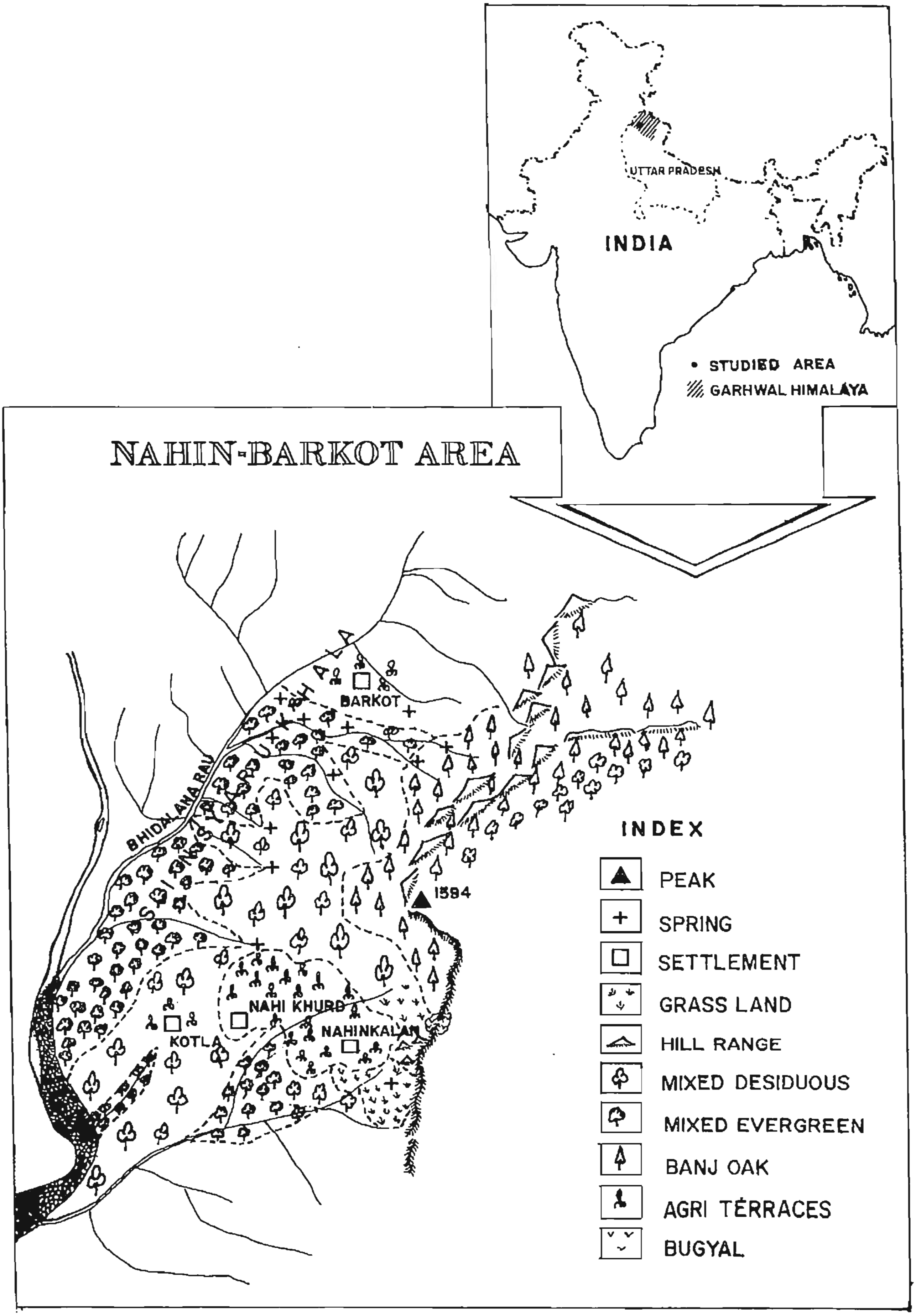
Objectives and Scope

The main objectives of the study were:

- To prioritise for conservation in a participatory manner, local sites and species of high biodiversity value.
- To prioritise participatory strategies for conserving these sites and species.
- To document the process of prioritisation.

  As a corollary to the attainment of the above objectives, given the short time-frame of the study, it was necessary to:

- Learn about the biological diversity of the area — its abundance, distribution, significance and value, and its interconnections with biotic and abiotic components.
- Learn about the local communities knowledge and dependence on the ecosystem it inhabits, especially the biodiversity. Where does the conservation of biodiversity fit, into the overall priorities of the local people ?
- Undertake the above in a way that respreads and enhances local knowledge of, and concern for, biodiversity.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MIXED EVERGREEN
BANJ OAK
AGRI TERRACES
BUGYAL

- Understand and find ways that motivate people to conserve.

Methodology

Participation and involvement of local people was a central feature, and so this study is based heavily on their knowledge and involvement. In the entire endeavor, an exceptionally knowledgeable local person was a critical co-partner.

The methodology was considerably shaped by and improvised along the way due to the possibilities and exigencies of the local situation.

At the outset, a **full village meeting** was held to share the essential objectives and ideas behind the project, and to ascertain the local people's response and suggestions.

Numerous, **intensive, field visits** with Environmentally Perceptive Local Individuals (**EPLI**, from now on) followed. This *saakshatkar* proved invaluable in understanding and assessing the area and the perceptions of the local people.

70% of the local adult population was interviewed. The majority of these participated in detailed and wide ranging individual interviews, the rest in group and household interviews.

The interviews focussed on the following **check list of issues**: ecological changes (eco-oro-history); threats and pressures; local perceptions about changes and threats; local identification of species and sites, their significance and value; conservation ideas; and local needs, hardships and aspirations.

Group discussions, with EPLI and other groups, were important, especially for assessing individual accounts, field visit perceptions and conservation suggestions.

> **Chau Masa and Bio and Work Diversity**
>
> The busiest four monsoon months, *chau masa*, in the local agricultural calender, coincided with the busiest phase of our short term study. As Bhopal, our local coordinator, said, "everything is diverse here, nature, agriculture and our never ending work." Interviews were held as the community sowed, transplanted, or weeded agri terraces; walked forests in search of fodder and wood, or on hill-top meadows, and atop *machaans* by night or day. The only free time for women was post-dinner, which was also the time for sacred celluloid stars and gods.

Care was taken to interview the various categories of people (stakeholders); women and men, different social classes, elderly and young (some very young), those dependent on jobs elsewhere, residents of various scattered hamlets and some outsiders who were regular visitors.

Species Prioritisation: Half of the areas adult inhabitants rated the value of a large number of native floral species on a ten point scale. Their main considerations while valueing species were: utility value, ecological value*, extent of decline and threat, and abundance\ rarity. The extent of decline and threat factor was assessed, separately also. Finally, species were prioritised by collating individual value ratings.

Although utility value of a species was generally considered the most important value by the local people, in many an instance they valued threatened species higher than high utility value species.

Examples of prioritised species are given in the table I, along with their threat status.

Sites Prioritisation: After mapping and listing, all sites were assessed according to the following criteria: Richness and abundance of species, species dynamics and threats; ecosystem functions and utility values; pressures and threats—their intensity, relative importance and the overall threat status; local consensual evaluation of change, during last 20 years and projected over the next 10; extremely ecologically vulnerable (ECO SOS ASAP) sites and sub sites; and suggested conservation strategies were recorded. An account of these site level assessments, is carried in the full report, "People plan for biodiversity conservation in the dehradun himalayas", for the BCPP of the WWF-India).

Sites were prioritised on the basis of richness and abundance of species. Later, on the basis of need and maximum possibility of conservation, strategies for conservation were assessed and chosen, for all sites, irrespective of their priority status.

A full village meeting to finalise strategies. Theatre was tried as a way and method to share back and explore the essential learnings and findings of the project. **Environmental folk songs and tales** followed. Then, the gathering suggested and assessed strategies to counter the major threats to biodiversity. The ideas suggested earlier and shortlisted, were also discussed and finally those considered the most effective and viable were chosen by the community as the optimal strategies.

Interestingly, the women took a lead in choosing the final strategies.

Method Learnings and Comments

Though it revealed very valuable information, an interview, questionairre format was very unfamiliar, dry and cerebral for the local people. They are used to a more conversational and engaging form of communication. Thus, group interviews and discussions were preferred in the second phase.

* Ecological value in terms of water retentivity, slope stabilisation and erosion control properties.

Table I: Prioritised Species Table

Local name	*Botanical name*	*Priority rating*	*Threat status*	*Population decline (% over 20 yrs)*
Trees				
1. Banj	*Quercus leucotrichophora*	9.2	T	50%
2. Amla	*Emblica officianalis*	9.1	S	
3. Sandan	*Ougeinia oojeinensis*	9	ET	80%
4. Semla	*Bauhinia retusa*	8.7	ET	90%
5. Tun	*Cedrela toona*	8.5	T	50%
6. Shisham	*Dalbergia sissoo*	8.5	ET	80%
7. Gainthi	*Boehermia ruguloso wedd.*	8.4	T	40%
8. Timla	*Ficus roxburghi*	8.3	T	40%
9. Dalchini	*Cinnamomum zeylanicum*	8.4	ET	80%
10. Bheemal	*Grewia optiva*	7.8	S	
Bushes and Shrubs				
1. Bhararha		8	T	70%
2. Khaksa	*Cornus marophylla*	7.5	T	40%
3. Kingorha		7.4	T	80%
4. Hinsar		7	T	50%
5. Saikna		7	T	40%
6. Kharainti		7		
7. Semali	*Vitex negundo*	6.6		
8. Gandhela	*Murraya koenigii*	6.5		
9. Itholna		6.3	T	40%
10. Bansa	*Adhatoda vasica*	6	T	40%
Vines				
1. Turarh		9.4		
2. Malu	*Bauhinia vahlii*	8.66		
3. Giloe	*Tinaspora cordifolia*	8.14	T	75%
4. Gol		7.22		
5. Pahari patta		6.6		
6. Gainthi		6.5		
7. Mainda singhni		6.2		
8. Hatha pola		6.1		
9. Serwala		4.7		
10. Bank		4.6		
Herbs and Grasses				
1. Golda		8.9		50%
2. Ringaal		8.5		
3. Pildu		8.5		
4. Brahmi		7.8		
5. Laingda		7.7		
6. Tachhila		7.7		
7. Bang		7		
8. Kali khatai		7		
9. Junglee gainda		7		
10. Parh kesar		7		

Key for Threat Status: Threatened—T, between 40-60% population decline; Extremely Threatened—ET, more than 60% population decline; Stable—S, less than 40% population decline. All considered over the last 20 years.

A group of EPLI played an integral role. Their first-hand understanding of the multi-dimensional local context makes them invaluable partners in any ecological planning and action for the local area.

> With the help of a theatre person, many villagers and the project team turned into script writers, actors and directors of a play. The idea was to share and explore the essential findings and learnings of the study. The spontaneous involvement and excitement generated by the play and folk songs, highlighted the power of a communicative and experiential way, to and share ideas and concerns. As a village elder said to us, "for any way to work it has to be enjoyable, too."

Importance was given to understanding the needs, hardships, aspirations and attitudes of the local population. This proved invaluable, for overall understanding and for effective biodiverty planning.

Biodiversity Profile and Status

For an area of approximately 40 sq. kilometres, the diversity at both the ecosystem and species levels is striking. *Banjoak (Quercus leucotrichophora)* forests cover the tops and upper reaches of all the hills, and excercise a determining influence on the climate and ecology of the area. Other major forest and landscape types are mixed evergreen and mixed decidous forests, meadows. grasslands and traditional agroforestry terraces.

In our short term study, we identified more than a 100 species of trees, 35 species of bushes, 25 vines and 70 grasses and herbs. For its size, the area has an astounding diversity of medicinal plants and we identified 50 species.

Some important tree species other than *banjoak* are *semla(Bauhinia retusa)*, *bheemal* (*Grewia optiva*), the ficus species - *timla (Ficus roxburghi), pilkha, pilkhi and kabarha; gald, gonta, tun (Cedrela toona), kaula (Machilus duthiei), parhanga, sandan (Oogeinia oojeinensis) and raini\rohini (Mallotus philippinensis)*. Some important medicinal plants are *amla (Emblica officianalis), baherha (Terminalia bellirica), dalchini (Cinnamomun zeylanicum), kingora (Berberis asiatica), gilloe (Tinaspora cordifolia), brahmi, parh kesar and kali khatai*. Many other floral species are yet to be identified.

Local accounts and our field visits suggest an impressive faunal diversity: tiger, leopard, leopard cat, serrow (all in Schedule 1 of India's Wild Life (Protection) Act, 1972), sambar, goral, barking deer (all in schedule 2 of the above Act), Himalayan black bear, wild boar, monkeys, langurs, marten, hare and many types of birds, bees, and butterflies, among others.

Our time constraint and local negative value and limited knowledge of fauna did not permit a detailed study of the area's fauna.

> "Take all the wild animals with you"
>
> This was what the local people said. There is a lot of anger towards wild animals as crop losses to wild animal raiding have doubled over the last thirty years. Wild boars, monkeys and sambar are the biggest crop raiders. Together with the increasingly unpredictable skies this makes rainfed agriculture a risky occupation.

Biodiversity and People - Knowledge and Use

The life and economy of the local community is immensely and variously dependent on local biodiversity. They have a detailed knowledge of almost the entire range of native floral diversity, especially remarkable in the following categories.

Knowledge of wild fodders stretches over hundreds of species, and includes their special properties and the timing and methods of harvesting. Local and regional *vaids* know most of the remarkable medicinal plant diversity, though popular knowledge is shrinking. Knowledge of some miracle cure and secret plants is restricted by local beliefs, to very few people.

Local food sources from the wild include, numerous fruits, berries, nuts, flowers, leaves and wild tubers. There's extensive and specific to use knowledge of tree timbers, leaves for agri mulching and food preferences of wild animals. Ecological values of plants, particularly water holding, slope stabilising and soil binding capabilities, are known. For fertilisation, the local agriculture is completely dependant on domesticated animal manures, and the main fodder source for the animals is the forest.

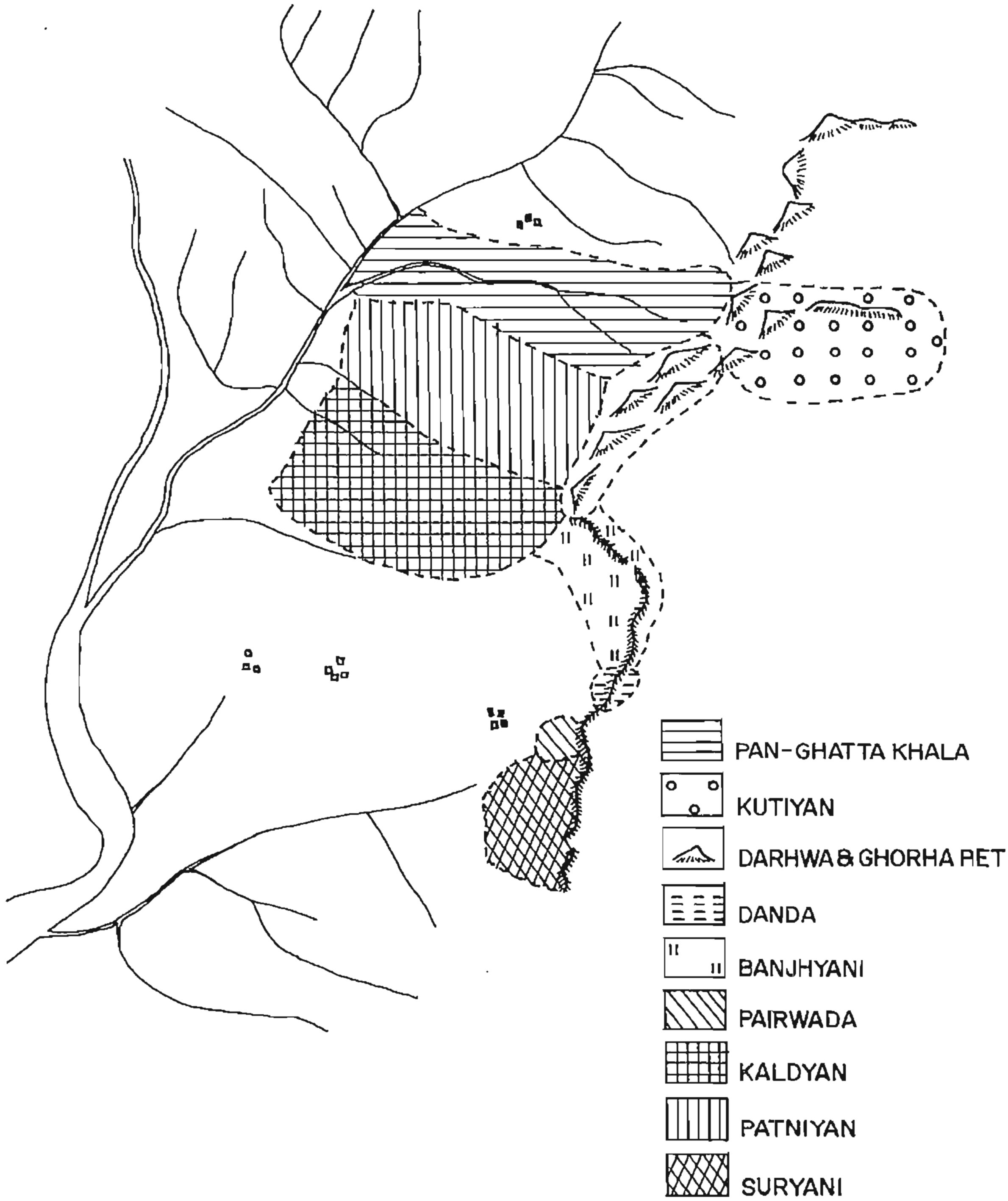
The knowledge base and value of biodiversity has been shrinking of late, especially amongst the young.

Prioritised Species and their Status

Assessment of population dynamics of native flora, over the last twenty years, by the local people, reveal: In a declining and drastically altering biodiversity profile, almost all floral species have declined. Many important (originally even abundant), species are today threatened. The important oak has declined (by half) *sandan* (by 90%), *tun (Cedrala toona), timla (Ficus roxburghi), parhanga, gald, gainthi* (all by about half). The abundant bushes *bhararha* (by 70%), *khaksa* and *saikna* have declined steeply too. The golden, chosen fodder grass, *golda*, is down to half.

The hardy, high value, once abundant *semla (Bauhinia retusa)*, has declined by 90%, mainly due to excessive

PRIORITY SITES



tapping for gum. Similar is the fate of all other plants targeted by medicinal plant contractors. *Kingora (Berberis asiatica)* and *dalchini (Cinnamomum sp.)*, have declined by 80% and *gilloe* by 75%.

Status of Prioritised Sites

A local consensual evaluation of extent of degradational change for all sites, over the last twenty years and projected over the next ten, reveals the following picture.

The minimum degradational change on any site over the past twenty years is 50%. If current trends continue, six of eight priority sites are fully likely to be devastated by the end of the next ten years, with no diversity worth the name.

The two biodiversity richest sites, one the home of numerous springs, *Panu Khala* and its catchments, *Darhwa* and *Ghorha Peti*, have seen degradation estimated at 50%, which is likely to go upto 70%, over the next ten years.

Suryani, once a site of hundreds of oaks, is today colonised by *kala bansa* and frequent landslides. Locals estimate the extent of change at an unbelievable 99%.

Pan Eco Bio Changes

Any way we look at it, enormous biodiversity loss and ecological change has occurred and is underway, across the area. Local people estimate the overall forest loss\degradational change, at seventy percent over the last forty years and at more than half, over the last twenty. The major changes are briefly stated in the following box.

Major Changes—At a Glance

* The most severely degraded and altered biodiversity component is ground level flora, especially the browsable species.
* Of the twenty perennial springs in the area, six have dried up. Water in eleven of the remaining fourteen has decreased, in many significantly, all over the last twenty years.
* The *joharhs* (here hill top ponds), are today silted. Local people spoke often of the hills being much drier, with profound consequences for the entire ecosystem.
* A sharp rise in crop losses to wild animals.
* Degradation of vegetation and soil loss on steep and fragile slopes has led to ten serious landslides and numerous landslips. Many sites are completely eroded of top soil. On degraded sites, the slopes have steepened further.
* There are almostz no young, baby trees and no real elderly one's either.
* *Kala bansa*, the exotic weed, is the commonest plant today, colonising many sites and threatening others. At 4500 ft, the well known *Lantana camara* has arrived and colonised one subsite.
* The weather is warmer, drier and near impossible to predict (and that for a rainfed farming community).

A local person felt the future, if current trends continue, would be "like the end of a *khalnayak* (villain) in a Hindi film."

Threats and Pressures

A detailed assessment of all major threats, overall and on each site was compiled. Given below is a summary of the major threats.

Increasingly frequent (especially between 1990-95) forest fires, were assessed as responsible for more than half of the floral diversity loss. There have been no attempts, forest department or local, to prevent or control fires for the last forty years.

Nomadic and local goats are the second biggest threat. This threat can be understood fully only by keeping in consideration the steep, fragile and often degraded slopes of the area.

The new, callous, non-regenerative methods of fodder and fuelwood extraction have enhanced the traditional local use pressures.

What happens when pure commerce chases wild medicinal plants has been stated earlier (Status of Prioritised Species). Where the targeted species, *semla (Bauhinia retusa)* and *kingora (Berberis asiatica)*, were dominant or abundant, excessive exploitation set off the process of degradation, of the entire site.

The above primary threats have led to severe soil erosion, landslide and slip rubble. These and post fire conditions are ideal for the rapid spread of exotic and other weeds, which today colonise many sites. These consequences of degradation are the new threats to biodiversity.

The result is an intricate degradational dynamic in full swing, with some variation across sites.

A Local Biodiversity Imperative

Numerous landslides and slips on degraded sites suggest that without a dense vegetational mantle these steep, heavy rainfall receiving hills, where a majority of the rock types are weak, heavily striated and\or loose, are likely to start rolling in numerous landslides.

Hunting is a traditional activity, and in a scenario of sharply increased crop losses to wild animals, it is seen as necessary to keep their populations down. Even gentle elders speak of shooting all the animals. The big constraining factor is a shortage of firearms. Hunters from outside also frequent the area.

The biggest forerunner of all external threats, was reckless limestone mining, from 1962-86. In 1988, after an agitation, it was halted by the Supreme Court, here and in the entire Doon valley.

On these biodiversity and water source rich, ecologically and geologically fragile, outer Himalayan slopes, any revival of mining, for limestone or other minerals, would be disastrous.

Local peoples need for a road into the area is another potential threat to biodiversity. A threat they were unable and unwilling to see at the beginning of the study. Many discussions later they are keen to minimise destruction in the making of a road, on steep fragile slopes. There is also a greater awareness of the threats (to biodiversity etc.) that may follow a road into the area.

Changing Local Perceptions and Attitudes

The sweeping degradational changes can be understood more fully only through the changes in local perceptions and attitudes. Especially for the young there is a loss of a sense of shared fatedness with the forest. This was strikingly evident during the forest inferno of 1995 when even as the forests were aflame, the locals kept lighting more fires, as elsewhere in the Lesser (Garhwal) Himalayas. Local people have been directly or indirectly responsible for much of the degradation of the local ecosystem. This is despite the fact that their livelihood and habitation depends on the health of the ecosystem. Ironically, this is also the very ecosystem they were staking their lives to protect ten years back. What has gone wrong ?!

Lack of livelihood and employment opportunities, a strong feeling of neglect, unfulfilled needs and aspirations, all these have contributed to the change. With their success of their agitation against the mine, local people lost the nearby road. Petitioning and pleading with the government for a road and for education, health and electricity has not yielded any results. Other than disillusionment.

As the extent of change emerged clearly, a mind-baffling realisation hit us. Over the last ten years, the area has seen at least as much biodiversity loss, as the mine had brought about in twenty five. While its true that degradation started with the mining and medicinal plant contractors and local attitudnal changes came later. At the same time, it appears that long governmental and societal neglect of people's hardships and aspirations and the inability to see peoples needs from behind the blinkers of an "ism, be it an environmental one, can unleash forces as powerful as the well recognised and patently destructive one's.

At the outset we were repeatedly told that the community no longer gathers for discussions and meetings, leave alone for solving common problems. The communities involvement in an ongoing watershed project was dismal, and it was widely believed that the benefits were being cornered by a few individuals. All this made us seriously wonder about the point in prioritising for conservation. Could this community come together to conserve?

However, as the study progressed, all worries on this score were laid to rest. To our surprise, our short-term study sparked off some heartening developments.

Positive Indicators

- Interestingly, the study set off a process of the community prioritising it's own needs and hardships. Stepping further, they got together in action, to seek solutions to some shared problems.
- Over the question of education, on 15th August 1997, people got together in a Golden Jubilee Celebratory Protest. Meetings with administrative and educational authorities followed, a Parent Teacher Association was constituted and today the village's school teacher, is more regular and responsible to the local community.
- The community is more involved and for the first time serious about protecting village areas under the Doon Valley Integrated Watershed Development Project. Two years and much else down the line, the first energetic, decisive and fully participatory meeting was held. The situation is nearer a consensus on keeping cattle and goats away from planted areas.
- Some important strategy implementation has begun. Latest news is, the strategy of not selling the forest to nomadic goatherders (the second biggest threat), was implemented for the first time, this winter. For the (increasingly) determined and assertive village women, this was the foremost strategy, and one they've campaigned for years over. (For more see, Strategy for Goats).
- There was clearly more widespread and immediate awareness of biodiversity and the ecosystem at the time of strategising than at the beginning of the study.

Strategies

All the strategies in this section were chosen and strongly endorsed by the local people and most were suggested by them. Hence, this section is an Action Plan for Biodiversity Conservation, made by the local community.

The chosen strategies fall into four broad levels/types:

(a) Threat Level Frontal Strategies.
(b) Site and Species Level Strategies.
(c) Local Need, Livelihood and Conservation Link-Ups.
(d) Other Important Strategies

Threat Level Strategies

Most major threats have a sweep across all sites and many even across the species, of the area. Depending on the nature of the threats, local needs and attitudes, these main threats have been taken on frontally and fully, rather than merely at a prioritised species and sites level. It is believed that a broader strategy would have a positive impact on biodiversity, across the area.

Fire Out the Forest Fire

For the biggest threat, this is a high priority, detailed strategy. A strong anti-fire shift in local consciousness and the fact that forest fires are not linked to any local need, opened big possibilities.

Preventing Fires

The emphasis was strongly put on prevention, not lighting and letting fires start. The final local gathering expressed an emphatic, "we won't let it happen !".

For greater fire proofing, and to make the nascent local attitudinal shift long lasting, the following methods were chosen:

An Awareness Campaign comprising meetings, posters, boards, street theatre, slide shows, songs and slogans. An interesting suggestion was spots on Doordarshan and Akaashvani(A.I.R), as village folk are avid, earnest audiences and a countrywide impact is possible.

Fire Lines, by clearing mule roads and forest paths of inflammable leaves and carrying them to underfertilised agri terraces, far from the village. Local people liked this idea of twin benefits.

Ensuring that **Fires from Agri Terraces,** do not move into the forest, will now be the responsibility of lighters.

Controlling Fires

But,"what if fire, somehow, does get lit ?", we asked.

"*Hum Bujhayenge* !" We will go and put it out !!! they said. But no one has put out a forest fire here, not for forty years. On this query, raised hands and voices filled the room, "I will", "yes", "we will".

After all this if someone still lights a fire...?, we asked. The community supported the forest departments important role, of enforcing the law, of fines and confinement. The FD's campaign and warnings, post the 1995 inferno have made a deterrent difference. Secondly, the FD's Fire Patrol should comprise of local people, as appointed outsiders simply never reach the forest.

Goats

Migratory goatherds alongside local goats are the second biggest threat. The goatherders have been coming to the area for the last thirty years or so and pay the village some money in lieu of grazing a thousand head of goats over three to four winter months. The goatherders were unavailable and these here are the local people's prioritised strategies.

> Migratory goats were the foremost issue for the women, who hold them responsible for the unprecedented fodder shortages. During the course of the study, the shepherds offered to double the money they pay to the village. The men got tempted, but the women put their foot down. "Fifty thousand or a lakh, we don't care about the money. We'll chase the goats if they come. *Hum to nahin dain dinda.*"

It was decided that migratory goats shouldn't be allowed into the area. Other than in passage.

Local Goats: The enormous pressure of concentrated goat grazing on degraded common lands near the village needs urgent attention.

Local tradition was revived and areas above water springs were declared out of bounds. Attempts will also be made to keep goats away from other degraded areas, including areas under the watershed project. For more on goats, see watershed section in the fodder and fuelwood strategy. Some locals also mooted the idea of a "goat tax", as a disincentive to keep goat numbers in check, the money to be used for local ecological regeneration.

Halting The Bio Invaders

Videshi Kharpatvars

Kala Bansa (Pogostemon plectron thoides) (KB)

Local people would love to eradicate it, if only they knew how. Yet, alongside being a threat to biodiversity, KB is playing a major ecological role of soil conservation and slope stabilisation.

Field studies suggest that the optimum strategy is to **reduce pressure on native diversity and put pressure on KB,** thereby supporting native diversity in its attempt to compete with KB.

Another way is to **bring KB to some use** and create some hitherto nonexistent pressure on it, through the following ways:

(a) It is an excellent source of organic manure, tried during the study with excellent results.
(b) Technology for extracting natural dyestuff of green, yellow and grey colours from KB is known to us. Ideal for local wool and natural fibre ropes.
(c) Its an exceptional local medicine for cuts and wounds. We've seen big wounds being healed by it, including some on our own feet. A marketable medicine could be developed.

Turning Bio-Invader to Bio-Restorer

On the degraded slopes of the watershed project site, KB is forever threatening to overrun the planted saplings and prevents the revival of native flora. Most of the thousands of saplings have died and the remaining are struggling.

A Way Out: Uproot KB from around the saplings and place them in lines above and below the rows of saplings. Thus forming rows, of herbacious bush contour bunds. This will provide growing space and moisture retentive mulch and manure, for the planted and trying to revive native diversity. KB will be suppressed without erosion and slope destabilisation, and soon small terraces will form.

Lantana Camara

At 4500 feet, its arrived, acclimatised, colonises one site and is ready to boom. Evokes local concern, but sans action, so far.

A combination of control methods comprising uprooting and cutting in two separate patches as a control experiment, was chosen.

Fodder and Fuelwood

As a strategic counter to the newly in vogue, non-regenerative methods of tree fodder utilisation, some simple principles that must be followed (based on local time-tested knowledge and beliefs), were chosen.

Some Principles of Tree Fodder Utilisation

Choti Na Kata __ Don't cut the tree tops. A strong local traditional belief. Many trees die if tops are cut.

Mota Phanga Na Kata __ Don't cut big branches of trees. This harms the tree and can even kill it. Seeds of many trees form only on uncut branches.

Chhote, Bachhe Perh Na Kata __ Do not cut small, baby trees.

Treating Forests Like One's Own: Living local examples of regenerative utilisation are numerous trees on private and common lands, under individual family control. From here fodder and fuelwood are extensively collected without any signs of degradation.

Watershed for the Watershed Project

The possibility of conserving by protective closing of areas, was severely limited for us. A watershed project had recently fenced off and planted with trees, extensive and degraded common lands near the village. But the fencing was only in name as the local people were not ready for it and had in fact, never intended to keep their goats, cattle and themselves outside. Today, people are more together about regeneration, not letting in goats and cattle and backing the guards. But, much more needs to happen if the lakhs spent under this project are to amount to something.

The current contextual viability of closing more areas was uncertain. Priority areas for long, short and ultra short term protection and rejuvenal breaks were identified. As this idea needs at least majority support to work, the village Paryavaran Samiti will take final consensual decisions on this matter.

For **Fuelwood,** only dry wood, gathered or cut, should be collected as far as possible.

Awareness, Sensitisation and Training

The need for awareness and sensitisation about appropriate, regenerative methods of utilisation, was felt. Main target groups are young boys and women recently married into the village, believed to be the prime exponents of the new, callous, methods.

Non Tree Climbers, tend to cut big branches and whole young trees. They will be encouraged to go to the forest with tree climbers.

Oaks must not be cut to make vine stakes as there are various other appropriate and less destructive options.

Energy Alternatives __ Bio Gas and Smokeless Chulhas

The large number of diverse livestock and much wasted dung, makes this area particularly suitable for bio-gas plants. There was great local support as the many benefits include drastically reduced fuelwood use and easier and better manure preparation.

Another appropriate choice for which people are ready is smokeless chulhas, as the current chulhas are energy inefficient and the small kitchens are filled with heavy smoke.

Medicinal Plants

Jarhi Bootiyan ya Thekedaron ki bootiyan?

Contractor driven extraction of some valuable medicinal plants like *semla, kingora* and *gilloe* has almost wiped them out from the area. These plants need a regenerative rest.

There should be no medicinal plant extraction through the contractor system, as this is driven by pure commerce, with no thought for sustainability and regeneration. When sustainable, medicinal plant collection should be undertaken only by a village cooperative or samiti, with a stake in long term conservation.

As the area has spectacular floral diversity, comprising of a large number of native medicinal plants, a local biodiversity garden, with focus on medicinal, threatened and economically useful plants could be grown. As this area is a meeting point of biomes, plants from the larger region of the outer Himalayan range, with altitudnal and climatic similarities, could also be grown.

The local people are interested in growing economically viable medicinal plants. These could be grown on the many agricultural terraces that are threatened by, or abandoned because of, wild animals. Experiments in the nursery garden can identify locally cultivable plants.

The People Wildlife Conflict

The finding of a substantial solution to crop raiding is a strong local priority. And the consequent reduction of the people - wildlife conflict is the necessary beginning to any faunal conservation initiative.

Pros and cons of numerous options were assessed. A two pronged strategy was chosen.

The first part is ensuring adequate water and food availability in the wild animals habitats. A pond\lake strategy (described later) can augment water availability in the forest, thereby removing the need for wild animals to come to the villages in search of water. Other strategies, especially those for controlling fires and goats, should help in ensuring that adequate food for wild animals is available in the forest. Local people also suggested that fruit and other trees (like timla, chhanchri, oak,...) that wild animals like, could be planted for them in the forest.

Secondly, to make crop raiding more difficult, the following promising methods need to be tried. However, a search for other, better, methods needs to continue.

Consolidation of scattered and fragmented holdings and\or dispersal of the village, putting up of more tands/ machaans (small, temporary watchtowers), making a barrier between the fields and the forest, using lights, torches and crackers to scare the animals, lighting cowdung cakes, playing taped sounds, targeting the alpha male monkeys and planting non-favoured crops.

ECO - SOS - Asap

Extremely vulnerable areas, mostly landslide and slip sites needing immediate attention, were named ECO SOS ASAP sites. The topographical and geological profile coupled with degradation (described earlier), makes this a very serious, snowballing threat, with numerous adverse consequences.

ECO SOS sites and subsites were identified and strategies chosen and eco and biodiversity restoration on them is seen as a priority. Attempts to undertake the above under the ongoing watershed project for village lands are on. However, additional help will be needed for those on forest lands. The Paryavaran Samiti (described later) could oversee and facilitate this process.

Livelihood - Conservation Link Ups: Bio Eco Hum Dev

To address the local shortage of income and employment opportunities, it was thought that the biodiversity conservation imperative could be linked with sustainable local livelihoods and incomes, thus increasing the conservation stake of the local community. The long term conservation impact of bringing in monetary value may be unpredictable, but our own and others experiences, in the Garhwal Himalayas, and elsewhere, of finding and developing sustainable uses of wild and cultivated diversity, emboldened us. However, in choosing species and developing processes for their utilisation, sustainable use had to be a paramount concern.

A Unit to Make Natural Products from Wild Diversity

The following species and products were shortlisted as appropriate, after assessing abundance, sustainable use possibility, and technological and marketing feasibility of products: various products of amla (jam, achaar, mouth freshener cum chooran, candy\murabba etc.; a burans (Rhododendron arboreum) drink, amarha and lassoora pickles and curry leaf powder. The organically grown Himalayan varieties of turmeric and ginger are also ideal for value addition.

To ensure hygienic conditions and quality control, essential in food processing but difficult to achieve at the household level, it was thought desirable to set up a small scale production unit in the area.

A Bheemal Unit

The bark of the small branches of *bheemal (Grewia optiva)*, contain a natural, anti-dandruff, shampoo, used for centuries by the hill people. A dry and\or liquid shampoo can be developed from the same. As it is also a gentle and yet effective cleaner of clothes, a soap, in liquid or bar form, could also be made.

Ropes from the beautiful golden fibres of *bheemal* could be dyed with locally available natural dyes, especially the one's made from kala bansa, the bio-invader. ***Pan Chakki* (Water Mill)**

A local need often spoken about was the re-installation of a water mill (*chakki*) to grind cereals and other produce. As locals are well aware, the available water is just enough to keep the chakki going. This would add to the local motivation for conserving water sources and their catchments.

Other Important Strategies

Hill Top and Other Ponds and Lakes_The Joharh Idea

The hill tops of the area have some big and small, natural and human made, *joharhs* (lakes and ponds), which have considerably silted up. Revitalising existing and making new joharhs and water holes, wherever possible, could help in:

- Providing drinking water for wild animals, cattle, birds and people.
- Recharging natural springs.
- Watershed treatment.
- Control of soil erosion.
- Enhancing the severely reduced moisture availability and regenerative capacities of the ecosystem.

To maximise benefits, as many joharhs as possible should be made. Ways to finance their maintenance, as and when needed, were also identified.

Bamboo

With its great sustainable use possibilities, bamboo has enormous scope as a multi-purpose wood substitute, as a raw material for handicrafts and for many other uses.

Paryavaran Vikas Samiti

A local organisation, with environmental conservation as its priority and sensitive to local needs and hardship, was mooted by several local people. It also has the critical role of organisational backup for strategy implementation.

Some specific priority areas are:

- Awareness programmes and campaigns: especially on fire, goats, fodder-fuelwood, local knowledge gaps (like ecological roles of big and small fauna) and the interconnectedness of it all.
- Projects that link up environment conservation with local needs and livelihoods. A percentage of all proceeds will go to build a local fund for priority environmental initiatives.
- Choosing areas and building consensus for their protective rotational closing.
- Addressing other (including new) threats.

The Prioritised Strategies Table, table II below, gives a clear idea of the role of the local community (column two) and the outside support needed for the implementation of the prioritised strategies (column three). The strategies are further rated according to their urgency and importance for biodiversity conservation (column four). The Table also reveals that the local community has taken upon itself a major role in implementing the conservation strategies.

Table II: Prioritised Strategies Table

Strategy	*Local Initiative*	*Outside Support*	*Priority Rating*
Fire			
Prevention			
(a) Awareness Campaign	Major	Resource persons (environment, theatre), funding.	I
(b) Making Fire Lines	Entirely	--	
(c) Preventing spread of fires from agriculture.	".	--	
CONTROL			
(a) Putting out fires	Major	Forest Department (FD)	
(b) Penal action against fire lighters	"	"	
Goats			
Nomadic	Major	Suggestions for	
Local goats	Entirely	funding village panchayat	II
Controlling Bio-Invaders			
Kala Bansa (Kb)			
(a) Putting pressure on KB, reducing it on native diversity	Entirely	--	
(b) Creating utility pressures			VII
i) Making manure			
ii) Natural dyes			
iii) Medicine	Major	Know-how & small funding	
(c) Bio-invader to eco-restorer	"	"	
Lantana			
Control experiment	Major	Daily Wages	
Fodder & Fuelwood			
(a) Adopted principles of fodder utilisation	Entirely	--	
(b) Watershed for Watershed project	Major	Ongoing, under Watershed Project	VI
(c) Out of bound for cattle	Entirely		
(d) Sustainable utilisation of fuelwood	"	-- .	
(e) Awareness and training	Major	--	
(f) Alternatives-biogas &smokeless chulhas	Partial	Resource persons Green technology, subsidy	
Medicinal Plant Conservation			
(a) Abolishing contractor system	Major	For policy change	VIII
(b) Biodiversity garden	Major	Funding	
People Wildlife Conflict Reduction			
(a) Food & water for wild animals in their habitats	Partial	Funding	IV
(b) Making crop raiding difficult	Major	Know-how, funding	
Joharhs (Ponds & Water holes)	Major	Funding/FD	
Eco Sos Asap			III
(a) On village land	"	From ongoing	
(b) On FD land	"	watershed project Funding	
Need/Livelihood &Conservation Linkup			
Natural Products and Food Processing Unit	Major	Technology/initial capital Marketing support	V
Water Mill (*Pan Chakki*)	Partial	Technology/initial capital	
Bee Keeping	Major	Funding	IX
Bamboo	Major	Ongoing watershed & FD	X
Paryavaran Vikas Samiti	Major	Training and resources	Organisation to backup strategy implementation

The project team plans to be involved in facilitating, supporting and monitoring the implementation of the prioritised strategies. Facilitation and monitoring have continued since the end of the study.

Lets see what happens.

Bio-diversity Conservation in U.P. Hills

Ajay Rawat

Introduction

Four representative areas were identified in Kumaon and Garhwal for the study of biological diversity of U.P.hills. The areas and their characteristics are mentioned below:

The first area selected was Kilbury Reserve Forest, which is in close proximity to Naini Tal. The sudden rise in tourism has invaded the domain of bio-diversity here and has almost swamped it. In the name of tourism, the administration is trying to drive the last nail in the coffin of environmental diversity.

There is a steep and remarkable variation in biological diversity in Kilbury. It is one of the few areas in Kumaon where oak is still thriving but owing to extraneous factors is in an endangered state. It is a part of the catchment area of the river Kosi which meanders through three districts in Kumaon, Almora, Naini Tal and Udham Singh Nagar and then enters Rampur district in the Plains. Owing to the wanton destruction of different species of oak in Almora district, the water regimen of the river has been derailed. The rivultes of Almora district have almost dried up owing to wanton destruction of forests and the rivulets of Naini Tal district are actually feeding the river Kosi. These rivulets are perennial owing to the oak population of Kilbury. Once these forests are destroyed, the water discharge of river Kosi will be drastically reduced.

Sitabani in the sub-Himalayan Tarai was selected owing to its high bird diversity. It is one of the most positive and undisturbed areas of tropical Kumaon. However two major problems related to forest management threaten the bio-diversity of Sitabani. Introduction of exotics particularly teak and lack of natural regeneration of principal species, particularly sal.

In the Garhwal two areas were selected as project sites, Akash Kamini catchment and the Upper Yamuna Valley. Akash Kamini harbours the vegetation of a wide range of climatic zones extending from sub-tropical to alpine. It is the only area in the U.P. Himalaya where the tree Litsea lanuginosa grows. It is a middle sized evergreen tree. The wood of the tree is used for fuel and the leaves are used for making compost by mixing with animal dung. The species is highly endemic and is reported to have become extinct in other parts of the Himalayan region. Similarly Kharsu or brown oak here has become endangered. It is a climax species and is the greatest forest forming species above 2200m altitude in the Himalaya. Much of the brown oak and adjacent alpine meadows have been historically under the influence of migratory livestock such as sheep and goats. Brown oak is used for fire wood, charcoal, fodder, agricultural implements and now in tasar sericulture. Its regeneration is the most important problem in Akash Kamini catchment.

Of late the Garhwal Mandal Vikas Nigam unmindful and insensitive to the bio-diversity of the area has installed pre-fabricated lodging houses as a hotel for the tourists on the slopes of a bugiyal or alpine meadow in the catchment. The bugiyal is basically an eco-system in itself and the delicate balance between ecology and environment has to be understood and respected. But the insensitive administration without understanding the ecology of the bugiyals has negated the factors affecting the ecological balance of mountain bio-diversity.

Conservation Issues in the UP Hills

In U.P. hills more than 80% of the people live in rural areas and depend on subsistence agriculture. It is the nucleus of human settlements; these settlements are generally located with forests above the agricultural lands in all directions of the habitats. The symbiotic relationship between forests and the people has been existing since time immemorial and the people in the hills have always understood this linkage for their sustenance. But over the decades the population has increased and so has the corresponding bovine population. In the hills crop production, animal husbandry and forestry constitute the three main closely and inseparably integrated components in hill farming system.

The problem for development strategies in the hills is that when one talks about agriculture, he refers to crop production on only and overlooks its linkages with forestry. It we have to save the environment and diversity of the hills, our development approach should not be agriculture versus forestry but agriculture and forestry.

It is for this reason that Upper Yamuna Valley was selected as project site because in this region apple orchards and agriculture have been responsible for nibbling forest. Farmers here have started extending agriculture to marginal and sub-marginal lands which are too fragile to cultivate and are causing serious erosion problems.

There is an increasing concern towards the deteriorating environment in U.P. hills and the threat posed to bio-diversity. But the planners don't seem to realize that environment cannot be conserved with poverty and without meeting the day to day needs of the people. Poverty alleviation and developmental programmes that have been launched in the hills hitherto, they did not have the required impact. Prof Shankar Lal Sah an agro-economist is of the view that the development approach has been fragmentary. The various development departments lack coordination, whereas multidisciplinary and coordinated efforts are needed to re-establish the linkages of land use and soil and water conservation. The gains of development are pocketed by the political village elite who have become contractors and commission agents. The government development has largely been a matter of 'batwara' (distribution); which has according to A.D. Moddie been thoroughly exploited by local politicians down to the village, and which now is crippled by corruption at every door., Although there has been much discussion on the dangerous depletion of resources and mostly it is the people who are blamed directly for the dwindling forests, the environmentalists do not seem to understand that in the wake of such lop sided development, the priority of the villagers in U.P. hills is not forests and bio-diversity but their survival. Their priorities today are sustenance, water, health, education, sanitation, fodder and fuel.

The situation here is really crucial. Damage here presents a greater risk than usually perceived because these lofty peaks are the source of the great Ganga system. It is the catchment area of the Indo Gangetic plain where more than one third of the Indian population resides. It is important to preserve the forests and bio-diversity of U.P. hills, but not at the cost of the people. With the increasing political awareness created by the Uttarakhand Movement, the people have started to realize the ecological importance of this area. After years of callous neglect, the cauldron of U.P.hills is boiling over with public anger and the people have started saying that till yesterday the government as well as the outsiders were ravaging our forests but now we shall destroy them. At the cost of our sustenance why should be protect our forests for the benefit of those who have been thwarting our ambitions and sucking our blood.

People's Attitude

The attitude of the people towards the forests is apathetic and towards the Forest Department they have deep-rooted antagonism since the turn of the last century. The colonial forest policy which promoted commercial forestry deprived the people of their traditional forest rights. Even after Independence the situation did not improve. After establishing its own pre-eminence, the Forest Department in the hills allowed the claims of other interest groups to supersede those of the hills people. Several Uttarakhand Sangharsh Vahinin activists who at one time supported the Chipko Movement felled thousands of trees throughout Garhwal and Kumaon during their 1988-89 'Ped Kato Andolan', or Felling the Trees Movement, which was launched to counter delays in environmental clearance for roads, electric lines and water pipe lines projects. Bipin Tripathi a protagonist of the Chipko Movement in Kumaon who led the 1978 struggle of saving the forests of Chanchri Dhar near Dwarahat in Almora district from being felled by a paper mill, has now changed his stance diametrically. Chanchri Dhar is the watershed of several streams supplying water to 18 villages. In January 1978 about 300 villagers camped there for 39 days and succeeded in saving the Chanchri Dhar forests. This was a peoples' movement and its leader Bipin Tripathi is now a changed man because he feels that several developmental schemes in hills have been held up due to environmental reasons though in the guise of tourism, rules are being brazenly flouted for the builders mafia. As a protest against this dual policy, Bipin Tripathi and his supporters cut trees in 111 places where the government was using the Forest Conservation Act to hold up developmental projects. The hill people want trees but they want development too, reiterates the activists of Uttarakhand Movement. Their argument is that whether the trees are for the people or it's the other way round.

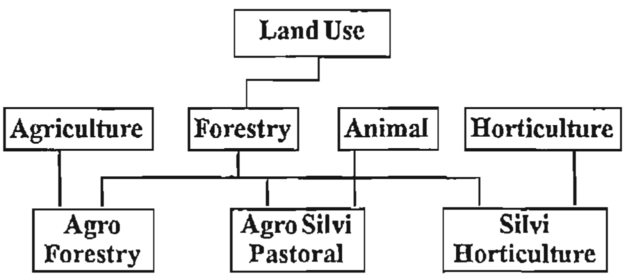
It is indeed an irony that the very region that gave birth to the Chipko Movement has activists promoting the felling of trees. Even in Reni, the birth place of Chipko, the Women folk hate to hear the word environment. This has happened because after the Chipko Movement, the conservationist element received greater emphasis which widened the gulf between the local reality and the perception of the conservationists. In mindless reaction to environmental and political pressure the government banned green felling above 1000 m.

Both the movements, Chipko and its antithesis the Ped Kato Andolan have one thing in common, the right of local communities to decide how they should manage and use their resource base. The government meanwhile has used the growing environmental concern to centralize environmental management without any concern for devolution of environmental rights and obligations. Thus if the forests and bio-diversity of U.P. hills have to be preserved then the government will have to win the support of the people and manage the forests with their cooperation. It is the community which determines the success of natural resource management projects by virtue of their need, numbers and physical presence all the time. The Forest Grievances Committee which had been constituted as a sequel to forest movements in the hills after 1961 had concluded in its report of 1921 that, "Unless local villagers, supported forest policies actively, no sustained management and regeneration of forests would be possible".

Land Use in Uttarakhand

In Uttarakhand more than 80% of the people live in rural areas and depend on subsistence agriculture. Basically hill agriculture is bio-mass based which is mostly obtained from forests. In Uttarakhand a village is an eco-system which comprises cultivated land, cluster of houses, forests, grazing and pasture land. From the mountain perspective, the role of forest in hill farming system is altogether different from the plains. Forests, Civil Soyam/Panchyat/ Reserve, supply fuel wood, fodder, compost, timber, staking and fencing material as well as food to the system. The problems with development strageties in the hills is that when one talks about agriculture, he refers to crop production only and overlooks its linkges with forestry. Forests in the hills are as intergral a part of farming system as arable land and livestock. Crop production with horticulture, animal husbandry and forestry constitute the three main closely and inseparably integrated components in hill farming as shown below:

LAND USE LINKAGES



Thus in our development approach, it should not be agriculture versus forestry but agriculture and forestry.

The farming system in the hills has a number of features, characteristic such as, inacessibility, fragility and diversity, a great variety of crops, including perennial fruit as well as fodder and different species of livestock. Thus to achieve sustainable development and to maintain diversity in the forests of Uttarakhand, forest usage and development will have to be treated as an overall resource use-pattern and peoples' sustenance.

Deforestation

The dilemma of deforestation faced by planners today results from the fact that they did not react when the danger signals first appeared. Even after the authorities recognized the problems posed by deforestation and the subsequent loss of bio-diversity, there was no unified land management strategy that sought to reconcile agricultural and forest related uses. According to Prof. J.S. Singh and Prof. S.P. Singh, each kilocalorie of agronomic yield requires the expenditure of about 7 kcal from the adjacent forests in the form of fodder, fuel and leaf manure. Even with this forest support system, agronomic production in the hills is sufficient only for about 50% of the populations' need. The remaining half must come from the plains. In view of various problems, including the ruggedness of the terrain, neither the agricultural area nor its yield can be increased. Landholdings in the Lesser Himalayan region are small, averaging 0.8 ha per household. The present situation, therefore calls for a change. The crop system in the Lesser Himalaya should be replaced gradually by tree farming and to encourage the villagers as well as to prevent the impending ecological doom in the Indo Gnangetic plain, food grains should be provided to the village people at an extremely subsidized cost.

Education and promotion of environmental issues at the grass root level are the most effective means of overcoming peasant resistance to changing long-established customs. Moreover, there is special need to involve women, because it is they who have to attend to domestic chores and are primarily responsible for agriculture, fuel and fodder collection, and maintenance of livestock. Therefore programmes to organize women, mobilize them and improve their educational facilities should be given highest priority. Together with this the government through NGOs should promote capacity building in the villages.

Local village people throughout the region depend on forests for meeting their fuel needs, and this leads to deforestation. It is recommended that alternative sources of energy such as electricity, cooking gas, kerosene oil and pressure cookers be supplied to them at subsidized prices to halt the destruction of forests as well as to encourage tree farming. Also, fuel-efficient stoves and bio-gas plants should be popularized. Rajendra Singh Mehra, who is working with the villagers in Naukuchiyal Tal has successfully installed 275 bio-gas plants which are operational through out the year. He is of a view that in the hills between the altitude of 712 m to 1139 m, bio-gas plants of Deen Bandhu model are extremely successful. The size of the plant should be 2 m^3. In those areas where bio-gas plants were installed by the government agencies they failed because they introduced those models which are suited for the plains. Then owing to their size 6 m^3 the consumption of dung was more.

Non-conventional energy sources like mini and micro-hydro power generation and wind power generation should also be tapped. There is a vast opportunity for wind power generation in the hills. The full potential of windy sites in the Himalayan region has not been estimated and an intensive survey of such locations is urgently needed. Finally, the sunny areas of the Himalayan region are suited to solar cookers which could be provided free or at subsidized prices.

Tree farming certainly involves less soil disturbance than crop cultivation which requires frequent ploughing. Further the amount of inputs, per unit of production would be less in tree farming. Deeper tree roots promote water absorption and check surface run off, helping to prolong the life of springs, the major source of water to the villagers.

The Water Crisis

In Uttarakhand with the depletion of depletion of vegetal cover many villagers are facing water crisis. The gravity of the situation can be gauged from the fact that in some districts like Pauri and Almora during summers the scarcity of water is so acute that it is supplied to the villagers by tankers. The most important source of water for the villagers since ages immemorial have been natural springs. But with their drying up in hundreds of villages in Uttarakhand like fuel and fodder, carrying water as head loads from distant places has become a full time activity. According to official statistics in Almora district e.g. out of 3003 villages, 2986 have been covered under drinking water supply schemes upto march 1995. However a majority of these schemes are not fully operative and the situation has not improved. A.D. Moddie is of the view that in the mid '70's the people of Uttarakhand began to articulate more clearly the growing threat of the phenomenon of drying and dying hill springs. Subsequently Dr. D.D. Pant, the then Vice Chancellor of Kumaon University undertook studies in the Bhim Tal sub-catchment in Naini Tal district. The findings indicate an alarming fact, that 40% to 60% of hill springs were either drying or dead.

It has been surmised that the cause of this has been increasing human interventions over decades, in the shape of deforestation, extension of cultivation and grazing and construction work in the mini catchment areas of Hill springs. But the micro-climatic changes induced by reduced rainfall and vegetation decline are the most alarming. The average annual rain fall in Bhim Tal Between 1971 and 1980 declined by 34% as compared with the previous 13 years. During the same period 9.3% of the forest cover was lost due to various reasons. Similarly in the Paharpani area the drop of 7.6% was most alarming between 1976-80 and 1981-86 and the extent of forest reduction was 13.3% since 1978. In the Ballia sub-catchment, rainfall declined by 9.5% in the decade 1974-85, while the forest cover dropped to 17.4%.

Most of the forests in Uttarakhand are situated in the sensitive catchment areas of some of the rivers. These catchment are not only rich in bio-diversity but they are intertewined with our long range ecological security and perpetuity of our glaciers and river systems. In U.P. hills there are 8 catchments, 26 watersheds 116 sub-watersheds and 1120 micro-watersheds. The details are given in Table 1.

The treatment should be initiated in the sub-watershed areas and the smallest unit the micro-watershed should be prioritized. In this way the areas being small would be easy to manage and even difficult areas which have been overlooked hitherto would be tackled. Moreover it would be easy to monitor the work done. The plantation should be done in the mini catchment areas of the hill springs and it should be conserved as far as possible as a sanctuary with minimum human and livestock intervention. Deep-rooted species like oak and utis should be planted to facilitate better ground-water seepage to enhance the discharge rate.

Destruction of Oak Forests

It is a matter of concern that in Uttarakhand the oak forests are being ravaged owing to apple cultivation and biotic pressure. Oaks supply leaf fodder for cattle, wood for fuel and timber for farm implements. Oak Forest soil is rich in humus and is often used as a supplementary manure. Agricultural activities frequently extend into oak forests and, with increasing demands for fodder and firewood, the trees are repeatedly lopped and seed output is reduces. Pressure from seed predators such as flying squirrel and langur has increased on an already diminished seed crop, and the scanty young generation is grazed by livestock. As a result of all these impacts these forests are fast disappearing.

In two of the project sites, Kilbury in Kumaon and Akash Kamini in Garhwal it was found that the young seedlings of different species of oak are not being disseminated subsequent upon which saplings are not being established, only mother trees have left, some of which are 200 years old. The failure or regeneration would not come to notice as long as old trees persist. Once these mother trees die, in the absence of younger trees and saplings oaks will disappear from Uttarakhand. It seems that in the current forms of chronic disturbances like regular lopping of trees leads to a reduction in seed output, photo inhibition in leaves and soil erosion.

Table 1

S.No.	Name of Catchement	Name and number of	No. of sub-watersheds Watersheds	No. of Micro-watersheds	Area in km^2
1	Yamuna	1 ABCD 2 Tons 3 Lower Tons 4 Yamuna 5 Asan	19	161	553.78
	Total	5			
2	Ganga "A"	1 Solani 2 Song	5	56	5531.78
	Total	2			
3	Ganga "B"	1 Nayar 2 Hiyunl/Malin	12	88	3096.95
	Total	2			
4	Bhagirathi	1 Bhagirathi 2 Bhilangna	18	159	7280.44
	Total	2			
5	Alaknanda	1 Lower Alaknanda 2 Mandakini 3 Alaknanda 4 Pindar 5 Lower Alaknanda	22	207	11059.17
	Total	5			
6	Ram Ganga	1 Khoh 2 Ram Ganga 3 Dhela	11	87	4459.18
	Total	3			
7	Kosi	1 Bhakra 2 Gola 3 Nandhaur	13	117	6620.11
	Total	3			
8	Kali	1 Lower Kali 2 Saryu 3 Kali	16	245	11311.40
	Total	3			
	Grand Total	26	116	1120	51125.00

The canopy gaps are formed very slowly. Thus controlled felling should be permitted so that the canopy gaps could be formed at one go and then the site should be allowed enough time to recover. Conservation should be facused on seedling dynamics; instead of saving the trees, the forests should be saved. Instead of tree as a management unit, it should be replaced in totality by a forest eco-system where different processes occur.

Further deterioration of oak forests is wrought by clearing for apple orchards. The temperate climate of Kumaon and Garhwal offer congenial conditions for apple cultivation between 1600 and 2700 m and this is the Oak Forest zone. The total area of apple orchards in Kumaon and Garhwal is 48,700 ha. According to the Department of Horticulture by the year 2000 this will extend to 67,400 ha.

It is a well-known fact that problems of soil erosion and loss of genetic diversity, water scarcity and general environmental deterioration results from the destruction of natural oak forests. A case study of villages in and around the Chamba-Mussorie fruit belt of Tehri Garhwal by the G.B.Pant Agricultural University, indicated that the destruction of oak forests to convert land for apple orchards created an acute shortage of fuel, fodder, water and other necessities of life for the villagers. Crop production was reduced due to obstruction of the bio-mass flow from forests to cropland, ultimately forcing outmigration of large numbers of people.

Construction Activities and Tourism

In the apple belt of Kumaon a new trend has been observed, the owners of big apple orchards have started selling their land to builders for group housing complexes. This will add to environmental degradation. It is essential that apple cultivation should not be promoted at the cost of oaks. In the existing orchards the production should be increased and the old orchards should be revived. Also there should be a ban on the sale of apple orchards for group housing activities.

A new threat posed to the forests and bio-diversity of Uttarakhand is the sudden spurt in tourism. On the one hand the builders are gobbling up large chunks of land in this region like cancer and on the other hand the uncivic habits of the tourists are wreaking havoc on the environment. The tourists litter the scenic spots, trekking and pilgrim routes with plastic bags and other non-bio-degradable material. The plastic disposed on the slopes of the hills is covered by the autumn leaves of the season. This process is repeated every year with plastic being sandwiched between leaves preventing rain water from seeping and percolating causing ecological disbalance. This deposit of plastic materials also kills the green life on the slopes of mountains.

The tendency now is to seek redressal in courts. But in Uttar Pradesh this does not work. In 1994 the Garhwal Mandal Vikas Nigam put up pre-fabricated lodging houses as hotel for tourists on the slopes of the bugiyal near the ancient temple of Tungnath. The High Court on 26th October 1996 gave directions to the Nigam to withdraw occupation of its camp site on the slope of the bugiyal. The insensitive administration without understanding the ecology of the bugiyals has moved the Supreme Court and the decision is awaited.

The administration cannot shut its eyes and passively permit the builders and other despoilers of forests to violate the natural cycle. The Supreme Court has reiterated time and again that the local government has responsibility qua the environment and the ecology of the region. But there is a wide gap in what is being said and what is being done. It seems that the administration has become a party to upset the ecological balance4 and the bio-diversity of this region. Rules are being framed either to benefit the builders and where they are not, the builders have the temerity to flout them brazenly. Mostly it is done with the connivance of the administration under political pressure. If an honest officers does not collude with the builders, then the politicians are there to oblige this lobby. Justice Ravi Dhavan of the Allahabad High Court, was narrating an interesting anecdote at the U.P. Academy of Administration, Naini Tal very recently of how the administration hoodwinked the courts.

The cleaning up of the trekking routes of Kumaon and Garhwal was under consideration before a court of a division which he and another of his colleague constituted. The issue concerned was that the glacier at Gomukh, the source of the river Ganga ought not to be affected by the warming up effect of kitchen fires and the route should be provided with toilet facilities and the bins to take in the litter normally thrown by tourists and pilgrims.

A NGO working there had proudly claimed to have solved Gangotri's garbage disposal problems with bins and an incinerator. But all that was to be seen were overflowing bins, trash left by tourists, pilgrims, petty shops and ashrams spilling down the hill side into the Ganga. Now can there be any issue he reiterates, cleaning up of a mountain, a pilgrim or a trekking route is otherwise a public duty of the agency of the State incharge of it. Justice Dhavan is a trekker himself and while trekking to Gomukh incognito without official escort or security, he found that all the wayside shops and kiosks to whom licenses were granted by one department of the administration had just disappeared overnight. The freshly made mud stoves recently used but abandoned, the poles and pillars of wood which supported the tin sheds were still there without the roof. At some places the shopkeepers were hovering around their dismantled shops with mournful and sullen faces.

On being asked what was happening the shopkeepers replied that some High Court enquiry is going on and one Justice Dhavan who is deputed for the task will pass through this route to Gomukh. He will spend two to three days in Bhojvasa-Gomukh and once the blighter goes back we will reinstall our shops. This is the attitude, the intention, the genuineness, the integrity of those who man the administration and pay lip service to protect the ecology and environment of a particular region. Justice Dhavan feels that to save the bio-diversity and the culture of this entire region, it should be declared as a bio-diversity HOT SPOT. Moreover polythene bags and plastics should be absolutely banned in the hills. It seems that the only hope for saving the Himalayan ecology would be a combination of four factors-bureaucrats sensitized to the issues, responsive courts and stringent laws, and public awareness of the need to protect. Public awareness is extremely important because one cannot overlook the greed in a section of the hill community itself who is colluding with the builders and the forest mafia. The Alpine belt between 3000-5000m covers less than 5% of the Central Himalaya is one of the most species rich area. It provides nutrient rich forage to domestic animals during summers. The inroads of tourism and over grazing has threatened the bio-diversity of these meadows or bugiyals.

Meadows and Medicinal Herbs

It is suggested that thorough investigation on meadow management, and the impact of grazing on meadows diversity should be made. Most of the meadows are under great pressure due to fuel wood collection by migratory graziers and tourists. Also extraction of medicinal herbs in these areas should be stopped. Instead villagers should be encouraged to grow such species in suitable localities to achieve the desired balance between production and protection. The additional areas like wastelands should be extended for cultivation of such species. But this cultivation of herbs should not be permitted in close proximity to forests and meadows. It has been observed that wherever farmers, especially some NGOs were cultivating medicinal plants near the fringe areas of forests, the production became forest based. An absolute ban should be clamped on illegal extraction of medicinal plants and herbs.

Similarly the timber line in Central Himalaya which stretches between altitudes 3000-5000 m is a unique high altitude ecosystem which supports a high biological diversity. Timber line is a special plant and wildlife habitat. Its importance increases manifold due to the transitional position of this timber line within the latitudinal pattern of timber line plants distribution as well as the Himalayan plant distribution. Unfortunately there is very little information on this ecosystem and the threats its bio-diversity is facing. It is unusually sensitive to even small disturbances and therefore well researched data should be collected and through investigations should be made on this unique habitat. Prof. Y.S. Pangtey is on the view that sufficient data is not available of the bio-diversity existing in and around timber line but his observations are that some common problems like indiscriminate tree felling, increased tourism, establishment of cattle camps and some ill planned developmental activities have contributed to certain of tree generation. The mountain environment becomes more stressful with its increasing altitude and thus the disturbances caused by outside agencies at this altitude enhances the stress and thus the vegetation is damaged. Moreover these disturbances lead to irreversible consequences making the whole timber line zone in the Central Himalaya a special concern for conservation efforts.

Lakes

The Central Himalayan region abounds with lakes. These lakes are the key sources of water supply, both drinking and irrigation. In Naini Tal e.g., district there are a constellation of lakes. Some of these lakes have been abused by the inroads of tourism. Building activity in and around the catchment areas and disposal of domestic waste as well as sewage has accelerated the rate of eutrophication and affected its water quality severely.

However these systems in the Central Himalaya have not received the attention they deserve although their overall productivity is relatively high. This has to be taken up on a priority basis and intensive work is required to list the plants and animals they harbour. A uniform policy for restricting building activity in the lake areas should be adopted for the whole of Uttarakhand and there should be no political compromise while implementing it.

Forest Fires

In the last decade forest fires have caused tremendous damage to the forest and plant-diversity of this region. The direct impact of forest fires is on the water springs which have started drying up, water retention capacity of the soil as well its percolation capacity is being reduced, annual growth of the forests is stopped for 1 to 3 years, it is destroying the nutrients and has added to soil erosion as well as aridity. Because of forest fires chir pine is being propagated, unpalatable perennial grasses are coming up instead of annual grasses, nests of birds and their eggs as well as animal life and reptiles are being destroyed.

These facts were reported by the villagers in different workshops. Their contention was that though the villagers are normally blamed for these forest fires, actually it is the timber and resin mafia who set fire to the forest land and during the fires they have a field day as they use the fires to their advantage.

One of the important cause of forest fires is the accumulation of chir pine needles during the summers. The thick rolling mattress of pine needles on the ground makes the forest a veritable powder keg that can burst into flames at the slightest spark. The damage they cause is irreversible.

Despite the harsh reality the Forest Department continues to underplay the destruction. Thus the statistics provided by them cannot be relied upon. From the data provided by the Indian Institute of Remote Sensing, Dehradun of the year 1995, one can gauge the damage forest fires do to the ecosystem. But unfortunately this data is upto 27th May and forest fires ravaged Kumaon and Garhwal upto June 20th. The total area affected under forest fire in Tehri district has been estimated as 910.01km2 or 20.58% of the geographical area. This area includes forest burnt area as 168.88 km2 or 3.82% of total geographical area, partially burnt forest area as 473.69 km2 or 10.71% of the total geographical area and the partially burnt fallow land/grassland/scrub land as 26.44 km2 or 6.05%. The overall accuracy of classification and subsequent estimation of these figures has been assessed as 88%.

The villagers accepted this fact in the workshops that fires are also caused by the traditional burning of pine needles and of pastures during summers by them to obtain freshly sprouting grass during the rainy season. Burning in pine forests by herders and villagers prevents the accumulation of slippery litter and makes grazing safer. They also agreed that the forest fires are caused by burning of agricultural residue, stubs and dry stems after the harvesting.

With the Forest Department poorly equipped to handle fires and the villagers indifferent to the blaze, the fires keep breaking out in a seething frenzy and consume more and more forests every year. Previously entire villagers would turn up to fight fires, today nobody shows up. Unfortunately there is a growing divide between the Forest Department and the villagers, the bone of contention being the Forest Conservation Act. The villagers who are denied of their traditional rights to fuel and fodder, see this as a chance to spite the forest officials who treat them as pests.

Traditionally a symbiotic relationship was maintained between the forests and the people in the hills. But now this relationship is waning. The whole historical process in the wake of development of forestry has alienated the people from the forests as well as the Forest Department. The situation did not improve even after Independence. It is high time that the Forest Department should adopt a peoples' approach and ensure the villagers' role in forestry. To prevent recurrence of forest fires, the establishment of a rapport between the Forest Department and the villagers in essential. This can be done by taking a sympathetic view of the fights and privileges of the villagers in the adjoining forests. This is a conflict that needs to be resolved. With increasing biotic pressure, such tussles have become an everyday affair. The administration should also focus on village workshops and mass campaigns regarding environmental issues in general and particularly so in areas of hot spots of bio-diversity with a missionary zeal.

And worse still the fire lines in the forests have disappeared beneath the undergrowth. They were natural protectors against fire but with paucity of funds the lines could bot be maintained. Similarly the earlier system of appointing one fire watcher for each beat to assist the guard has been scrapped for lack of funds. Previously, the Forest Department would carry out controlled fore sessions in February to make sure that by summer there weren't excessive pine needles on the ground. But today, the funds given for this are so abysmally low that not enough of this is done. For fire fighting operations upto 1995 the Forest Department was allotted only Rs. 1 per hectare.

There is thus an urgent need to spruce up the Forest Department on fire fighting with better communication channels and detailed drills. Additionally a ban should be put on the burning of forests for grass by the villagers. More important, however is the conflict that needs to be resolved and proper funds given to the department for forest fires.

Remote Sensing

Finally satellite remote sensing data holds great promise to provide timely information and can be reliably used to identify forest fore affected areas. Furthermore this information can be an obvious input to plan forest fire management strategy.

In 1960s and 1970s commercial logging and the construction of strategic military road for defence were extended to the higher altitudes below tree line, opening up vast areas to exploitation. Moreover, large areas of forests were destroyed in the construction of these roads. According to the Public Works Department (PWD), the total length of roads in Kumaon alone increased from 360 km in 1947 to 6421 km in 1991. Some of these roads have limited vehicular traffic. Most roads have been given unnecessary loops and bends in order to oblige the local politicians who want the roads to pass through their villagers. At time the PWD will gratuitously increase road length in collusion with local contractors so that they can make more money. According to a rough estimate, atleast 60 mature trees are felled in constructing one km of road in the hills. Prof.K.S. Valdiya, an eminent geologist, estimates that the construction of one km of road requires the removal of 40,000-80,000 m3 of debris. This debris is dumped by the PWD on the adjacent slopes, killing the vegetation and choking mountain streams. Road construction in hills leads to an increase in water runoff and soil erosion along with huge losses of soil nutrients. Roads also invite invasion of pioneering species at higher altitudes, causing further disturbance in the ecosystem. Another practice which is adopted by the PWD is also damaging the saplings. Subsequent upon landslides on the shaken hill sides, the debris generated is again disgorged on the hill sides and the Forest Department is a mute spectator to it.

Government Schemes

In the hills in the last decade several schemes have been launched on the basis of environmental considerations. Most of these projects are centrally sponsored. Some of the schemes are:

1. Integrated Eco-development Project.
2. River Valley Project.
3. Development of Civil Soyam Forests.
4. Watershed Projects

All these schemes are overlapping since the catchment area and the area of operation is the same. There is no coordination between different departments running these schemes. Most of the departments take advantage of this confusing situation and it is alleged that they hoodwink the monitoring agencies by showing them each other work.

The same villagers at times are presented as beneficiaries before different evaluating agencies by different departments. Some NGOs are also working in these areas and they are peeved that several government officers in the past have presented the work done by the NGOs as their own. There should be transparency in the working of the departments involved in these schemes and they should coordinate with each other through workshops and interface.

It is imperative that the eco-development projects to be implemented should be integrated in approach, both in theory as well as in practice and the planning should be done absolutely by the villagers. The implementing agencies should act as facilitators while micro planning is being done by the villagers and help them in capacity building.

While preparing the plans, conservation of water, rehabilitation of degraded land and ultimately protection of forests should be taken as priorities and biotic pressure as well as agriculture should be taken as indicators for planning.

For planting of trees indigenous species should be preferred and the choice of the villagers should given due weightage. Hitherto the villagers have not been taken into confidence and they have not been involved in site or species selection. Most emphasis should be given to protecting and growing food producing trees that are indigenous and provide nutritious food to the local people. Such trees include kafal (Myrica esculenta), walnut (Juglans regia), chestnut(Castanea sativa), almond (Prunus amygdalus), and bushes like kilmora(Berberis asiatica), and raspberry (Rubus ellipticus). There are also indigenous trees such as wild apricots(Prunus armeniaca) and chieura(Diplonema butyrecia) that yield edible oil of excellent quality. As a case in point, some villages in the Chamba block of Tehri Garhwal are self sufficient in edible oil because they own several chulu(wild apricot) trees on their private land.

Already a colossal damage has been done by group housing schemes and hotels in the hills by builders. It is imperative that only those outsiders, irrespective of any caste, creed or religion should be permitted to buy land in U.P. hills who will stay there almost throughout the year. A ban should be strictly clamped on the sale of land to those people who want to own luxury cottages for their summer sojourn and would ensnare the villagers to buy their land at exorbitant prices. This will not only save the bio-diversity of the region from being disturbed but the social fabric as well. The marginalized people will be discouraged from adopting the sons of soil approach towards outsiders. Almost the whole of Himalayan region is in a political turmoil currently and soon the people of U.P. hills will be pushed to such a situation. The warning signals are already there and if the situation does not change the time may soon come when this dormant feeling may surface. Seeing the land situation, it is suggested that not more then two nalis* should be permitted to people who want to settle down in the hills for house construction. Hitherto large chunks 40 to 50 nalis are being purchased by outsiders for their summer retreat and by the builders almost a whole ridge for group housing.

Tourism should not be allowed to come in the way of land, water, forest wildlife, plant gene and cultural resources of the Himalaya. A careful balance and watch should be maintained. Eco-tourism should be popularized in the hills and to ensure peoples' involvement villagers should be given subsidizes. For promoting villages tourism the villagers should be encouraged to construct small huts in the traditional style with some basic amenities in close proximity to their houses.

Non-timber Forest Produce (NTFP)

NTFPs are a significant source of subsistence products, employment and household income in areas near forests. Tribal populations depend heavily on NTFPs income and subsistence. One reason why NTFPs are so important for tribals and forest dwellers is that they have been pushed towards more and more marginal areas especially in the Tarai region of Kumaon. In Uttarakhand there is a need of an institution for NTFPs promotion with the following objectives:

1. There is a call for a more practical and effective methodology for making assessment of the availability of important NTFPs.
2. To promote cooperative marketing of NTFPs collected by the villagers.
3. Considering the importance of herbs and plants and their increasing demand, it is necessary to increase their production by way of growing in places of their occurrence and cultivating in some suitable places.
4. Marketing information to be collected for the advantage of growers, collectors, processors and traders.
5. To ensure higher earnings and generate employment opportunities for villagers by taking up projects based upon NTFPs.
6. To improve collection, storage, processing, transportation and marketing.
7. To fix minimum procurement prices of NTFPs.
8. To undertake extension and training programmes among tribal and non-tribal communities. Since women play an important role in the village economy, their participation must be ensured.

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*1 nali = 200.2 m^2

9. Ban illegal and unscientific extraction of NTFPs.
10. The oil growers in India are facing a serious problem owing to cultivation in unirrigated lands under rain fed condition. An important source for production of oils seeds is of forest origin. In the Kumaon and Garhwal hills there are more than 50 species of trees and plants which produce oil seeds, but a negligible percentage of their potential is being exploited. There is a high concentration of chullu or wild apricot trees in several areas of Kumaon and Garhwal. A detailed survey of chullu was conducted in the villages of Purola and Naugaon blocks of the Upper Yamuna Valley and it was observed that out of 257 villages which were surved, there is a good concentration of chullu trees in 200 villages. Chullu fruit are eaten by the villagers and for making oil and chutney. Even then only 25% is consumed and the rest goes waste. Chullu oil is used as a substitute for almond oil and its cost is much less. If we calculate the total oil potential of Purola and Naugaon blocks it comes to almost 200 tonnes annually and the fruit potential to 8000 tonnes. If this resource could be exploited to its full optimum and infrastructure for its marketing be developed, it would improve the economy of the people. Further it would be propagated by the villagers which ultimately would increase the tree cover.

Chir Pine

Chir pine plays an important role in the hill economy. It is the primary source of oleo-resin. The value of oleo-resin as a raw material in resin and turpentine based industries e.g., paints and varnish, perfumery, pharmaceuticals, paper soap, textile and shoe polish etc. is well known and well documented. With the diversified use of the resin products in various industries, the demand for the same is increasing day by day.

But unfortunately there is a reduction in the regeneration of chir pine. As a sequel to the chipko Movement green felling above 1000 m has been banned owing to which mother trees cannot be felled. The other reason is frequent fires in chir pine forests causing heavy mortality to the saplings. Besides, the fires have honed into a controversy regarding resin tapping, a major source of employment in the hills. According to forest officials 30 to 40% of all pine trees are given on contract for tapping resin. There is a rule that tapping should be done only from trees which have trunk diameter of 102 cm and above. But contractors openly flout this rule and cut deeper than allowed to draw more resin. In a fire, such trees are completely burnt since resin is highly inflammable. Then there is intense rivalry between different lobbies to get this contract. Often one contractor sets fire to a particular stretch because he didn't get the contract. Chir pine requires a lot of sunlight to grow. It is advisable that controlled felling should be permitted in chir pine forests under strict supervision.

The Forest Department will generate revenue by auctioning the mother trees and so will the villagers. During my field study I witnessed several mature trees in the pine forests in village salla Rautela in Almora district. These were in the Panchayati forests, and had permission been granted for their felling, the villagers could have generated atleast Rs 15 lakhs and utilized the money for development works in the area. Similar is the situation in several other villages.

Several environmental activists are apprehensive about the expansion of chir pine in U.P. hills, their perception is that other forest species are endangered by it. Chir pine has certain characters which made it a highly invasive species. It is an early successional species having the a ability to colonize disturbed sites, such as landslides, damaged land, severely burnt and clear-cut forests.

Environmental activists, while campaigning against the chir pine, often emphasize that chir pine needles behave like polythene in the sense that they do not easily decompose. This is not true, chir pine needle is also an organic matter subject to degradation by decomposing organisms.

Prof. S.P. Singh who has researched on chir pine is of the view that several species of cold climates, including those of higher elevations in the Himalaya have a similar or slower decomposition rate than chir pine. Then, the rapid decomposition is not always desirable he remarks. A rapid decomposition rate results in a rapid release of nutrients from decomposing substrate, which may lead to nutrient loss at an enhanced rate from the eco-system. The slow rate of decomposition may be useful in nutrient-poor sites, as the nutrient releases are gradual and losses from eco-systems limited.

The expansion of chir pine at the cost of broad leaf species is often regarded as a matter of concern as the tree leaf fodder of broad leaf species becomes scarce. But the chir pine forest is a rich source of grasses and this is one of the major reasons of frequent burning of chir pine forests by villagers.

Prof. S.P. Singh states that it is possible to introduce underwood of broad leaf species in chir pine forests by preventing fires. The presence of broad leaf underwood would not only increase the species diversity, it would also hasten the decomposition of litter, if required. The recalcitrant chir pine litter when mixed with nutrient rich broad leaf litter would decompose faster. The broad leaf litter in this case, would act as "primer" for increasing the population of decomposers. He reiterates that it is a real good fortune that the region is blessed with a species like chir pine, which is capable of attaining a high rate of precious biomass production in an extremely inhospitable environment.

Chir pine has expanded disproportionately because of a disturbed regime perpetuated by the activities of increasing human population, the rise in livestock density and to an extent policies of forest managers. The young and rising Himalaya are inherently vulnerable to land-slides and erosion and these disturbed slopes can be readily revegetated by woods, largely because the region has a species called chir pine. Any wrong decision regarding chir pine may deprive the region of whatever forest cover exists today.

The Foothills

The Central Himalaya with its foothills, the Tarai and Bhabhar has been nourishing the agriculture of the Indo-Gangetic plain. Increasing demand for renewable natural resources, both for sustaining an increasing human population and for supporting their gradually changing life style denuded the vital eco-systems in these critically important hill slopes. One after another, hitherto inaccessible areas were made accessible and forests were wantonly destroyed.

To add to this due to demographic reasons most of the Tarai belt was gradually brought under the plough to increase agricultural production. The loss of natural forest cover on the hills had already been instrumental to increased frequency of floods. And now the reclamation is Tarai and Bhabhar has let loose a torrent of flash floods.

The depletion and degradation of natural forest cover in this crucial area is already proving disastrous. It must be realized that this apparently wild looking area had been designed by nature to ensure real sustainable productivity, to reclaim it was a myopic decision. And now illegal timber trade is wreaking havoc on the forests of this region. Illicit timber trade has become a lucrative business and there is a nexus between the police, the timber mafia and the politicians. The forest official find themselves in a hapless situation. The timber mafia is armed to the teeth and several forest officials have been brutally murdered by them.

Organized encroachment with tacit political support on forest areas has added to the problem of deforestation and conservation of bio-diversity. Encroachment in Tarai and Bhabhar started in 1953 from Damuwadhunga forest block. According to the latest data available of 1987, by this year 8005 ha of valuable forests had been encroached upon and destroyed. This process must be stopped. Forestry and bio-diversity must not be mixed with politics and political compulsions.

In a bid to repair the damage done, the Forest Department has introduced programmes of social forestry in Dub-Himalayan Tarai and is doing commendable work. But instead of indigenous species, fast growing species like eucalyptus are being propagated. In Bajpur the farmers have reported that owing of eucalyptus the water regimen has been affected. During the field study in Bajpur block it was observed that the water table in several villages has gone down. Previously water could be obtained at 10 m for sinking a tube well but now the villagers have to dig almost upto 70 m. this drastic change cannot be attributed to eucalyptus alone, agricultural activity which has nibbled forest is also responsible. The Tarai region after colonization has lost its water retention capacity to a great extent. Before reclamation this area acted as a natural sponge, absorbing excessive water during the rains and releasing it during the lean period.

Hitherto, no effort has been made by the Forest Department for extension activities here to catch peoples' attention and to enthuse them to take up social forestry on a large scale. One of the immediate needs in social forestry programme is to build up a good extension work. It should aim at convincing the people of the importance of forest to them, and their duty to protect, conserve and develop it. Tarai, prior to denudation of its rich forest cover inspite of its being smaller in size, has been a giant in as much as that it has been the basis of the fertility of the Gangetic plain as also it has ensured the perenniality of its rivers. It can even now turn out to be as such, provided of course that its human as well as natural resources are utilized appropriately. With social and agro-forestry along with the farmers taking to horticulture in a big way the vanishing green cover of the Tarai can be retrieved and replenished considerably.

The Forest Department

While discussing the forest issues whether in workshops or seminars it is customary to start with the Forest Department on the prosecution box for all the ills that are happening. There are suggestions galore and some are very radical. In the Central Himalayan region there are numerous environmentalists and environmental activists who believe that the Forest Department should be discontinued and the forests should be given to the people. But these radicals do not seem to realize the financial and other constraints under which the officials of the Forest Department are working.

In the last decade as discussed earlier several environmental projects have been launched in the hills in which there is tremendous overlapping. Together with this there is uncertainty in releasing of founds and enough scope for bungling. The procedure for releasing of funds is very intriguing The Ministry of Environment, New Delhi e.g. releases the funds to the State of Uttar Pradesh and after passing various channels like the Uttarakhand Department, the Chief Conservator Hills, and the concerned

Conservator it reaches the Divisional Forest Officer. Subsequently the D.F.O. releases the fund to the Range Officer through the treasury. Finally the Range Officer releases money to the Forester and the Forest Guards. The whole process of channelizing of funds is extremely cumbersome and circuitous.

There is another impediment in this regard. A chaos is created when the money is to be released from the Conservator to the D.F.O. because at his level he cannot withdraw the money directly unless there is a direction from the Finance Controller in Lucknow to the concerned treasuries who in turn issue instructions to the concerned banks.

This leads to unnecessary delays in releasing of funds and offers ample scope fur bungling of money and commissioning which in turn has a direct bearing on the quality of work done. During the current year the fund to be released for the environmental projects in April 1995 was delayed upto March 1996. Subsequent upon this the payments were made to the labourers in one instalment. This again provided opportunities for the middlemen to take advantage of the predicament of the labourers of late payment as well as of bungling of muster rolls. Ultimately it is the forest of the area which has to bear the brunt of this financial laxity and the people are eluded with the objectives of the environmental projects.

In the field, plantation and other works are supposed to be done as prescribed by the Working Plan of the Forest Department. But there is a tremendous gap between what is being prescribed and what is being followed. Several reasons can be attributed to this:

1. The Working Plan is for 10 years and the budget is allocated every year since the District Plan is slated for one year. This leads to a sense of uncertainty.
2. The plantation programmes are slated for five years. It is too short a period and should be extended to atleast 15-20 years, upto the time the saplings have been fully established.
3. There is a glaring fallacy in the preparation of nurseries and raising of plants owing to paucity of funds. Nursery is basically a process of raising plants which are subsequently planted on identified sites. Once the area has been selected, the procedure before planting is that the growing stock in nurseries is to be ensured in advance. Together with this the planting site is charted and the species identified. Until the nursery stock is not ready, no area is undertaken for planting.

But in practice this procedure is not being followed which ultimately results in achieving only paper targets. It also has a negative effect on the success of plantations, in the first two years the success rate of plantations goes down.

It has a detrimental effect on bio-diversity also. Mostly those species are being planted which are easily available, which are not indigenous and which at times are incongruous with the locale. In the hills e.g. pine is being propagated even in those areas where other species can flourish. This is disturbing the whole succession of species and the edaphic potential. Furthermore the plantation work is target oriented and accountability is fixed on the field staff. Thus they prefer to plant only those species which are fast growing and where the chances of success are optimum.

It is true the department has some limitations but at the same time it requires a change in its approach, from policing to dissemination of social fencing. The Forest Department is obsolete in its functioning and the regimentation prevalent during the colonial rule of your obedient servant has been retained. There should be more openness in the department as well as transparency. An attitudinal change has to be brought within the department itself. For all forestry programmes the involvement of the field staff is essential. Hitherto, the field staff from forest guard upto ACF have no say in planning. Only D.F.O. and onwards the officers are concerned with the planning aspect. As there is a difference of perception between the higher ups and the lower echelons as well as a communication gap, the forest guard who has to implement the plan with his best intentions will act according to his perception.

Moreover in all the projects being initiated by the Forest Department, the field staff below the ACF level is given no prior information or guidance regarding the project. But once the project has been implemented and is in the stage of completion, then suggestions start pouring in from the senior officers. Similarly there is a difference of opinion between officers regarding bio-diversity subsequent upon which contradictory orders are issued to the field staff. The difference of opinions should be sorted out at the D.F.O. level so that conflicting orders are not issued to the field staff.

History of Conflict

The People in the hills do not have faith in forest Department. They have been alienated since the time the British introduced forestry in the Central Himalayan region. When the British occupied Kumaon, The colonial administrators encouraged an increase in population in this sparsely settled region and developed a relatively self sufficient agricultural economy, not only in the lowlands but also in the uplands. Expansion of agriculture by the clearing of forests was promoted which resulted in the reckless felling of trees.

In 1893, the British introduced organized forestry in the hills and this disturbed the former relationship between the people and the forests. With the establishment of forest reserves, the authorities clamped restrictions on the felling of trees and grazing of animals so that the people felt that their rights were being encroached.

Furthermore, the needs of the villagers were not considered before forest policies were introduced. No commendation was awarded to claimants whose freedom to exploit forests was restricted. The paradox that resulted form the British policy is evident. On the one hand, the extension of agriculture and consequent growth of population was encouraged, on the other access to most of the forests was restricted to ensure commercial timber production, especially after 1920. This resulted in a drastic reduction of the forest support base for agriculture on a unit area basis.

When resentment reached a critical level, people began to burn forests. In July 1921 alone, about 113,400 ha of reserved forest in Kumaon Division were burnt. Subsequent upon this the government appointed a committee which produced a report popularly known as the 'Kumaon Grievances Committee's Report'. One of the main recommendations, issued in 1926, was that isolated forests to be excluded from forest management and ultimately made panchayati or community. As a result, forest panchayats were formed, keeping pasture lands within easy reach of communities in the hills. Inspite of these concessions the situation did not improve.

Thus the feeling of animosity generated by the British forest policy, even Independence could not entirely remove. Even today these is a feelling of mistrust towards the Forest Department.

Joint Forest Management

In the prevailing situation Joint Forest Management can bring about a congenial relationship between people and the Forest Department. The tradition of Community Forestry or Van Panchayats is already existing. In Uttarakhand there are 4991 Van Panchayats today; if these Van Panchayats are strengthened and bottle necks in their functioning be removed, Joint Forest Management will become a reality. It will remove the scars left by the British forest policy and forestry will literally become a peoples' programme in U.P. hills.

Local Communities and Bio-Diversity Conservation in Mexico: A Case Study

Harsh Mander

During the past decade and a half, a large number of highly significant local ecologically-inspired movements have been taken root in rural Mexico, which aim to regain control of local communities over natural resources and to promote their conservation (or more accurately their sustainable use). Despite the fact that such 'explosive, but pacific, social movement(s) of ecological inspiration have been growing during the last decade in practically each main indigenous region of rural Mexico' (Toledo, 1998), not enough is known about these movements even within Mexico, and much less in the rest of the world. Far more is known about the Zapatista indigenous rebels of Chiapas, but there are many lessons to be learnt from the 'silent revolution' of rural Mexico for seizing control by the local communities of their bio-diversity resources. This paper, based on a 10 day field visit to Mexico, attempts to outline 2 such experiences, based on vastly different approaches, with regard to the respective roles of both the local communities and the external facilitating agents, in such a community-based effort.

The Sierra De Manantlan Biosphere Reserve

The first community-based experience of forestry management that we will look at more closely is that of the Sierra de Manantlan Biosphere Reserve, which is an interesting example of a sensitive but 'top-down' effort initiated by an activist university to establish a biosphere reserve.

The Sierra de Manantlan Biosphere Reserve spans two states of Mexico, Jalisco and Colima, in West Central Mexico. The reserve establishes a legal regime in which an approximately 30 per cent core area is to be untouched and completely protected, and in the remainder, around a 70 per cent buffer area, sustainable extraction is permitted.

It is accepted by both local government and university authorities, that these objectives were not determined in consultation with the local community, but were established by the external agent, in this case an activist wing of the University of Guadalajara. The turning point for the University was 1977, when a disease resistant relative of maize, *zea diploperennis* was discovered, which became a symbol of the importance of preserving wilderness areas for conserving their genetic wealth in situ, and attracted a flurry of research into the Sierra's distinctive flora and fauna.

The University moved from a single-species preservation approach to one that sought to preserve the entire eco-system. The Sierra de Manantlan Biosphere Reserve was established in 1987 by Presidential decree, and was recognised by UNESCO's Man and the Biosphere Programme in 1988.

The University then gradually began to reach out to the local people, and found among them widespread poverty and unemployment, very high rates of infant mortality, incidence of infections diseases, high emigration rates and social conflict and violation of human rights. There is always a rhetoric to the discourse, but clearly people became more and more important as the processes went on. The University became convinced that it must take up programmes of rural development, for their own sake, and to build communication and support within local communities for the reserve.

The situation was further complicated by the fact that only 1 per cent of the area of the reserve is government land. 60 per cent is community-owned land of *ejidos* or erstwhile large estates expropriated and handed over to communities during and after the Revolution, and 39 percent is private property. The declaration of the reserve did not involve any expropriation, but instead a major zoning regulation.

Today, 11 years after the establishment of the reserve, local communities are generally still not party to the objectives of the reserve, and many are still not even aware of these objectives. They welcome the reserve, but mainly because of the rural development works undertaken by the university. It is noteworthy that unlike in India, the Mexican government undertakes virtually no anti-poverty rural development programmes. The only real social security system for the unemployed rural poor in Mexico appears to be illegal emigration to the USA !

For seven years after the reserve was created in 1987, government did not invest a single peso in the management of the reserve, nor did it enforce the new regime of protection. It was left to the University to fill the institutional vacuum, but without legal authority, budget or adequate human resources. However, the conspicuous absence of the state meant that protection in the reserve was not significantly enforced.

In 1994, federal government established a Directorship of the Reserve, supported by GEF funds from the World Bank. The Director was appointed in consultation with the University, from its own ranks, and enjoys a great deal of autonomy and authority. The Director performs his functions in consultation with the Local Council. Each of the 30 communities are represented in the Local Council; the representatives are elected by the assemblies of the *ejidos* and indigenous communities.

It is expected that the elaborate and extended mechanism for systematic consultation with the community established by the Director of the reserve would enhance the informed support of the community to the conservation goals of the reserve.

However, securing the full and genuine support of poor local communities continues to be dogged by several problems. Most importantly, the assemblies of the *ejidos* are not genuinely representative of all sections of the community and includes only the heads of families which have land-rights in the *ejidos*. This excludes on the one hand families without land rights, the underprivileged *avecindados*, and on the other hand women, except when they are of single-women headed households.

A second problem is associated with the creation of the reserve without changes in the tenure regime . This means that local populations own lands bearing forests, but are restricted from harvesting its resources, without being paid any compensation. If the conservation movement genuinely arises from the community, as is the case in our second case-study, this may not be a serious problem. However, in a more 'top-down' model like the one presently under discussion, it can create serious conflicts of objectives.

We have observed that the role of local communities in the setting of conservation goals and planning strategies in the past was mostly passive, and that this is sought to be corrected. However, even apart from this, what remains a matter of concern is that the implementation of the conservation strategies does not actively involve the community. There are for instance no volunteer squads of the community for putting out forest fires or for guarding the forests against illegal felling, and no system for community self regulation.

UZACHI: The Experience of a Union of Indigenous Communities in Oaxaca

The second experience included in this study, of the UZACHI, a union of indigenous communities in the state of Oaxaca, a strikingly successful example of vigorous and professional action directly by traditional Indian communities in seizing control of and in the protection, management, regeneration and sustainable use of their dwindling forest resources. It is a rare example in which the external agent, in this case an NGO, did not initiate the process of community control, but was instead invited by the community to provide critical technical and networking assistance to the community organisation after the community had, as the result of its own suo-moto organised action, regained control of the forests.

UZACHI is a union of 4 communities, Compaltepec, Capulalpam, Xiacui and La Trinidad, of 2 ethnic indigenous Indian tribes, the Zapotecos and the Chinantecas, which own a total of 24,996 hectares of community land, of which as much as 21,895 hectares are forests. Although this area has out been formally declared a reserve, levels of protection and sustainable use enforced by the community are in fact far superior to those encountered for instance in the first case included in this paper, of the biosphere reserve of Sierra de Manantlan.

The vibrant community based forest management observed today in the UZACHI, has its roots in a prolonged, often bloody, struggle by the local indigenous communities to regain control of their commercial lands and forests. They had been dispossessed in the 1850, with the imposition of private property on the pre-Hispanic system of communal ownership and management of indigenous lands, and the conversion of these communal lands into massive estates or *haciendas*. After the agrarian struggle of 1910-1917 as part of the Revolution, rights of peasant communities over their community lands was once again recognised by law.

However, after the Second World War, peasant communities were barred from the commercial use of their forests, and the state assumed this domain even for forest lands owned by peasant communities. The government gave private national, international and para-state companies 25 year concessions' to commercially exploit the forests.

For the forest owned by the 4 communities that later formed a the union named UZACHI, a former Canadian company Tuxtepec had been awarded rights of commercial extraction by the federal government. A prolonged struggle by the individual communities, involving resolute direct (and sometimes violent) political action and petitioning the courts, yielded suspension of the timber exploitation permit of the paper company in 1981 and its final cancellation in 1983.

What is important to note here was that despite community ownership of forest lands, the federal government started from a position of intense, and corrupt regulation, which in practice meant handing over control of even community lands to private and often foreign paper and lumber companies, whose objectives tended to be extremely short term and recklessly extractive. In 1980, practically all community forests of commercial value were under the 'concessionary' control of private industry.

The struggles of the 4 indigenous communities in the Sierra Norte de Oaxaca, which subsequently came together to form the UZACHI union, were not unique. During the 1980s, indigenous communities all over Mexico fought for restoration of their control over their forests and the expulsion of private industry, and government gradually yielded to these demands, mainly by withdrawing. Peasant communities were now left free to draw up their own forest management plans, and to exploit on preserve their forests according to their own decisions. Today in Mexico, there are 3079 local rural peasant communities thus managing their own forests. This has been described (Bray,1995) as **the largest experiment with community based forestry in the world.** The results, however, have been mixed. The experience of the UZACHI recounted in this paper has been one of the most successful.

It must be stated at the outset unambiguously that the primary motor that has energised the local communities to organise themselves and to struggle so resolutely to regain control of their lands, and has sustained them in their highly professional forest management decisions during the past are decade since the formation of the union, has been their concern to ensure sustainable profits and livelihoods from the exploitation of the timber wealth of their forests. They are not motivated primarily to preserve the bio-diversity of these forests for its own sake, even though culturally they have a reverence for forests and living things.

Once the communities regained control, the UZACHI union was acutely conscious of the need for technical guidance as well as networking for funds and markets. Government policy was by this time effectively one of 'laissez faire'. The union therefore invited the NGO, ERA, and together they have developed what in many ways is a highly productive, and yet non-dependent, relationship between an active local community and a highly professional external agency.

Whether it was enlightened community self-interest, or cultural factors, on both, that motivated the community, but the end result has been extremely favourable to bio-diversity conservation objectives. As the end-product of an elaborate procedure of community consultation, a forest management and land-use plan has emerged, which earmarks only 8,613 hectares out of a total forest area of 21,895 hectares (39.33 per cent) for forest production. Even out of this, more than half (4,475 hectares) are earmarked for domestic use base firewood and house construction. On the other hand, a total of 13,037 hectares (59.54 per cent) has been earmarked for protection. It would be clear that this is a highly enlightened plan, aiming at a high degree of protection.

The subsequent steps for preparation and operationalisation of forest management plans were as follows:

1. The first stage, from 1987-91, was one of overall appraisal and strategic inventory gathering . For accomplishing this task, the NGO, ERA, mainly trained young people from the community with high school degrees for this work, to collect critical social and economic information and to prepare a forest and socio-economic inventory.
2. The second stage, with some degree of overlap, from 1991-93, was one of negotiation with principal stake-holders of the community, such as agriculturists, landless workers, forest workers, people engaged in mining etc. The NGO and the technical directorate of the union held a series of rural communal participatory workshops with stake-holders in the 4 communities.

   This elaborate process of systematic community consultation led to a broad consensus regarding land-use of the community, into the following broad categories:

   (i) Forest production area, further subdivided into
      (a) domestic use area for firewood and house construction; and
      (b) commercial use area for timber extraction.

   (ii) Forest protection area, for
      (a) watershed and protection of natural fountainheads;
      (b) wildlife;
      (c) recreation,
      (d) untouched areas for bio-diversity conservation

   (iii) Restoration area for areas that are
      (a) over exploited;
      (b) affected by fires; and
      (c) affected by pests

   (iv) Areas for agriculture and grazing.

3. The third step was to develop a consensus on the policies to be followed for each of these zones. Here again, the technical directorate with inputs from the NGO gave technical information, and a range of options with implications to the community, and reached a consensus about policies.
4. The last stage of the strategy is to operationalise these policy decisions. At this stage, the involvement of the community is less intense, and the NGO, professionals and community leaders play a more active role. But even here, the effort of the NGO is to build the capacity of community leaders for eventual independent decision making in consultation with the community.

At the apex of the UZACHI is the assemblies of the 4 communities. The heads of all families, whether with or without land rights, are members of each assembly. In this way, the assembly is much more representative than that of the *ejidos* of non-indigenous land communities, which as we have seen in the context of the first case study, excluded those without land rights. However, it remains unrepresentative of women, unless they head the households.

Each Assembly controls its designated forest area, and runs a saw mill. A Council of Administration oversees the running of the communal enterprises. Each assembly elects 4 members to the assembly of delegates of the union. From among the assembly of delegates is democratically elected an honorary Council of Administration, for management of land, forests and general administration, and an honorary Council of Vigilance, again to ensure no corruption. Working under these is the technical directorate, with paid employees.

The UZACHI is strikingly successful on a wide variety of yardsticks as an effort of community based forest management. We have seen that even though the area under its control has not legally been declared a protected area, the community has itself chosen to earmark a significant part of its forests (almost 60 per cent) for protection, and enforcement is outstanding because it is the result of a genuine community consensus. The union was able to build an elaborate structure for on-going forest management, comprising honorary community leaders and delegates on the one hand, and paid technical hands on the other. The former successfully built on the pre-Hispanic Indian tradition of life-long obligations for volunteer service, and the latter on systematic and highly successful capacity building by the NGO. Both these wings of the union structure are performing their duties with high professionalism and self-confidence, and increasing autonomy from the NGO.

Although the paramount motor for the community efforts was not doubt to ensure revenues and livelihoods from the forests, the decisions of the UZACHI in the short period that they have assumed control of their forests have been extremely responsible and professional. The volume of timber to be harvested every year is discussed in the assemblies, along with the community organizations and specific responsibilities for control of fires and surveillance of the forests. This is more intensive and effective than the system of protection in government forests in Mexico today.

The only major limitation on the sustainability of this effort is funding. Government withdrew in the 1980s in favour of control of community forests by communities, but although more recently it has provided moral support and legal backing to community action, it has not provided funds. This carries the danger for enhancing pressures for extractive use of forest wealth. There are also dangers inherent in leaving local communities to their own devices, to seek out funds, especially in the present globalised economy. Local communities are negotiating with powerful multi-national companies, with inherent dangers of the latter establishing afresh their hegemony over the natural resources of poor communities once again, but this time from the back door.

Lessons from the Mexican Experience

Mexico and India share in the enormous diversity of their ecological zones, in the richness of their mega bio-diversity wealth, and in their cultural wealth of indigenous tribal populations. However, they have vastly different political and economic systems. India, since its Independence, has sustained a parliamentary democratic political system, and until recently pursued a proud policy of economic self-reliance (or what its critics would describe as a policy of over-protection of national industries in a socialistic, planned economy). By contrast, Mexico since the Revolution has mostly been led by military regimes, and has opened its economy after the Second World War to large multinational companies, particularly of North America, which operated with few restraints and regulations. In the context of forests, in India most forests are owned by the state, whereas in Mexico, around 70 per cent of the forests are owned by peasants communities. Even so, there are important lesson that India can derive from the recent Mexican experience of community-based forest management.

The first, and most significant lesson from the Mexican experience is that rural peasant communities *can* take the lead in highly professional and responsible forest management, and through genuine community consultation and consensus, earmark and enforce significant forest regions for high degrees of protection. It is instructive to contrast the two specific experiences from Mexico included in this paper. In the first case, the university of Manantlan without extensive community consultation, prepared a technically sound plan and secured legal sanction for the establishment of the biosphere reserve. Even so, in the absence of active community involvement, the quality of actual preservation of the core area is still not satisfactory. By contrast, the forest areas of the UZACHI have still not been declared under law to be protected areas, even so because the movement for protection was initiated by the community, and the land-use and forest management plans were prepared with a high degree of community consultation, the degrees of both proposed and actual protection are significantly higher than in the statutory biosphere reserve.

The second important lesson from the UZACHI experience is that even for indigenous communities with strong traditional cultural bonds with the natural environment, the major motor energising the community to establish control over and manage its forests, is the desire to preserve the potential of the forests for profits and livelihoods. In other words, except in rare circumstances, it is unlikely to expect rural communities, even indigenous communities, to be impelled to preserve the bio-diversity of which they are immediate custodians, only for the sake of promoting goals of conservation. They are much more likely to be motivated by goals of sustainable extraction.

However, this is not necessarily inimical to the achievement of conservation goals. As we have seen, informed and enlightened self-interest, with no legal or state imperatives whatsoever, still led the communities to set aside as much as 59.54 per cent of their forests for complete protection, except non-extractive, non-consumptive uses. Therefore, our conclusion is that left to themselves, if rural communities perceive forests as potential sources of sustainable livelihoods and revenues for themselves, and if they are assisted in seeing that this can be achieved sustainably only with significant degrees of protection, sustainable use goals are compatible also with high degrees of community protection of their bio-diversity.

The third important lesson from the study of the Mexican experience has been with regard to the role of the external agent. Again, in the first case of the Sierra de Manantlan Biosphere Reserve, leadership was provided by an activist university which played a role similar to that of an NGO, to establish conservation goals, to work with government to establish the legal and administrative mechanism to enforce these conservation goals, and to educate the community and win its support for these conservation objectives. By contrast, the UZACHI achieved far greater success because the initiative for the ecological movement arose genuinely and suo-moto from the community, and the NGO, ERA, was invited in later as a partner and technical consultant.

However, the fact that in case of the UZACHI the NGO did not play a leadership role, does not mean that its contribution was not critical. On the contrary, the replicability of the UZACHI experience is limited because there are not many NGOs that combine the high degree of technical professionalism with the conscious detachment achieved by ERA.

The greatest success of ERA, which is a model for all external agents seeking to facilitate rural community management of bio-diversity and in fact all other kinds of community empowerment work, is that it so effectively provided its critical inputs of technical information and choices, but without creating dependencies. Instead, from the first stage of preparing the forest and socio-economic inventories, through the subsequent stages of negotiations with stake-holders and preparation of the land-use plans, it worked through local persons, often high-school educated men and women, whose capacities they systematically built in the course of these activities. As a result, in just a decade of this collaboration, both the community leaders and technical personnel are handling their responsibilities autonomously with high professionalism and self-confidence, and the NGO is in an advanced stage of withdrawal from its supportive work in the community.

The last major lesson from the Mexican experience relates to the role of the state in enabling, and facilitating, community management of bio-diversity. We have observed that in Mexico after the Second World War, the state had a highly controlled, and highly corrupt system of controls over forests, through which it awarded concessions for clear felling to national and foreign lumber companies, even of forests owned not by the state but by peasant communities. Peasant movements to regain control of their devastated forests in the 1980s, led to a complete reversal of these policies, in which the state withdrew almost completely from the sector. It was a swing from a tight but corrupt system of controls to one of almost complete decentralisation.

This withdrawal of the state from the forestry sector meant that local peasant communities were left to their own devices entirely to manage their forests, which constitute 70 per cent of the country's forest wealth. Local communities had to take their own initiative and find their own resources, to engage technical consultants to prepare their forest management plans, to run their forest production units, and to negotiate the globalised markets for their products. There were some communities, like the UZACHI, which were conscious, proud, capable of establishing strategic links with NGOs and universities, and handling world markets, while maintaining their own world-view. But there are a large number of counter-examples where communities lacked both these competencies and strategic support from external agents, and because of the passivity of the state, the danger is a very real one that powerful corrupt national and foreign interests can again seize control over the community-owned bio-diversity of poor peasant communities of Mexico, albeit through the back door. Thus, neo-liberal policies have 2 faces, one of which facilitate decentralisation and community control, another which create an enabling environment for re-entry and effective control by powerful globalised industry.

The most thorny related question that remains is the issue of what kind of state is most conducive to the development of community initiatives. If one is to generalise from the Mexican experience, the levels of community initiative for protection of bio-diversity among some indigenous communities of Mexico, largely unmatched in its scale, vigour, technical proficiency and autonomy in the Indian experience, arose initially in the context of highly centralised and corrupt military government. The ecological community movement in Mexico was consolidated in a situation inspired by neo-liberal economic philosophies, a situation of almost complete withdrawal of the state from the forestry and rural development sectors. In India, both situations are not found, either of centralised non-democratic political regimes, or of laissez-faire in the sectors of ecology and rural development, nor do we believe that they are desirable. The difficult question, however, that can only be answered with far greater empirical research and socio-historical evidence, is whether a paternalistic welfare state but one with a weak and corrupt delivery system as prevails in rural India, actually inhibits proud, conscious, autonomous, self reliant and technically sophisticated action by local communities, both for the protection of their threatened bio-diversity, as well as for solution of their problems of livelihood, survival and justice.

In Mexico, the best thing that government did to enable community control over forests, seems to have been to withdraw, or what may be described as its de facto policy of complete decentralisation and deregulation. This has resulted in the last decade and a half in Mexico in what some experts describe as the biggest experiment with community based forestry in the world (Bray, 1995). It has been estimated that above 2,000 rural communities principally on the central and southern portions of Mexico are involved in some kind of environmentally motivated action (Toledo, 1998).

The virtual disappearance of the state from the sector of bio-diversity conservation in Mexico, is possibly at least in part the result of neo-liberal economic policies that are holding sway worldwide. Even though this had the unintended effect of unleashing such major community initiatives, it is our conviction that the state can and must play a role in bio-diversity conservation, not of the corrupt controls and collaboration with the lumber industry of the past, but an active role in leveling the play field for local communities, supporting them with funds, with technical inputs, and in striking strategic links with NGOs and universities, in negotiating globalised markets, and with legislation.

In summary, then, we are arguing that decentralisation is desirable because it releases bio-diversity from the stranglehold of corrupt, unaccountable, centralized controls. But decentralisation must not be interpreted to mean the abdication of state responsibility for bio-diversity conservation, or for that matter for livelihoods of the poor. The state remains responsible to actively and creatively support decentralized community forest control and management. Thus decentralisation should be carefully nuanced, not to legitimise the withdrawal of the state from its responsibility for bio-diversity conservation, but to alter its role from one of over arching control to one that genuinely facilitates and supports decentralised community action.

Acknowledgements

This paper was written against a number of serious constraints, of time, language and culture of Mexico; and the host organizations were welcoming but naturally also very busy with other preoccupations. That the paper could still be written was due to the generous time, inputs and insights which I received from Dr. Jorje Soberon, Dr. Eckart Boege, Dr. Edvardo Santana, Mr. Salvador Garica Ruvalcaba, Ms. Dominique Louette, Mr. Sergio Graf Montero, Mr. Mario Montano, Dr. Enrique Jardel, Mr. Fransisco Chapela Mendoza, Prof. Reynaldo Lopez Garcia and Mr. Ricardo Ramipez Dominguez. I am also especially grateful to Dr. Victor Toledo for his unpublished article 'Bio cultural Diversity and Local Power in Mexico: Challenging Globalization', in: L.Maffi's (ed.) (1998) Endangered Languages, Endangered Environments, in press, which gave me many valuable insights into community based forestry in Mexico, and Mr. Shekhar Singh from whom I learnt a lot about the subject.

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Communities Acting for Conservation: Participatory Management of Coastal Resources in Southern Thailand

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SUMMARY

This case study is based on a number of conservation and development initiatives being carried out through a network of Small Scale Fishermens' Clubs and a network of NGOs in southern Thailand. The study highlights issues related to participation in biodiversity conservation, the linkages between traditional livelihoods and conservation, the role of different partners and institutions in initiating and sustaining conservation and the importance of addressing policy for achieving long-term change.

The study is based on work being carried out by communities and NGOs in Pattani and Phang Nga Districts. It first describes how the initiative got started and how it evolved. Some of the conservation activities being carried out by the community groups and NGOs are also briefly introduced. The role of NGOs in supporting and facilitating these activities is discussed. Some of the key factors for the success of the initiative are synthesised and lessons that can be transferred to other similar initiatives are highlighted. Finally, the paper highlights some constraints and limitations that might be faced in applying this strategy to different situations. The conclusion briefly discusses the importance of this approach in "mainstreaming" biodiversity conservation.

Introduction

This case study attempts to highlight participatory approaches to coastal resource conservation in Thailand. While many of the conditions that have contributed to the success of the initiatives are specific to the country and the site, we feel that there are lessons to be learnt from it which could be of great use in designing participatory conservation strategies in India.

This particular case was selected because we feel that it is 'unique' and important in several ways: it focuses on coastal/marine resource conservation, which generally tends to get less attention than terrestrial/forest resource conservation; it was initiated primarily by the communities rather than by external agents; it clearly demonstrates the linkages between local livelihoods and sustainable resource use; it demonstrates roles of different stakeholders working in partnership towards the same goals; it has a strong focus on participatory research and monitoring; it has had a significant impact on local and provincial level policies; and, it highlights how communities can take control of conservation when government agencies and legislation fail to do so.

Sources of information that contributed to this paper included reports (in English) written by local NGOs as well as research/monitoring data (in Thai) collected by the communities. Extensive discussions were held with the staff of various NGOs involved in this initiative as well as with local community groups and leaders during site visits.

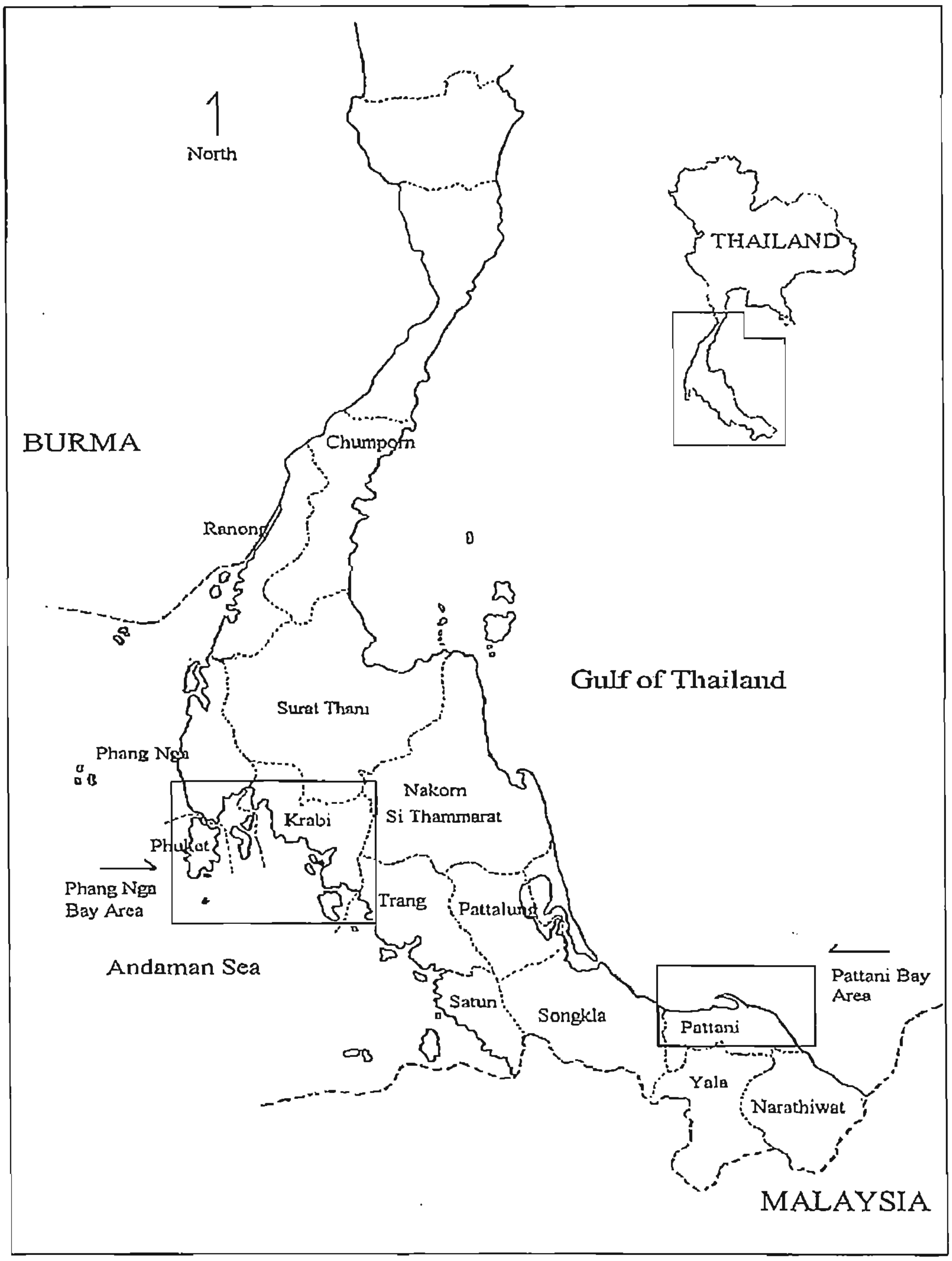
Background

Location

While many of the initiatives described in this paper are taking place all over southern Thailand, this report focuses primarily on the provinces of Pattani and Phang Nga.

Pattani: Pattani Province is located on the eastern cost of southern Thailand in the Gulf of Thailand and covers an area of 1,940 sq. km. It consists of three main zones: the *coastal zone* to the north and the east of the province, which is made up of white sand beaches along the coastline; the *flat plain zone* to the center and the south of the provinces which comprises most of the area of the province and is composed of fertile agricultural land; and, the *mountain zone* in the extreme south of the province and is part of the Sangalakiri mountain range. The area that is of significance for this report is the coastline, which is 116 km in length. In particular, the report focuses on the bay that lies along this zone, Pattani Bay, covering a water surface area of 53 sq. km.

Phang Nga: Phang Nga province is located on the western part of southern Thailand on the Andaman Coast. The Andaman Coast can be divided into three geographical areas: the *upper Andaman coast*, where the coastline quickly drops off to deeper waters at the continental shelf and has many small shallow bays between the coastline and deeper waters; the *middle Andaman coast* or the Phang Nga Bay area which is made up of mangrove forests, sea grass beds and coral reefs; and, the *lower Andaman coast* which has the longest coastline of the three areas and covers two of the southern provinces of Thailand as well as many large islands. The focus area for this report is the Phang Nga Bay area, which also includes Phang Nga Marine National Park.



Conservation Values

Both Pattani and Phang Nga have high biodiversity values. Pattani Bay is located in an estuary zone that forms an important national and regional wetland. The fertility in this estuary is known to be higher than that of other areas in the Gulf of Thailand partly because of the major rivers that flow into the Bay, bringing in a constant supply of nutrients. This makes Pattani Bay an important breeding and feeding ground for a large number of marine species. Studies have shown that the biological richness in Pattani Bay is very high and that it contains some of the best remaining mangrove forests on the eastern coast of Thailand. Currently, this area does not have any *legal* conservation status.

The Phang Nga Bay area is one of the most important areas in the country in terms of coastal biodiversity. Coral reefs, sea grass beds and mangrove forests provide important habitats for a great diversity of marine, coastal and terrestrial species. In addition, the area is also an important habitat for the endangered dugong as well as a nesting site for at least three species of marine turtles (leatherback, olive ridley and green).

Social Setting

Fishing and farming are the main livelihoods of the people living in Pattani and Phang Nga. This report focuses on the small-scale fisherfolk living in the coastal areas of these districts. The fisherfolk, nearly all of whom are Muslim, are ancestors of those who moved up from the areas which are now part of Malaysia nearly 200 years ago.

Due to their migration routes and form of livelihood, most of the communities are located on the coast in bays, at the mouths of rivers, along rivers, or on the islands which are not far from their fishing grounds (normally not more than 2 hours travel by boat). Houses are built in clusters because of limited land availability and the need for mutual assistance. Until recently, the fisherfolk paid little attention to land ownership and most of them are thus lacking title deeds.

The small-scale fisherfolk work all the year round for up to 24 days each month, although there are three periods when they do not go out to sea or can catch only small amounts. They largely fish close to the shore. Their fishing equipment is simple, based on traditional methods of fishing and non-destructive in nature and includes fish gill nets, shrimp trammel nets, crab bottom gill nets, cast nets, hooks and bamboo traps. Some fishermen still use small boats with no engine, manned by one person. Most boats are now equipped with a 'long-tailed' engine (1-7 hp) which allows them to go further from the shore often and need one assistant. Those without a boat make their catch from the shore or from fishing in the mangrove forests.

The lives of the small-scale fisherfolk depend solely on the sea and its resources. This way of living is hard and risky and most fishermen must use their earnings immediately. They thus have few or no savings. In the past, due to their religious beliefs and culture they led simple lifestyles highly dependent on nature. This is still true to a large extent and their kinship ties are still very strong.

Conservation and Development Issues and Problems

Many of the conservation and development problems in both Pattani and Phang Nga are similar. A key problem is the over exploitation of coastal and marine resources. This has a negative impact on both biodiversity as well as the livelihoods of the small-scale fishermen. Other problems include increasing urbanisation and industrialisation, impacts of tourism, expansion of shrimp farming and destruction of mangrove areas. The main issue discussed in this paper is the first one, i.e. the loss of biodiversity and livelihoods through destructive fishing practices.

Unlike land based resources, coastal and marine resources are considered common property resources which can be used by all people as long as they are not exploited unsustainably. Until recently, this system worked quite effectively and both Pattani and Phang Nga Bays were rich in marine resources. However, with decreasing fish catches elsewhere, more and more people from other provinces are moving into these areas. Along with this increasing pressure, the introduction and uncontrolled use of modern fishing technologies has also changed the situation. Marine and coastal resources are now considered "open access" resources, resulting in the degradation and destruction of marine species and their habitats.

One of the biggest threats to both biodiversity and livelihoods in the region is the increasing numbers and size of mechanised boats using push nets and trawl nets, along with the increasing encroachment of these vessels into the restricted 3000m zone. Even more than 50 years ago, it was apparent that these techniques were extremely harmful for future regeneration of marine species. The Fisheries Act of 1947 declared the use of mechanised push nets and trawl nets within 3000m of the shoreline as illegal.

The traditional fishing methods used by the small-scale fisherfolk are highly selective in the species caught and generally do not have any long-term negative impacts on marine resources. In contrast, push nets and trawl nets tend to 'scoop up' all fauna, regardless of species or size. This is an extremely wasteful form of resource exploitation as up to 60% of the species caught may be non-target species and are generally sold cheaply as "trash" or by-catch. In addition, this method of fishing tends to catch both mature and immature animals, which affects future regeneration as well as livelihoods since prices for smaller animals are lower than those for mature ones. One study showed that up to 40% of the catch from push nets and trawl nets consists of juvenile fish.

Push netting becomes even more ecologically and economically destructive when it is illegally carried out within the 3000m zone. Here, the fishing equipment devastates breeding and feeding grounds of marine species by destroying coral reefs, sea grass beds and other habitats. With increasing competition and decreasing catches on the high seas, more and more trawlers equipped with push nets and trawl nets are encroaching into the ecologically fragile 3000m zone, with very serious impacts on the ecosystems and biodiversity of these areas.

The people who bear the brunt of the destruction of coastal ecosystems are the small-scale fishermen who fish close to the coastline using traditional fishing gear. Over the last 15 years, these fisherfolk have seen the increasing encroachment of push netters into their fishing areas totally destroy their once plentiful source of livelihood. In addition, the trawlers carrying the pushnets, which are much larger than the traditional fishing boats, often destroy the standing nets of the small-scale fishermen.

This loss of biodiversity and therefore of their livelihood has had many negative socio-economic impacts on the small-scale fishermen. These include increasing indebtedness and a high level of unemployment. Drug abuse, especially among the youth is also increasing. Many fishermen have migrated to neighbouring countries to work as illegal labour on rubber plantations or fishing boats. A more serious consequence is that some small-scale fishermen have started taking loans to buy their own push nets and trawl nets as they feel this is their only way to make a living any more.

Government legislation and enforcement have been largely ineffective in controlling this problem. A recent study found that although the government had a register of boats with push nets, the actual number of such boats (registered and unregistered) was at least four times as high. Although there are supposed to be fines imposed for encroaching into the 3000m zone with a push net, these are rarely enforced. Patrolling is almost non-existent and most push netters operate with impunity within the 3000m zone without fear of being arrested. This has led to some very serious conflicts between the traditional fishermen and the push netters.

Community Action

This section gives a brief description of the action taken by communities in partnership with NGOs and other external agencies to address the problems of destructive fishing and the loss of coastal and marine biodiversity.

Initiation

Over the last few years both the small-scale fisherfolk communities and local NGOs had been getting increasingly concerned about the situation and government apathy towards it. Somewhat independently, both groups decided that something needed to be done to address the loss of biodiversity as well as the increasing poverty in the area. While the initiatives emerged separately and had differing aims to begin with, they soon converged to develop into an exciting and innovative initiative for community based conservation and management of coastal resources.

About five years ago, local village groups of small scale fishermen started meeting to discuss the issue of destructive fishing and the impacts of this on their livelihoods. A year later, with the help of local NGOs, 100 village representatives from eight southern provinces held a meeting to further discuss these issues. During this meeting, they discovered that they had many issues in common. They decided to form the Federation of Small Scale Fishermen to address these in a coordinated fashion.

Following this, the small-scale fishermen held regular meetings in each of the provinces over the next couple of years. During this time, the organisational structure of the Federation was set up, problems and opportunities related to resources and livelihoods were discussed, and strategies were developed and implemented. Local NGOs played a key supporting role through these stages both by helping to finance the many meetings and by acting as facilitators during the meetings.

However, this role of the NGOs evolved over the course of time. Initially, the NGOs started their activities in the area with a series of *ad hoc* activities focused around awareness raising on conservation issues. These included developing information materials on marine ecosystems and popular campaigns focused on single species like turtles and dugongs. The different NGOs rarely coordinated with each other in the planning and implementation of these activities, most of which lacked continuity or follow up.

At about the same time that the small-scale fishermen were starting to organise themselves, the NGOs also started networking with each other better. They realised that the key to long term conservation of coastal resources in the area was to empower the small-scale fishermen to manage these resources themselves. The NGOs also developed links with local research institutions and sympathetic government officials. Together, these groups have provided an important and invaluable support to the small-scale fishermens' groups through funding, research, networking, capacity building, coordination and facilitation.

Most activities are planned and implemented by the communities, with NGOs playing a supporting role in some and no role in others. For some 'cross-cutting' activities such as training/capacity building, networking, research, surveys, monitoring, and policy linkages NGOs might play a more active role. These activities and roles are discussed in section 5. The activities described below are not exhaustive and are specifically focused on conservation issues.

Boundary demarcation: Since the encroachment of trawlers with destructive fishing gear into the 3000m restricted zone was one of the biggest problems, communities in Pattani decided to demarcate this boundary physically as a first step towards controlling the encroachment. The villagers used traditional materials such as bamboo and palm fronds to demarcate this boundary. After they had demarcated 3 km of the boundary, they invited provincial and district level government authorities to see their work and discuss the issues of illegal encroachment. The government authorities were impressed by the initiatives undertaken by the villagers and took on the job of boundary demarcation themselves. Currently, 116 km of boundary along the coastline has been demarcated.

In Phang Nga, the small-scale fishermen have been waging an ongoing campaign to get the boundaries of the Conservation Area around the Phang Nga Marine National Park extended. The original boundaries of this Conservation Area (where only small-scale, sustainable and non-destructive fishing practices are allowed) were modified to exclude almost half the area because of pressure from trawler operators. The Fishermens' Clubs are now pressurising the Fisheries Department and the Royal Forest Department to re-instate the original boundaries of the Conservation Area and exclude trawlers from this zone.

At the macro level, the small-scale fishermens' groups are pushing for better implementation of the 3000m legislation as well as lobbying for a policy change to increase the restricted fishing boundary from the existing 3000m to 5600m.

Traditional artificial reefs: In Pattani, after the boundary had been demarcated, the fishermen observed that shoals of fish had started moving towards this boundary. This was discussed during village meetings and the villagers concluded that the materials used for the boundary were providing "safe areas" for fish. On further discussion with elders in the community it emerged that the boundary was mimicking a method of developing artificial reefs *(sung)* that had been practised earlier but had been long forgotten.

After a series of discussions, the fishermen decided to revive this traditional method and to place these *sung* along the newly demarcated boundary in order to rehabilitate marine resources. Each *sung* consists of a bamboo pole with coconut palm fronds tied to it. Sacks filled with sand are used as weights. Once placed in the sea, the sacks get embedded into the bottom and the fronds spread out to provide a refuge for marine fauna. The ends of the bamboo stems emerge out of the water, showing their location. Strict regulations are implemented on fishing near these sites (with only line fishing being allowed within a certain radius).

Immediately after the placement of a number of such traditional artificial reefs, the fishermen initiated a study to determine the impact of these reefs on marine resources. There was a steady upward trend in the amount of catch (using different species of shrimp and crab as indicators) from the first month after the placement of the reefs. However, the fishermen realised that they could not prove that this was because of the reefs and the control and management of the area as they had not collected baseline data before placing the reefs. They therefore collected official fishing records of the previous three years (based on the market records) to verify this.

Based on the study, it became apparent that the placement of the reefs was an important conservation strategy. Not only did they lead to a direct increase in the quantity and diversity of marine resources, but they also made it easier to control the infringement of the boundary by illegal vessels. It also showed that given adequate protection, coastal and marine resources have a remarkable rate of recovery that allows for long term sustainable harvesting. Many species such as bottle nosed dolphins, black fin sharks, sting rays and sea turtles that had not been seen in the area for over 30 years were now starting to return.

Once again, the communities invited government officials including the provincial Governor to examine their work and discuss implications. In particular, the villagers shared the results of a study they had undertaken comparing the traditional artificial reefs developed by them with the steel and concrete reefs being erected by the Fisheries Department. The fishermen felt that the concrete reefs were expensive to construct and not maintained because of lack of ownership. Their location was often inappropriate because fishermen were not consulted before they were put in place. They also often destroyed the gear of traditional fishermen because their locations were not marked. Impressed with the work of the communities, the government agreed to collaborate and even fund the traditional artificial reef programme.

Patrolling: In both Pattani and Phang Nga, local communities have all but taken over the role of the government in trying to ensure compliance with legislation which limits fishing within the 3000m boundary from the coast. Community members take turns to carry out patrols

Organisation

Currently, the Small Scale Fishermens' Network and a loose coalition of NGOs (and donors) are working together for coastal resource conservation and management in southern Thailand. A major donor for the activities of the network as well as some of the NGOs is DANCED (Danish Cooperation for Environment and Development). A number of other national and international donors also fund the various NGOs. The organisation of the community groups is as shown in the table below (this can vary from site to site, but the general structure is more or less similar):

Organisation	*Level*	*Decision-making Structure*	*Frequency of Meetings*	*Activities*
Fishermens' Clubs	Village, Sub-district & District	Elected Chairman, vice-Chairmen and Committee made up of representatives from each village	Daily or Weekly	Relatively localised, covering one or more villages eg. patrols, community forests, conservation areas, etc.
Fishermens' Associations	Provincial	Elected representatives from each District level Club	Monthly	More 'strategic' eg. lobbying at provincial government level, etc.
Small Scale Fishermens' Network	Regional (Southern Thailand)	Elected representatives from within provincial representatives	Quarterly	Coordination (eg. with donors & other community organisations), administration (funds allocation, etc.) and lobbying at national level

At present there are about eight different (local and national) NGOs working with the Network in southern Thailand on conservation and development issues. While most of the NGOs have different sources of funding and their own individual "projects", they all work within the framework of a common vision. Their work is divided up not so much by different ideologies and strategies but by geography. Different NGOs generally work in specific areas and each province has at least one NGO working in it. Some, like the Andaman Project and Wildlife Fund Thailand work in more than one province. In such cases, staff of different NGOs often work together on each others' "projects". The NGOs meet regularly once a year when they discuss problems, opportunities and strategies while reaffirming common objectives.

Objectives

For a complex initiative such as this one, which involves both internal and external organisations at various levels, it is difficult to describe a specific set of objectives as these may vary from organisation to organisation. However, since many of the activities described below are actually implemented at the sub-district or district level, it might be useful to describe the objectives of a "typical" District level organisation to gain a better idea of what these organisations are aiming to do.

The objectives of the Small-Scale Fishermens' Club of Nong Jik District, Pattani Province (made up of six villages) are:

- To eliminate illegal fishing and the use of destructive fishing gear within the 3000m coastal boundary
- To rehabilitate and conserve coastal and marine resources
- To coordinate the union of small scale fishermen in Nong Jik District
- To collaborate with external organisations, both government and non-government to resolve problems

Activities and Results

This description of some of the key activities undertaken by the Network (through the Fishermens' Clubs at different levels) and the NGOs is mainly based on the two sites described earlier, Pattani and Phang Nga. The activities are linked to a range of objectives, many of which are similar to those described above. While the activities have been "isolated" for the purpose of this paper in order to provide a "flavour" of the kind of work being undertaken by the community groups and the NGOs, they should not be seen as such. All of them have emerged through a long process of consultation, negotiation and analysis carried out jointly amongst the different partners.

at night, using their own boats and their own fuel. Most village and district level Fishermens' Clubs donate to a Petrol Fund that helps purchase fuel for the patrols. In some cases, communities have set up co-operative stores where part of the profits go towards purchase of fuel for patrols and the repair of boats damaged by trawlers during patrolling.

Patrolling has always been a difficult activity not only because of the time and resources involved but because the illegal encroachers are often armed. In 1997, a fisherman from Phang Nga was shot and killed while patrolling by a trawler that was illegally operating within the 3000m boundary. Such armed conflicts are not unusual and the small-scale fishermen are usually the losers. In addition, enforcement was difficult because the fishermen did not have any legal authority to arrest encroachers and official complaints against them usually had little effect.

This situation is slowly changing as the awareness of the local government increases and the scale of the problem becomes more apparent. A formal request made to the provincial office to supply an enforcement task force of 10 persons and a boat to assist with law enforcement was agreed to. Now the villagers in Pattani are usually accompanied by an armed government official (from the police or marine police) while patrolling at night. Further work towards formalising this system of "participatory patrols" is under way and it is likely that implementation of this activity will be funded almost entirely by the Ministry of Agriculture and Cooperatives.

Conservation Areas: In both Pattani and Phang Nga, local communities are setting aside and managing areas of high diversity and strategic importance such as mangrove forests, sea grass beds and coral reefs as "Community Conservation Areas." The selection and management of these areas depends on a number of factors, such as status, threats, conservation & economic values. Sometimes an area under direct threat from cyanide fishing or push netting might be declared a Conservation Area. In other cases, community forest areas threatened by development pressures might be selected. Degraded areas left over from previous (badly managed) logging concessions also might be targeted for rehabilitation and management. Or areas of conservation and potential economic importance such as coral reefs and sea grass beds are set up as Conservation Areas within which no use of resources is allowed.

Villagers discuss these issues and agree on areas to be set aside as Conservation Areas. They also discuss, record, publicise and implement regulations for these areas, depending on the management objective (ranging from no utilisation to limited use to replanting). Once the areas have been selected, communities liaise with various government departments such as the Land Department, Forestry and Fisheries Departments to obtain official recognition for these areas. Often, they will invite a high-ranking government official to declare the Conservation Areas. Through these measures, most of the Conservation Areas have gained some level of official recognition and support but as yet there is no *legal* framework that supports the initiatives. Despite this, Community Conservation Areas are continuing to increase in number as more and more communities develop this management option.

Marine Turtle Conservation: Three species of marine turtles (leatherback, green and olive ridley), all endangered, nest on the beaches of Phang Nga. Turtle eggs fetch a high value in the market and it is common practice for nests to be dug up and the eggs sold for up to 30-50 baht each. Although one of the major turtle nesting beaches in the area, Sirinath National Park, is legally protected, poor enforcement means that turtles nesting here are still vulnerable to external threats.

With the assistance of local NGOs, villagers from Mai Khao have started a unique "buy-back" scheme to help conserve marine turtles. Whenever they discover a turtle nest that has been dug up by someone, they first try to persuade the offender to put the eggs back or "donate" them to the village Club. Failing that, they use community funds to buy up all or a proportion of the eggs from the person who discovered the nest (at rates that are slightly lower than the market rates but are still competitive). The eggs are then incubated by the villagers and the hatchlings released into the sea as soon as they are born.

This initiative was first promoted by NGOs several years ago but died out after a promising start for a number of reasons. Last year, the villagers themselves revived it and have now made it a key activity of the village Fishermens' Club. The factors that led to the activity being initiated again are probably linked to: an increased awareness about conservation on the part of the villagers; a few motivated and dynamic village members who have been promoting it; and finally, the profile and publicity generated for the village and the Club because of it. The villagers' conservation work has already appeared in the local media (newspapers, radio and TV) and is now being picked up by the national media. On 13 April 1998, a number of turtle hatchlings "rescued" by the villagers will be released into the ocean at a ceremony attended by the Governor of Phuket Province.

Since the survival rate of hatchlings released into the sea after artificial incubation is uncertain, villagers are now working towards more effective patrolling of the beaches and protecting the nests until the turtles hatch naturally. They also intend to raise awareness on the initiative among other villages and particularly within school children. They hope to be able to co-operate more effectively with local schools to help with patrolling and protection of the turtle nests.

Overall Impacts

The activities briefly described above have had a number of wider impacts, some of which are discussed in more detail in following sections. In general, the increasing ability of communities to take collective action and achieve results has led to their growing empowerment and confidence in tackling larger issues. Their increased exposure and capacity has also enabled them to directly source funds for a number of initiatives both from government departments and from external donors. There is increasing communication and collaboration between the communities and the government on a range of issues from joint patrolling to ongoing dialogue and open exchange of ideas and problems. The participatory survey, research and monitoring activities have helped develop a useful base on information for current and future decision-making.

In most cases, the pilot activities (combined with coordination, lobbying, and negotiation) have led to some level of policy reform, both at the micro and the macro levels. This policy influence has probably been the most important and effective impact of the initiative. Some of the policy changes that have occurred include: revoking of the policy to allow registration of new fishing vessels; inclusion of priorities related to conservation and development in the 8th 5-year plan of the national Government (such as eliminating push netting, banning mangrove clearing, rehabilitating ecosystems, and institutionalising participatory resource management); and allocation of local government budgets towards many activities initiated by the Fishermens' Clubs. In February 1998, a much awaited government decree was passed banning the operation of push nets in the whole of Pattani Province.

The socio-economic impact of the initiative has also been significant. Livelihoods and incomes from small-scale fishing have increased to such an extent that many people who had migrated out of the area are now returning. In just one village in Phang Nga, over 50% of the villagers are now debt free within the few years since the conservation activities were initiated. Social stability has also increased to a great extent.

Finally, in biodiversity conservation terms, the recovery of the coastal ecosystems as a result of the improved enforcement of regulations, increased awareness and local level conservation and management has been remarkable. Mangrove forests, sea grass beds and coral reefs that have been protected and managed by the communities are visibly improved and obviously more diverse. Species of both conservation and economic importance such as turtles, dugongs, dolphins, sharks, shrimps and crabs are increasing in number. And the number of people using destructive fishing gear continues to decrease steadily indicating that the results may be sustainable in the long term.

Role of NGOs

As briefly discussed earlier, local and national NGOs have played a critical supporting role throughout this initiative. This role is recognised by both the NGOs themselves as well as the communities. While the initiation of activities, implementation, monitoring and evaluation is primarily undertaken by the community groups, NGOs have helped create an environment which allows the communities to operate effectively. Some of the key functions and activities of the NGOs are described below.

Information Sharing and External Linkages

Communities recognise this as one of the most important functions of NGOs. Many community members are illiterate and even those who are not, are often too busy to keep track of external events and policies that might impact their lives. NGO staff, who regularly interact with local villagers and who are also well-connected externally, help to bridge this information gap. The timely sharing and joint analysis of information, whether it is a change in policy, funding opportunities, training workshops, meetings/ seminars or activities undertaken by other groups helps communities and NGOs take effective action on these issues. NGOs have also helped community groups develop, expand and strengthen linkages with a range of other players including local universities, different government agencies, donor organisations and small-scale fishermens' groups both within and outside Thailand.

Capacity Building

NGOs have played an important role in building capacity of community groups through coaching, training, learning by doing and reflection. This has helped villagers to more effectively undertake a range of activities including participatory action research, monitoring and evaluation, fundraising, and lobbying/advocacy. Through training and workshops, they have also helped strengthen communities' skills in problem analysis, project writing, small-scale business management, etc. NGOs have also helped organise study tours for villagers both within and outside Thailand to learn from the experiences of others facing similar problems. In February 1998, a group of villagers from Pattani visited fishing communities in Kerala, India who have long been involved in fighting for rights of small-scale fishermen. All this helps to strengthen the capacity of local organisations to campaign for policy reform and government support for their conservation and development activities.

Facilitation and Negotiation

Another key role of NGOs has been in that of coordination, facilitation and negotiation. One of their main tasks is to continually bring different stakeholders together in various fora and facilitate a process to help them air, discuss, analyse and resolve problems and issues. This includes bringing villagers from different areas together and bringing communities and governments together through meetings, seminars and workshops. This is an important strategy for the different interest groups to better understand each others' perspectives and come up with mutually acceptable solutions. It should be noted that the NGOs do not provide the solutions but rather help to create an environment that enables the key players to come up with these themselves. In cases of serious conflict or lack of trust, NGOs may play a more active mediation/negotiation role.

Awareness Raising

NGOs have helped to raise awareness on conservation and development issues and linkages both 'internally' and 'externally'. Information campaigns aimed at different target groups (local and national media, school children, policy makers, local groups) have been effective in raising the profile of the conservation and development problems and issues in the region and getting the support of local level actors. Several documentaries on the struggle of the small-scale fishermen to conserve their dwindling resources have been produced and aired on national and television. This has also helped to garner support of other groups such as academics and the media.

Funding

Finally, NGOs obviously have an important function in funding many of the activities that enable the community groups to function and network effectively. A large proportion of the NGOs' funds are used for helping to organise meetings, trainings, research and publications. Communities now have the skills to tap funds from government departments and donors directly for major conservation and development work and most NGOs do not fund "hard" costs (such as equipment or infrastructure). It is interesting to note that community groups do not see availability of funding as a major benefit of working with NGOs - they value the other roles of the NGOs much more.

Key Factors for Success

This section examines some of the key factors that have led to the "success" of this initiative. Some of these factors are related to the existing social and environmental setting while others are the result of actions taken by the communities or external partners.

Social Structure

One of the important factors for success has been social cohesion. Almost all the small-scale fishermen are Muslims and are bound through ties of kinship even with geographically scattered communities. This religious and social homogeneity has made it easier for community groups to understand and work with each other with minimal conflicts. The strong and mutually supportive social structure has provided a foundation for enabling the network to function together rather than as a number of scattered initiatives with different objectives and strategies.

Quick Results

When questioned as to what keeps the communities working together against huge odds and powerful competing interests, one of the replies is "we can see positive impacts immediately". The resiliency and rapid recovery rate of marine ecosystems has played an important role in maintaining and strengthening community interest in conservation. After only a year of enforcing regulations and establishing Conservation Areas, the regeneration of ecosystems and resources was clearly visible. Communities could begin sustainable harvesting of these resources within a very short time and incomes began increasing within the first year of protection. This is obviously a great incentive for communities to continue and expand their conservation initiatives.

Conservation and Development Linkages

The direct link between biodiversity conservation and the existing livelihoods of small-scale fishermen is probably the single most important factor for the high level of community involvement (in fact, for communities taking the lead) in this initiative. Fishing is the only source of income for most of the small-scale fishermen. Therefore the loss of biodiversity through over fishing and destructive fishing by 'outsiders' has an immediate negative impact on their social and economic well-being. Again, this provides a strong incentive for them to act towards reversing this loss of biodiversity, maximising recovery and ensuring that resources are used sustainably in the long term.

Self-Mobilisation

The fact that the communities faced a common problem which was having a serious negative impact on their lives contributed towards the self- mobilisation process by which this initiative got started. External factors contributed but the ideas, objectives and activities were generated largely by the communities. This gave communities a strong sense of ownership over the process and outcomes and once again provided a strong incentive for them to want to succeed in their endeavours. It is also likely to contribute a great deal to the long term sustainability of this initiative even in the absence of external support.

Scaling Up

Like many conservation initiatives, the origins of this one were small, scattered and localised. However, within a few years the movement has spread widely throughout southern Thailand. At the local level, enough communities are taking part to allow development of a "critical mass" that can be mobilised for creating change within existing systems. The fact that the small-scale fishermen have an informal network through their kinship ties has helped the spread of the initiative. In addition, the fact that most fishermen, even if not related to each other meet at sea at some time or the other and discuss these issues has also played a role. The NGOs who help document and disseminate information have also helped. However, most importantly, communities themselves have recognised the importance of strengthening their impact through scaling up and have actively worked towards this. Community members with communication and leadership skills take on the role of 'catalysts' and actively engage in the spreading the ideas and methods to new areas and new villages. One of the early objectives of the Small-Scale Fishermens' Network was to expand the activities to all 13 southern provinces of Thailand. This pro-active approach towards scaling up has been an important reason why these initiatives have moved from being 'pilot' projects to a wide spread programme covering 13 provinces. It has also been an important reason for the policy impacts created by the initiative.

Policy Linkages

Realising that mere protests, demonstrations and "pilot" activities cannot achieve long term results, both community groups and NGOs focused on campaigning for policy change through demonstrated results and "educating" policy makers. This was done in many different ways: inviting policy makers to observe results of pilot activities; documenting and disseminating results to policy makers; organising meetings with government departments to discuss issues and options (for example, Phang Nga Clubs meet with the provincial governor each month to air grievances and get feedback); lobbying for policy reform with the help of NGOs; working through community members represented in local government boards; using 'higher level' relationships (eg. those between heads of NGOs and MPs) to push for national/provincial legislation, etc. Most activities initiated at the local level also had some sort of policy link which was actively pursued. For example, demarcating the boundaries of the 3000m zone was linked to lobbying for better enforcement, budgets and personnel for enforcement and expansion of the boundary to 5600m. Linkages were formed not only with the Fisheries Department but with a number of other government departments and agencies to ensure coordination.

Participatory Action Research and Monitoring

A key factor in being able to convince decision-makers about the validity of the activities and the reforms sought by the communities has been the availability of objective data to back these up. In collaboration with NGOs and local Universities, community groups have undertaken a range of baseline studies, action research projects and monitoring. Baseline data on number of pushnets, activities of the pushnetters, number of offenses, existing levels of marine resources, current socio-economic status of villagers, livelihoods and tenure, etc. have provided an invaluable basis for monitoring change. Monitoring of changes in marine resources is carried out regularly by the fishermen themselves and most of the Fishermens' Clubs have research teams' who undertake these activities. NGOs and academics help the villagers to analyse and present the results of the research and monitoring. This is then used to lobby for policy reform, law enforcement, and funding. In addition to participatory research and monitoring, the communities also regularly evaluate the overall impacts of their activities and make adjustments as necessary.

Conflict Management

The approach of the Fishermens, Clubs and the NGOs to external conflicts and internal dissentions has essentially been one of non-confrontation. Because of the 'democratic' nature of the Clubs, with elected representatives, conflicts over leadership have been minimal. Similarly, internal dissentions within members of the Fishermens' Clubs are of low frequency and intensity as they have formed the Clubs because of common interests in the first place. Conflicts are more common at the village level between Club members and villagers who are not members (often village level political leaders). In such situations, a number of strategies are adopted: non-members are engaged in "other" activities to bring them into discussions; information (especially success stories) is shared and discussed widely within the village; credit is given to village leaders at all times and "loss of face" is avoided. When confronted with external vested interests and pressures, communities and NGOs use their "contacts" at higher levels to put "subtle" pressure on the outsiders; raise the profile of the issue by inviting dignitaries without vested interests to support initiatives; and use press and information campaigns to highlight the problems. In general, by focusing on a non-confrontational approach, working from the 'outside' and letting the results speak for themselves, conflicts and pressures have been manageable.

Lessons Learned

Five broad "lessons" emerging from this which can be built into other conservation initiatives (particularly those that have a focus on participatory approaches and coastal/ marine conservation) are:

Build on the Existing Strengths and Capacity of Communities

The fact that external organisations did not enter the area by focusing on weaknesses, blaming communities for the degradation of biodiversity, or with predetermined solutions has played a key role in the overall success of the initiative. Instead, the focus was on building on the strengths of the communities: their existing networks; their social cohesion; their traditional knowledge; their local institutions; and, their common vision. This allowed communities to be in the "driving seat" giving them full ownership of the process and the results. In the long term, this will ensure that the initiatives and process will continue even if external agents withdraw. In fact, with their current level of skills and capacity, communities feel confident that they can continue to work for improved conservation of coastal resources with or without the help of the NGOs and with or without the support of the government.

Create "Space" to Enable Local Institutions to Function Effectively

This implies that external agents, be they NGOs or donors or governments need to "step back" and play a supporting and facilitating role rather than a controlling and implementing role. They should help create the "space" or environment that can allow local institutions to function effectively and reach their potential. In many cases external agents, while well-meaning, can actually stifle or destroy local institutions by coming in with large funds, preconceived decisions and strong ideological biases. In this case, however, NGOs worked with communities and existing institution's, both formal and informal, to identify areas where support or facilitation was needed. They provided this support in a way that helped communities take control of decision-making processes. Once the necessary "space" was created communities were quick to take the initiative and work towards collaborative priorities.

Focus on the "Process" not the "Project"

This means allowing adequate time frames, flexibility and coordination amongst the different external and internal players to provide the environment needed for change. To a large extent it means that external agents need to be less fixed on targets, structures and procedures and be willing to take the risk of allowing local processes to take a priority. For example, many of the activities described in previous sections emerged after months of almost daily meetings amongst the villagers during which they discussed and analysed the problems and opportunities thoroughly and then came up with consensus solutions. It also means that NGOs and other external partners should work beyond the "boundaries" of their individual projects to achieve synergy. In this case, NGO staff, while paid through different projects and organisations, often worked closely together on issues as part of a single "team". The main strategy here was coordination, not competition. Again, this meant flexibility of the part of the NGOs and their donors to enable this. It is also important to sustain external support for a much longer period of time (even though actual investment may be low) than with normal "time-bound" projects.

"Mainstream" Conservation to Increase the Support base and Acceptance

When biodiversity conservation is seen as an integral part of social and economic development, there is a much greater chance of initiating and sustaining both community and government interest in it. Focusing on conservation as separate from or in addition to development issues (for example, by limiting it to legally Protected Areas), tends to "marginalise" it. In such situations, often neither communities nor governments will see conservation as an urgent or immediate priority. Reinforcing and demonstrating the direct links between conservation and development ensures that it becomes an important part of decision-making at all levels and all sectors. The value of this is apparent in this case where communities are actually lobbying to have conservation areas *expanded* while external commercial interests are against this.

Minimise Future Threats by Working Towards Policy Reform

Individual 'successes' can often be undermined by external threats unless reinforced and supported by wider policy. While supportive policy is not the ultimate safeguard, it can help strengthen and dramatically scale up impacts. For example the persistent lobbying against push netters in Pattani by the small-scale fishermen, combined with the many activities undertaken to show the positive impacts of sustainable, small-scale fishing has resulted in a policy to ban all push netting in the entire province. As mentioned previously, almost all activities have a policy link and the Fishermens' Clubs and the Network in particular spend a large proportion of their time in advocacy and lobbying for policy change.

Constraints/Limitations

While the strategies and approaches described in this paper have been remarkably successful in controlling harmful exploitation of marine resources and promoting conservation, there are certain limitations to their application in many (especially terrestrial) situations. Some of these are discussed below:

When does a Common Vision Develop?

In this case, as in many others, communities mobilised themselves to address conservation and development issues only after the situation had become untenable. Although push netting had been around in the area for a long time and was slowly increasing, it was only after the severe destruction of resources began to have a direct impact on their livelihoods that communities acted to address the problem. It is possible that by the time this situation arises, much biodiversity may be irretrievably lost. This is a much more serious issue in the case of terrestrial ecosystems where loss of biodiversity is difficult to reverse. In situations where communities may not yet see conservation as an immediate priority because of limited external threats *at a given point in time*, it may be necessary for external agents to take a more pro-active role in facilitating the process of developing a common vision and agreed objectives. This in turn may have an impact on community ownership and participation, ultimately affecting the long term sustainability of the initiative.

How Long can Traditional, Conservation-oriented Livelihoods Last?

As discussed in this paper, the existing livelihood strategies of the small-scale fishermen are compatible with conservation values. However, the question remains about how long these livelihoods will remain small-scale, traditional and conservation oriented in the face of massive development pressures. In addition to pressures related to large-scale and destructive fishing, the small-scale fishermen are also facing pressures from expanding shrimp cultivation, tourism and pollution. Given these pressures and the rapidly changing external environment, there is always a likelihood that lifestyles traditionally based around sustainable fishing will change and many of the conservation benefits of the last few years will be undone. This is an issue that can undermine many conservation approaches based around maintaining traditional lifestyles and needs careful consideration when developing a strategy. In this particular case, while some small-scale fishermen began using push nets when faced with dwindling catches from traditional methods, they soon returned to traditional fishing after enforcement was effective and catches started increasing. When discussions on this issue are initiated, the fishermen are adamant that they will maintain their traditional lifestyle as long as they can make an adequate living from it. Based on evidence to support this, (traditional lifestyles have survived in the face of incredible external pressures) it seems likely that this will remain true at least for the immediate future.

What about Restrictions Imposed by Protected Areas?

As mentioned above, "community ownership" over the process and outcomes is an important factor for success and sustainability. In this case, community groups were able to design, manage and implement conservation and development strategies including what areas to 'close', what restrictions to impose on use, what quotas to allow for harvesting, etc. This would not be feasible in most legal Protected Areas which severely curtail access to and use of resources by communities, let alone developing management strategies for the area and resources. This strategy therefore, may only be applicable for areas of high conservation value that are not *legally* protected. Alternately, elements of the strategy could be applied to PAs that include multiple-use zones or "buffer" zones.

How Different are Terrestrial Ecosystems?

Some unique features of marine ecosystems and resources have contributed to the success of the initiative. Marine ecosystems recover rapidly on protection, allowing sustainable harvesting of resources to occur within a relatively short time. This is not feasible for most terrestrial ecosystems, where the time frames for recovery are longer and investments often higher. This means that often, where communities are very poor and cannot wait for several years for returns, their interest in conservation is likely to be low unless other direct benefits can be developed.

Factors that add to the complexity of applying this strategy to terrestrial systems such as benefit sharing also tend to be less of an issue in marine systems. Usually, recovery rates for marine resources are not only rapid but also very high. Since the small-scale fishermens' ability to harvest resources is limited by their traditional equipment, there are adequate resources for everyone.

Communities dependent on marine resources are often more willing to set up "closed" areas for limited or no use of resources that communities dependent on forest resources. This could be because they are aware that conservation of coastal and marine habitat is important for increasing numbers of economically important species which can easily be harvested once they move out of these areas. In essence "closed areas" in marine systems will mean more resources for harvesting within a relatively short time whereas the same in terrestrial systems might be perceived as "lost" resources.

Finally, it should be mentioned that another complexity related to terrestrial resource conservation and management, tenurial issues, tend to be less of a problem in marine systems (at least in Thailand). Because marine areas and resources cannot be "owned" like land areas, there are fewer vested external and internal interests to deal with. This is made obvious from that fact that one of the more difficult activities within this initiative is that of conservation and management of mangrove forests - here land tenure and external interests play a major role in slowing down consensus building processes.

What about Biodiversity Values?

While the initiative has succeeded in rehabilitating and conserving once-depleted marine biodiversity to a great extent, it can be argued that continued use of the resources, whether sustainable or not, might compromise overall biodiversity values. While this is possibly true, it can also be argued that in similar situations, this might be the most effective strategy for biodiversity conservation. "Traditional" biodiversity conservation strategies such as setting up strict Protected Areas with no use of resources permitted tend to have a limited applicability in marine situations. This is because most marine species are highly mobile and will certainly be exploited once they move outside the Protected Area. For conservation of coastal/marine biodiversity, it might be more important to ensure that critical breeding and feeding habitats are protected (turtle nesting beaches, mangrove forests, sea grass beds, coral reefs). This can be done through passing and enforcement of legislation against habitat destruction rather than through banning sustainable use of marine fauna. In essence, what the communities in this study are doing is exactly this - by mobilising to prevent further destruction of critical habitats (at the same time ensuring sustainability of their selective, non-destructive fishing), they are effectively conserving coastal and marine biodiversity.

Conclusions

In particular, the initiative highlights three major issues: firstly, that biodiversity conservation and *traditional* livelihoods are not incompatible but in fact are closely linked. Secondly, that by making conservation-linked development a priority in all areas, not just in and around Protected Areas, support for and impacts of conservation are likely to be much greater. And thirdly, that with the right external support and skills, primary resource user communities can successfully initiate, undertake and sustain conservation at all levels - from the local to the national policy level.

It is obvious that no single "strategy" can contribute to effective biodiversity conservation in all situations. Each situation is unique and a number of external and internal factors will contribute towards determining what might and might not work for conservation. For example, only strict protection might maximise biodiversity values but this may also lead to conflicts and low community participation resulting in high external inputs and overall unsustainability. It might also tend to create small "islands" of biodiversity that would always be vulnerable to external threats. On the other hand, sustainable use may compromise biodiversity values but may lead to greater support and more widespread acceptance of conservation.

The optimum approach lies somewhere in between and in most cases, selecting and implementing a biodiversity conservation strategy will involve essential "trade-offs" between the different stakeholders involved. Any site or situation will probably demand a combination of strategies that may include areas of strict protection as well as areas of controlled resource use. However, whatever approach is selected, the process should involve participation and consensus of major stakeholders (and agreement on compromises and trade-offs) if it is to be sustainable.

We feel that many elements of the community-based conservation initiative described in this paper can be applied towards achieving effective biodiversity conservation in coastal/marine areas. While its application in terrestrial situations might be somewhat more limited, we still feel that there are some elements that are widely applicable. In particular, we strongly feel that this approach should be explored and expanded in areas that may not be legally Protected Areas. This would be an important addition to biodiversity conservation strategies that focus on the relatively small amount of areas under PAs.

Special Papers

Conservation Biology and the Preservation of Indian Biodiversity

Anthony J. Gaston

Introduction: Conservation Biology as a Discipline

Conservation Biology, although only two decades old as a recognised discipline, is one of the most popular research areas in biology, especially at North American universities. It attracts large numbers of graduate students, many of whom wish to make a contribution towards improving the planet, or at least understanding the problems of the biosphere, while obtaining a post-graduate degree. Like much recent research, it is a field driven by practical goals, but unlike most others it is not dominated by commercial interests.

Several books have been published on the subject of Conservation Biology (e.g. Soule and Wilcox 1980, Soule 1986, Hunter 1996, Caughley and Gunn 1996) and the Society for Conservation Biology, founded in 1978 now has more than 5000 members. Since 1987, it has published the journal "Conservation Biology". In this paper, I set out to analyse the contribution that the discipline of Conservation Biology has made to the broader field of conservation, to discuss the major preoccupations of the field over the past decade, and to assess the contribution that this science can make towards assisting biodiversity conservation in India.

The field of conservation biology draws on several pre-existing strands of science, especially wildlife management, and ecology. However, the traditional concerns of wildlife managers, as typified by papers in Journal of Wildlife Management: sport hunting mortality, home ranging behaviour of large mammals, habitat manipulations that benefit single species, for example, are not prominent in conservation biology. Instead, conservation biologists are more concerned with species that are not hunted, with general patterns of biodiversity, with large continental, or planetary scale problems, and with interactions between people and wildlife other than those involved in hunting. Because of these concerns, conservation biology seems to offer more of interest to conservationists in India, where sport-hunting is almost completely banned, than traditional North American wildlife management techniques.

Recent Trends in Conservation Biology

To review the major preoccupations of Conservation Biology, as a field of science, I classified the papers published in the journal Conservation Biology up to 1997 (volumes 1-11) into several broad categories. Many other journals publish papers on conservation biology topics, but the eponymous journal has become a major outlet for research in this field and its contents should provide an indication of current thinking among people who are trying to apply scientific methods to the problem of conserving animals and plants.

The largest category of papers dealt with the general conservation needs of a particular species, species group (e.g. frogs, orchids), or ecosystem (Figure 1). These contributions form a continuum with similar work published over earlier decades by Biological Conservation and Environmental Conservation and in the relevant taxon-based journals. Perhaps surprisingly, given its fairly limited conservation implications, the next most frequent subject was genetics, followed by different aspects of people/ecosystem interactions (harvesting, disturbance, development) and landscape ecology, within which habitat fragmentation was the commonest topic. The prominence of genetics studies probably relates to the huge expansion of DNA-based research in North America and Europe following the development of modern molecular genetics techniques that put DNA analysis within reach of even modestly-funded laboratories.

Landscape ecology, protected area design, and population viability analysis (PVA - see below), which together covered 18% of papers, are really about the same central problem: the fact that habitat fragmentation reduces population size and lowers the likelihood that populations will persist. Technically, PVA can be applied to any population, but in practice, people do not generally consider it worth worrying about for populations of greater than 1000 individuals. Hence, this area of Conservation Biology is really about the problems of small populations. Many papers on genetics are related to the effects of small populations, as are those concerned with extinction processes. Hence, it is clear that the issue of small populations and the likelihood that they will persist, is central to Conservation Biology.

Two recent offshoots of small population studies are population viability analysis (PVA), and metapopulation analysis. PVA uses demographic data on a given population to predict how long it is likely to persist under current conditions. Normally this is done through computer simulations, and the increased speed and ease of use of PCs has been an important element in making this a fairly routine task. Good examples are given by Caughley and Gunn (1996). Metapopulation analysis explores the dynamics of groups of incompletely isolated sub-populations, such as those of birds or insects inhabiting isolated forest fragments. This type of analysis asks questions about the importance of movement between fragments and the persistence of sub-populations under different rates of immigration. These types of study are relevent to the plight of large mammals in Indian protected areas, where movement between reserves is possible, but greatly restricted by increasing human activity in intervening areas. A PVA may include a metapopulation analysis, but the simulations involved are far more complex than for a single, freely interbreeding, population without immigration.

The late Graeme Caughly (1994), in a very influential paper published in the Journal of Animal Ecology, made a distinction between the study of small populations and the study of declining populations. Although his approach has been criticised, it does seem a useful distinction if we are reviewing conservation concerns, because our assessment of vulnerability to extinction usually depends on one or other scenario: the declining population, or the population which, although not known to be declining, is small enough to be of concern simply because of its size. I am going to concentrate on the problems of small populations: what Conservation Biology has to say on the topic and what relevance it has in India.

Islands, Habitat Fragmentation and Population Persistence

Although the ideas of habitat fragmentation and small population jeopardy are familiar to most people, I shall briefly describe their genesis and rationale. A good history of ideas in this field has been provided by Quammen (1996). The conservation implications of small populations and their dynamics were clearly recognizable on the basis of MacArthur and Wilson's (1967) seminal book "*The Theory of Island Biogeography*", but Preston's (1948, 1962) accounts of the general distribution of abundance in animal and plant communites were an important forerunner. Preston, who built on earlier observations that species richness increased with sample (island) size, was probably the first to explicitly observe that reserves and sanctuaries, by themselves, would not support the total species complement of a region. He also described at length the exact relationship between the size of an isolate, whether an island, or simply an arbitrarily defined area, such as a parish, or state, and the number of species that could be found there.

The contribution of MacArthur and Wilson (1967) was in providing a plausible mechanism to explain the empirical relationships described by Preston (1962) and others. Their explanation was relevent to islands, whether those created by water, or those isolated by other types of inhospitable habitat: mountain forests isolated by lowlands, woodlots encircled by arable fields, or urban parks surrounded by houses and roads. They suggested that the number of species to be found within such islands was the product of the rate of immigration of species from outside and the rate of local extinction. Both immigration and extinction were seen as perpetual and inevitable processes, with the probability of species extinction being inversely related to island size because the smaller the island, the smaller the populations of animals and plants that it could support. This is the genesis of concern over the persistence of small populations.

Why are small populations more likely to become locally extinct than larger ones? There are three lines of argument:

(1) small populations, especially if confined to a single area, are susceptible to extirpation by stochastic (random) environmental events, such as lightning fires, tornados, or droughts;
(2) small populations are liable to suffer from stochastic demographic events. For instance the sex ratio may become very skewed by chance, resulting in a lower effective population size;
(3) small populations have a lower genetic diversity than larger populations. Inbreeding leads to the disappearance of alleles that may be beneficial when heterozygous, but harmful when homozygous. Hence small populations may be less well-equipped to meet the challenges of disease and parasites, or to adapt to progressive habitat changes brought about by plant succession.

Of these three types of threat to small populations, there is more direct evidence for the role of stochastic events in population extinction than there is for loss of genetic diversity (Caughley 1994). However, decreased genetic diversity is an inevitable consequence of lowered population size and may contribute to extinctions where the most obvious cause is environmental.

The relationship between isolate area and species richness has been established for numerous taxa over many different areas and is just about as strong a generalization as we can find in ecology (Preston 1962, May 1975). Early observations suggested that a tenfold increase in area was associated with an approximate doubling of the number of species: a relationship originally observed by Darlington (1957). Standardized comparisons among different geographical areas and habitats have been made using the dimensionless parameter z (the slope of the log-log regression of species richness on area). Estimates of z typically fall between 0.18 and 0.35, equivalent to a 1.5 to 2.2 times increase in the number of species for a tenfold increase in area (Diamond and May 1981). This relationship holds over a broad range of geographical scales, from isolates the size of football fields to those as big as New Guinea. In the long-term, this relationship suggests a very bleak future for biodiversity because it predicts that the total species complement of the biosphere is intimately connected to the area of available habitat (Pimm et al. 1995). As human needs require an increasing area of the planet for agriculture, airports, factories, golf-courses, housing estates, and the like, species will inevitably decline. However, we do not know how rapidly that process is likely to proceed, and there may be things that we can do to mitigate it.

Reserve and Population Size and Probable Persistence

Evolution teaches us that species and populations are ultimately impermanent: extinction is as inevitable for species as death is for individual organisms. However, evolution typically operates on the time-scale of hundreds of thousands, or millions of years. From the point of view of the wildlife manager, the most pressing question that arises from studies of small populations is "how large does a population have to be to ensure that it persists for the forseeable future (usually taken as 100 years or more)?" Attempts to set up broad guidelines (e.g. minimum of 50 breeding individuals) have met with disapproval because the appropriate minimum is bound to be very species- and site-specific. Answering the question requires us to know about extinction rates, but these can only be estimated where species lists are available over a substantial period of time. There is plenty of information like that for Europe, but European ecosystems are intensely man-modified and changes are constantly ongoing so, in most cases, it is not possible to tell what proportion of local extinctions are due to intrinsic "small population effects", and what is simply the result of habitat change, pesticide use and the myriad other anthropogenic effects impinging on them.

Overall extinction rates are believed to have been much higher during the past few centuries than previously, and are predicted to increase even more in the future (Pimm et al. 1995). There have been several attempts to estimate extinction rates in relation to isolate area or population size for a variety of taxa, based on historical species lists (Burkey 1995). Although all these estimates are very crude, they are worth considering, because they may be the best indication we have of what to expect for similar sized populations in India. An especially pertinent study is that of Newmark (1987, 1995) on mammalian species extinctions within 14 North American National Parks. Newmark found a highly significant negative relationship between extinction rate (species lost/(species originally present* time interval)) and Park area. His calculations suggested that extinction rates over the scale of 100 years would be negligible for parks of more than 10,000 km², but that for parks less than 100 km² in area the annual probability of species loss was 1/250. Hence a park containing 25 species (about the number of mammals supported by many Parks and sanctuaries in India), would have lost 20% of its species in 50 years.

Newmark likened the events in the Parks that he studied to the case of land-bridge islands: islands that were once part of a large land mass but were insularized by a rise in sea level. At their creation, these islands would have supported most of the fauna of the large land mass of which they form remnants. For terrestrial, non-flying animals, immigration ceased when the islands formed and their faunas then proceeded to "relax" to a stable species richness appropriate to the reduced areas. Newmark assumed that areas outside the parks, if not totally inhospitable to wildlife, severely reduced the possibilities for dispersal, leaving the Parks resembling islands in the sea.

We should not take Newmark's estimates too literally, but they probably represent the most comparable figure obtained so far for considering the effects of reserve size on the persistence of large mammals in Indian protected areas. Several other studies have estimated extinction rates for a variety of taxa in relation to isolate size (summarised by Burkey 1995). Although the absolute rates vary considerably, all studies find that extinction proceeds more rapidly in small isolates than in large ones. This means that, in the absence of immigration, a greater proportion of the initial species complement will disappear over a given period of time from small sanctuaries than from large ones. Newmark's study suggests that the difference can be fairly dramatic.

An Example: Wildlife Sanctuaries in the Himalayas

There is no doubt that ideas about habitat fragmentation and metapopulation dynamics are very pertinent to the Indian situation. Being a heavily populated country in which landscapes are strongly modified by people, means that wildlife habitat is very fragmented, especially for the animals that might find it difficult to disperse across agricultural landscapes. I am going to concentrate my examples on the Western Himalayas (from the Kali-Gandaki Valley of Central Nepal to the western border of Pakistan), partly because that is an area that I am familiar with, and partly because good information on protected areas is available for Himachal Pradesh in Singh et al. (1990) and for other parts of the Indian Himalayas and for Nepal and Pakistan in Green (1993). Most of the data that I present derives from these sources, although I have modified species lists somewhat on the basis of information from my own observations in Himachal Pradesh and Jammu and Kashmir (Gaston et al. 1981, AJG unpublished). Although protected areas have various designations (National Park, Wildlife Sanctuary, Wildlife Reserve), I refer to them all as "sanctuaries" for convenience. I included those designated in IUCN categories I-IV, but excluded those set up mainly to protect wetlands (e.g. Pong Dam, Renuka and Gobind Sagar in Himachal Pradesh, Haigam in Jammu and Kashmir), and those not exceeding 1500 m in altitude, as the latter support an essentially lowland fauna. In considering species-area relationships I have included all species, but for detailed, species-specific analysis I have omitted those species confined to trans-Himalayan areas, where the bulk of their population exists on the Tibetan Plateau. (e.g. Marco Polo Sheep *Ovis ammon*, Tibetan Antelope *Procapra picticaudata*, Kiang *Equus kiang*).

Firstly, to establish that Himalayan protected areas are no different from any other isolates in their species richness, I compared the numbers of large ungulates and carnivores (body mass >10 kg) occurring in each sanctuary with the size of the area. The species lists currently available are probably most accurate for these species. Those sanctuaries included range from the 2 km^2 Shilli Sanctuary, near Solan in H.P., to the Shey-Phoksundo National Park in Nepal, more than 3500 km2 in extent. The largest sanctuary area in the Indian Himalayas is Hemis N.P. in Ladhak (1400 km^2), although the combined area of the contiguous Great Himalayan National Park, Pin Valley National Park and Rupi Bawa Sanctuary is slightly larger (1500 km^2). As predicted by the species-area relationship, the number of ungulates and large carnivores increases with sanctuary size (Figure 2). The linear regression of log species richness on log area gives an estimate for z of 0.18: at the lower edge of those observed elsewhere, and suggesting an increase from 3 species in a 10 km^2 reserve to 10 species in one of 10,000 km^2.

An interesting feature of this correlation is that it seems to derive largely from the effect of area on altitude range (the difference between the highest and lowest altitude within the sanctuary). Large sanctuaries are likely to embrace a greater range of altitude than small ones, and in fact the two variables are strongly correlated ($r = 0.69$, df 45, $P < 0.001$). The number of ungulate and carnivore species in each sanctuary is more strongly correlated with altitude range than with log area ($r = 0.72$, and 0.66, respectively, Figure 3). A stepwise multiple regression analysis shows that sanctuary area makes no significant contribution to explaining species richness, once altitude range has been taken into account.

Notice that these results do not provide any evidence for local extinctions. The observed species-area relationship would have been predicted simply by Preston's (1962) "canonical" distribution of abundance. However, what the relationship does indicate is that many of the current Himalayan sanctuaries are too small to support more than a minority of the Himalayan megafauna. In addition, an uncritical deduction from the relationship between species richness and altitude spread is that we need to create sanctuaries with a big altitude range. That would only be true if we wantede to maximize biodiversity within each sanctuary. In fact, for a constant sanctuary area, populations of any given species are likely to be smaller the greater the altitude range, because the extent of any single altitude zone will be correspondingly reduced. What we need to do is to ensure that an adequate area of each altitude zone is protected, irrespective of the number of sanctuaries involved.

If we examine the presence of different ungulate species among sanctuaries, we find that the most widespread are the two smallest, the Musk Deer (*Moschus chrysogaster*), which occurs in 74% of sanctuaries (N = 47) and the Goral (*Nemorhaedus goral*, 72%, Figure 4). The least widespread are the Hangul (*Cervus elephas hanglu*, 6% of sanctuaries) and the Markhor (*Capra falconeri*, 15%). Considering total area, rather than numbers of sanctuaries, Markhor occurs in the smallest protected area (area of all sanctuaries in which it occurs 641 km^2), and two other species occur in areas amounting to less than 5000 km^2 (Hangul and Himalayan Ibex *Capra ibex*, Figure 5).

How do Himalayan sanctuaries compare with the North American Parks where Newmark identified progressive mammalian extinctions? Regretably, they are generally much smaller. Taking the Western Himalayas as a whole, the total area covered by sanctuaries (c. 25,000 km^2) is comparable with the area covered by National Parks in the Canadian Rocky Mountains (c. 22,000 km^2). However, the individual Himalayan sanctuaries are much smaller, on average (460 km² vs 3200 km², Figure 6). A comparison of Indian sanctuaries with those used by Newmark is even more striking. Only 3/41 (7%) in the Indian Himalayas exceed 800 km², compared to 9/14 (64%) in Newmark's study (Figure 7). Moreover, in the case of Himachal Pradesh, the area at different altitudes represented within sanctuaries is not evenly distributed. There is a much smaller area protected below 2500 m than in the zone 2500-4000 m (Figure 8). Yet the lower altitude zone is much more disturbed and hence the need for protection in this zone is greater than at higher altitude. This result is similar to that found by Hunter and Yonzon (1993) who showed that in Nepal certain critical altitude zones, supporting a very rich biodiversity, were underepresented within sanctuaries (especially 1000-3500 m).

In addition to their small size, the effective area of wildlife habitat in many Indian sanctuaries is much smaller than their nominal boundaries suggest. For instance, Nargu Sanctuary in H.P. contains 170 villages and 26,000 people; the density of domestic grazing animals in the Khokan Sanctuary approaches 10/ha (Singh et al. 1990). Even the remote Hemis National Park in Jammu and Kashmir contains 20 settlements with 1600 people permanently resident (Green 1993). In contrast, most North American Parks contain few settlements, apart from ranger quarters and tourist facilities (although the latter may be extensive).

Habitat Fragmentation and Population Isolation: The Case of Himalayan Tahr

The size of Protected Areas only becomes a problem once the dispersal of animals and plants between them becomes restricted. How much are current wildlife populations in the Western Himalayas fragmented?

Mountains, by their nature, tend to support very fragmented ecosystems (Bleich et al. 1990). The restriction of organisms to certain altitude zones means that their habitat is necessarily discontinuous, broken by river valleys below and the barren wastes of the alpine above. For most flying animals (bats, birds, insects) and for wind-dispersed plants, such barriers are relatively insignificant, often amounting to only a few km of inhospitable ground. However, for mammals, especially small ones, they can be formidable (Brown 1971, McDonald and Brown 1992). On top of this natural fragmentation and mosaic structure there are the effects of agriculture and other human activities that have altered much of the temperate zone in ways that make it less attractive to dispersing wildlife.

An example of a formerly widespread species now confined to small habitat fragments is the Himalayan Tahr (*Hemitragus jemlahicus*). The species' range in the Western Himalayas, as depicted by Schaller (1977), extends from the Pir Panjal range in Jammu and Kashmir through the hills to the south of the Great Himalayan range into Nepal (Figure 9). The approximate area within which Tahr might be found in India amounts to 18,000 km², and the species is believed to occur in Protected Areas amounting to 3,620 km² in area. Unfortunately, the present habitat of Himalayan Tahr is very restricted, requiring precipitous cliffs adjacent to forested areas at altitudes between 2000-4000 m. Such habitat makes up only a small proportion of any existing sanctuary, with the exception of Kanawar in Himachal Pradesh (which is, in any case, rather small). Excluding alpine areas, little used by Tahr in the Indian Himalayas, and areas adjacent to villages or away from steep slopes, I estimate that only 1600 km² of potential Tahr habitat exists in Indian Protected Areas: 700 km² in H.P and 900 km² in U.P.

Surveys conducted in 1985 and subsequently suggest that the Himalayan Tahr of Himachal Pradesh are currently split into four populations: in the upper Budhil and Ravi Valleys, in Chamba District (1, Figure 10)), in the Dhaula Dhar range above Dharamsala, Kangra District (2), in the Great Himalayan National Park and adjacent areas of Kullu District (4), and in Daranghati Sanctuary and areas extending eastwards through the upper Rupin and Supin valleys, into weatern U.P. (5). A population that existed previously in the area between the Beas and Uhl valleys (3) seems to have been extirpated some time in the past 30 years. It is possible that the Dhaula Dhar population is in contact with that in the Budhil and Ravi valleys: however the continued existence of this population has not been confirmed recently. Only the size of the population in Great Himalayan National Park (GHNP) can be estimated, being 50-100 animals, but adjacent areas (Kanawar Sanctuary, Rupi Bawa Sanctuary) may support as many again, so this population may be in the region of 100-200. Numbers in the Budhil/Ravi and the Dhaula Dhar populations are probably smaller. The size of the eastern Himachal population is unknown, but probably not larger than that in the GHNP area. Consequently, the total population of Himachal Pradesh, allowing for one or two remnant populations not recorded here, is probably between 400-800. Both the Budhil/Ravi and Dhaula Dhar populations, and possibly all of these isoaltes may be of a size vulnerable to stochastic extinction.

Within the Great Himalayan National Park, the Tahr population appears to be further fragmented. Since the Park was established, sightings have occurred in two discrete areas: the Sainj/Tirthan divide around Dela and Gumtarao, and the upper Jiwa Nalla (Figure 11). The intervening habitat suggests that the Jiwa group may be in contact with Tahr in the Kanawar Sanctuary, but the potential for dispersal between those animals and the Dela/Gumtarao group seems small, because they are separated by the well populated Sainj Valley. Current developments in Sainj (a road, hotels) make future communication even less likely. As Tahr have not been recorded in recent years on the south side of the Tirthan Valley, the Dela/Gumtarao group is probably not in regular contact with groups in Rupi Bawa Sanctuary, with which GHNP shares a common border. The Dela/Gumtarao group numbers 30-50 Tahr. It is unlikely that any of the other freely intermingling groups are larger than that. We do not know whether the other populations in H.P. are subdivided, but it seems quite likely. Given that Berger (1990) found that there was a high probability that Bighorn Sheep (*Ovis canadensis*) populations of less than fifty animals in western North America would become extirpated within a few decades (see also Krausman et al. 1993), the size of current Tahr populations in Himachal Pradesh does not give much cause for optimism.

In comparison, populations of Ibex, another caprid, which occurs at higher altitudes (>3500 m, Schaller 1977), appear less fragmented. With the exception of a few high-altitude roads, such as that crossing the Rhotang Pass, their habitat is not dissected by human activities. Although they occur in only 6 Protected Areas in Himachal Pradesh, amounting to a total area of 1550 km², their habitat is continuous and relatively undisturbed throughout the Great Himalayan Range as far East as the Sutlej (Figure 12). The population of the Great Himalayan Range may be somewhat disjunct from that of Lahoul and Ladhak, but the total area available to each greatly exceeds that covered by protected areas and re-establishment by immigration following local population die-offs seems probable. If we take only the populations on and to the south of the Great Himalaya, the numbers of Tahr and Ibex may be of a similar magnitude, but their distribution and the prospect for dispersal among local populations suggest that Ibex are much more secure, in the long-term, than Tahr.

Lessons from Conservation Biology

Like a lot of science, the message from Conservation Biology studies on small populations is fairly obvious. To ensure their persistence, at least over the next hundred years, we need to maximize the effective size of wildlife populations. Less obvious, but perhaps more important in the long run, is the realization that the effects of habitat contraction are not immediate, but are played out over a variable period of time. Merely halting habitat destruction will not halt species extinctions until the species complement has "relaxed" to its equilibrium number. Hence, just maintaining the status quo in the situation we have now is almost certain to lead to more extinctions. Things can only get worse from here!

Increasing the effective size of wildlife populations can be done in two ways: by increasing the density of existing populations through better management of sanctuaries, or by enlarging or combining sanctuaries, and by increasing their inter-connectedness through increasing protection for surrounding areas. The second objective becomes especially important where sanctuaries are too small to support persistent populations, even with the best management, and that seems to apply to many sanctuaries in the Indian Himalayas.

We cannot say with certainty how big Himalayan sanctuaries should be in order to ensure the persistence of all elements of the megafauna, because we have little information on population sizes and no evidence for extinction rates. In any case, it is not the size of the sanctuary, but the area within which protection from poaching and habitat disturbance is effective, that is most important. However, if we assume that large animals outside sanctuaries are generally at a higher risk than those inside, then any objective appraisal of the present sanctuaries in the Western Himalayas of India would conclude that they are too small. If we were setting out to design a sanctuary network taking into account the findings of Conservation Biology for large mammal populations elsewhere, we would certainly want to have more sanctuaries with effective protected areas of greater than 1000 km².

At the same time, in a situation of limited resources, it is disadvantageous to have sanctuaries that contain large resident populations of people. Taking the example of Nargu, if only 1% of able bodied males within the human population was to indulge in poaching, that would still provide for more than 60 poachers actually resident in the sanctuary (let alone those in peripheral villages within easy walk): an impossible enforcement prospect for the sanctuary staff. Sanctuaries that harbour little wildlife and have poor prospects for improvement do not confer much benefit for biodiversity conservation in themselves, although they may do so where they provide some protection for movement corridors among better protected areas. We need to rethink the design of wildlife sanctuary networks on the basis of wildlife population viability and consider the influence and status of surounding areas. In addition, within sanctuaries, we need to increase the dispersal options for fragmented populations such as that of the Himalayan Tahr in the Great Himalayan National Park. In other words, we need to be considering the sanctuaries and their surroundings from a landscape perspective.

Taking the specific case of Himachal Pradesh, successive Chief Wildlife Wardens have been energetic in creating a network of sanctuaries that protects a wide variety of ecosystems in the State. However, demarcation and gazetting of sanctuaries is only a first step. As things stand today, what is needed is better protection for existing sanctuaries, rather than an extension of the network. Acheiving this goal is outside the scope of my paper, but an essential first step is in recruiting widlife managers who are highly motivated and understand the needs of wildlife conservation. It is my experience that only a minority of officers and guards within the State forest services have the necessary motivation. Recruiting and keeping those officers and guards within the wildlife sector is a first step to ensuring that areas designated for protection actually receive it. Given that there is only a small pool of talent available for this task, a proliferation of protected areas appears especially unwise. Hence both the dynamics of small populations and the realities of the forest service suggest that concentrating efforts by creating fewer and larger sanctuaries might be the best strategy.

Even if some expansions in the area of individual sanctuaries can be achieved it is not realistic to hope for wildlife sanctuaries on the scale of those in North America, given all the other pressures on land in India. Consequently, a second lesson from Conservation Biology is that wildlife managers face the need for constant intervention. Standing back and letting nature take its course will not protect most of the Indian megafauna in the long run. Intensive management will be needed and practices like translocation and reintroduction are likely to become typical rather than exceptional. We would all like to see nature wild and free, without the imposition of human authority. The lesson of Conservation Biology is that such an approach probably will not work. Continuous intervention on behalf of biodiversity is the price that we have to pay for our own preemption of most of the biosphere.

Acknowledgements

I thank Peter Blancher, Virinder Sharma, Sanjeeva Pandey and Dan Perleman for comments on the paper and discussions on wildlife issues in Himachal Pradesh. For assistance with creating the maps, I thank Christine Eberl. My participation in the Biodiversity Conservation Priorization Workshop was made possible by World-Wide Fund for Nature-USA, thanks to Janis Alcorn..

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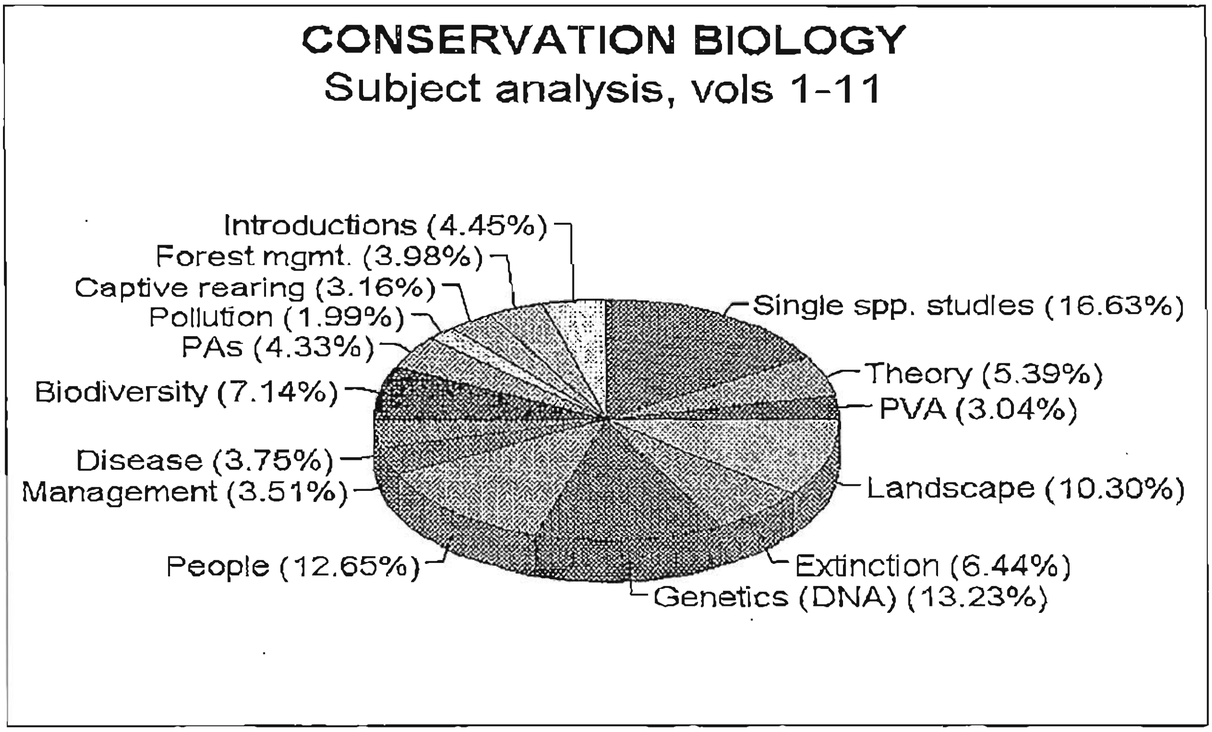
CONSERVATION BIOLOGY
Subject analysis, vols 1-11
Introductions (4.45%)
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Captive rearing (3.16%)
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PAs (4.33%)
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People (12.65%)
Single spp. studies (16.63%)
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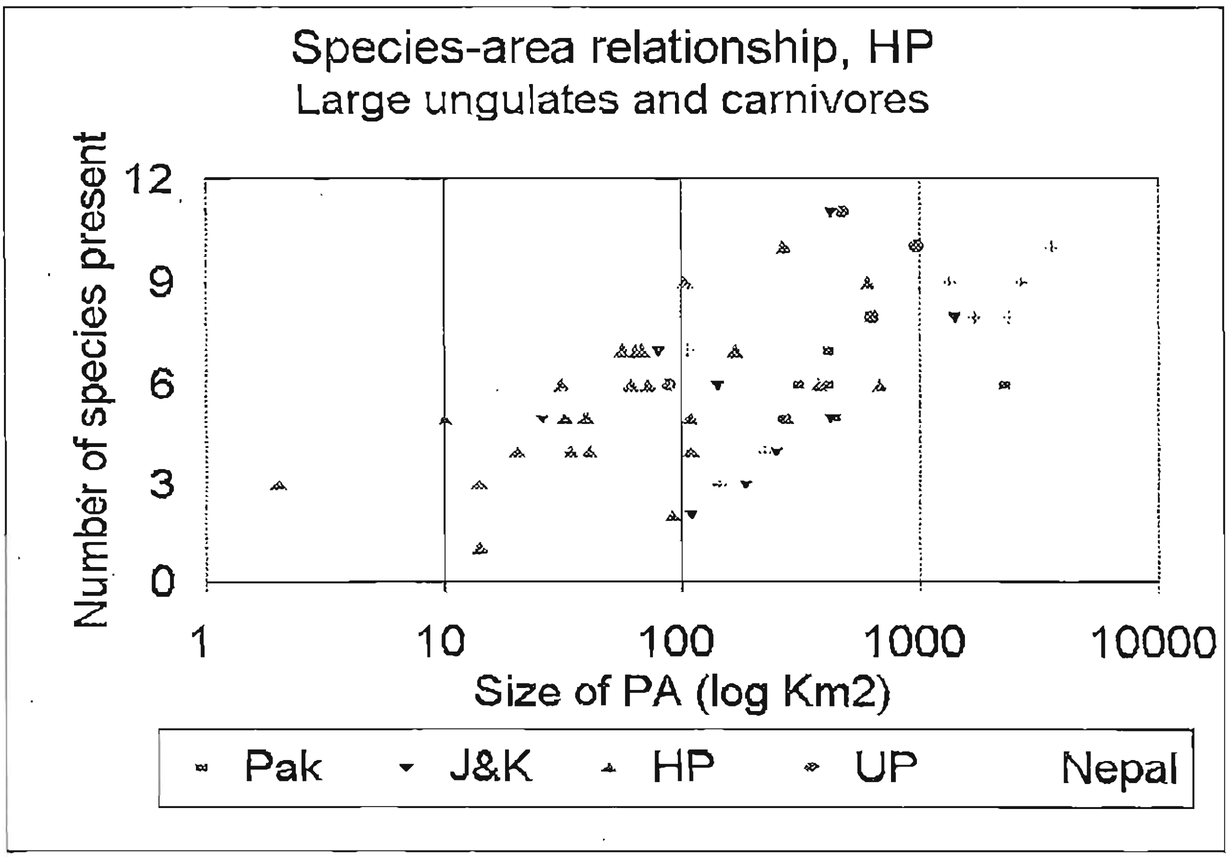
PVA (3.04%)
Landscape (10.30%)
Extinction (6.44%)
Genetics (DNA) (13.23%)


Species-area relationship, HP
Large ungulates and carnivores
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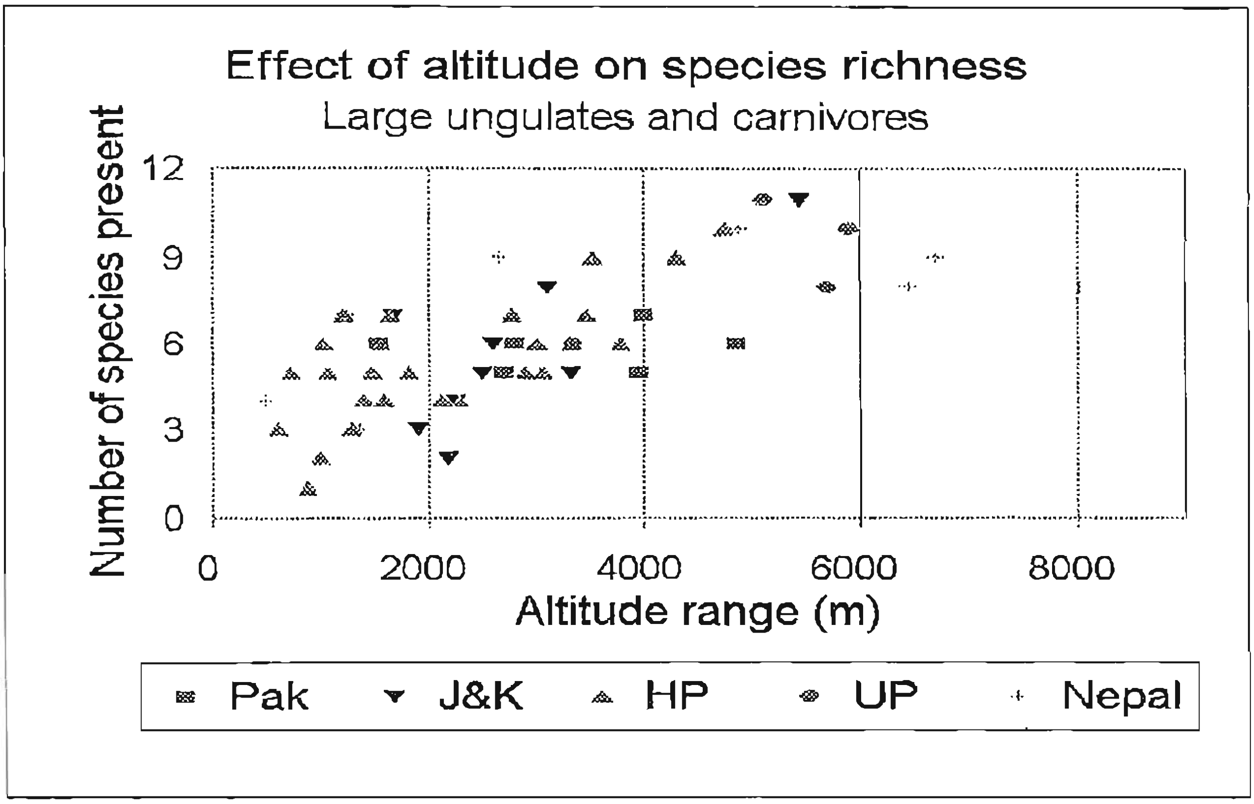
Effect of altitude on species richness
Large ungulates and carnivores
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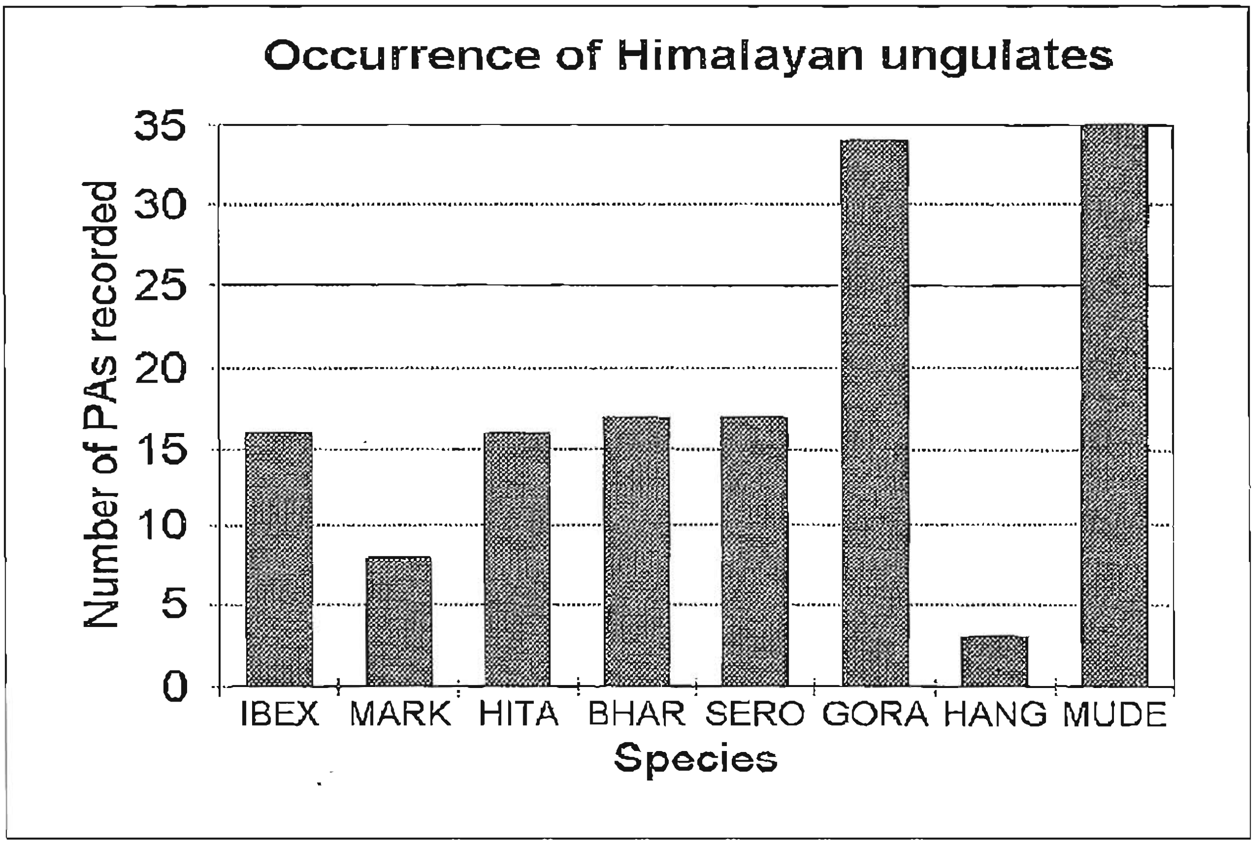
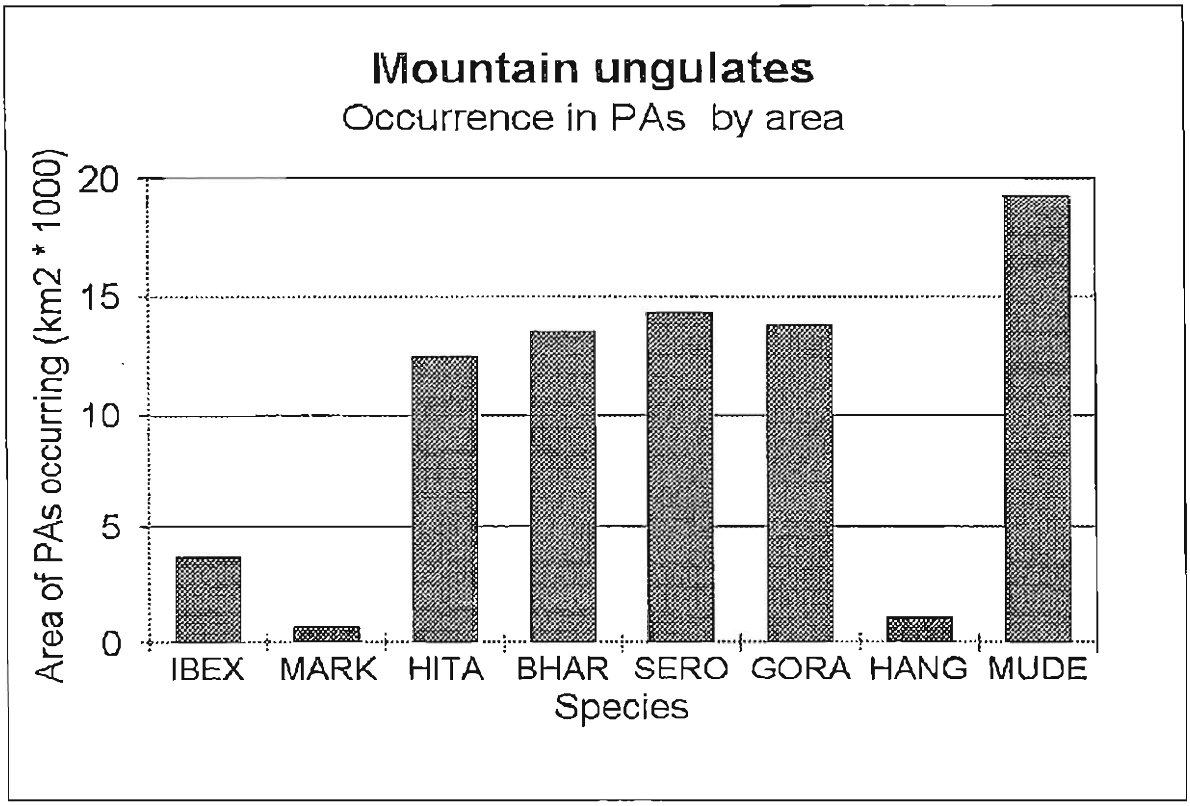
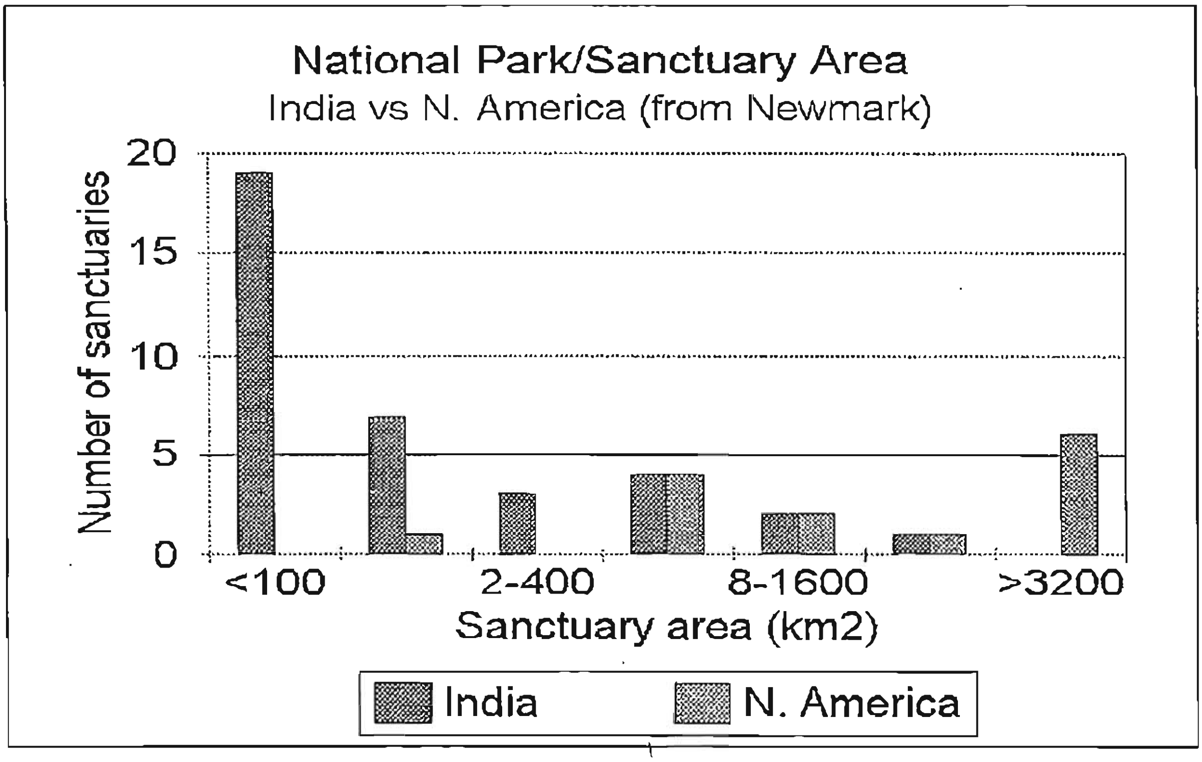
2000
4000
6000
8000
Altitude range (m)
Pak
J&K
HP
UP
Nepal

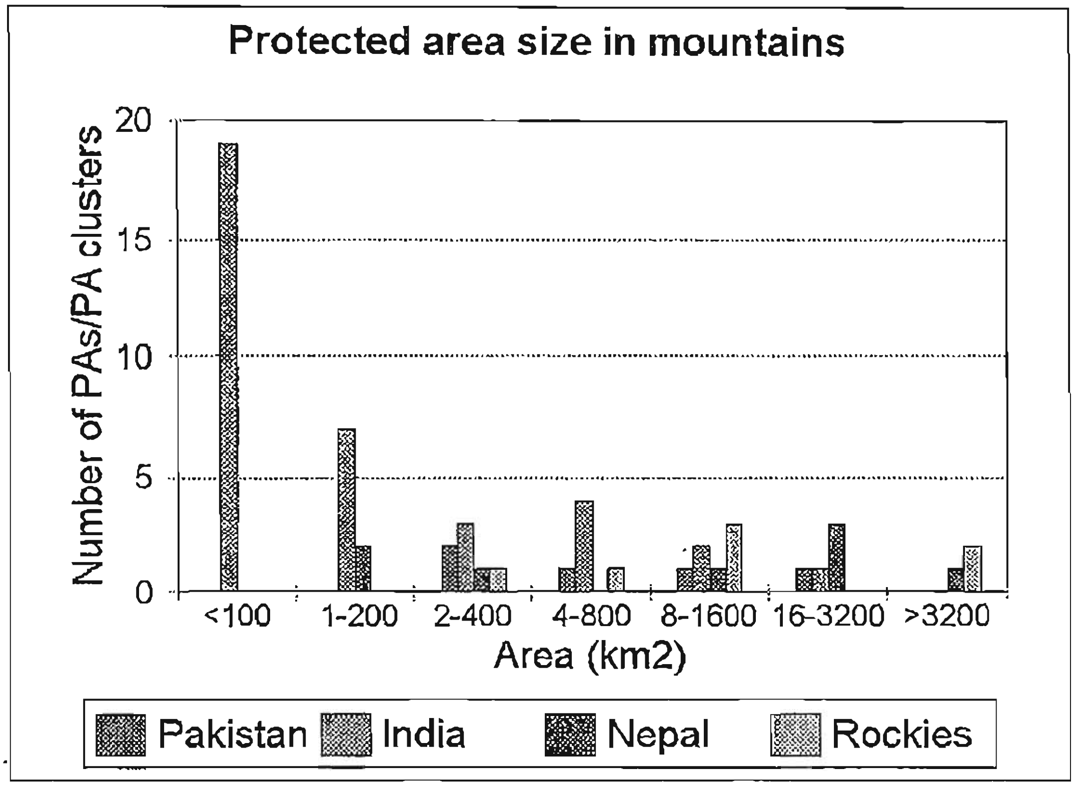

Occurrence of Himalayan ungulates
Number of PAs recorded
35
30
25
20
15
10
5
0
IBEX
MARK
HITA
BHAR
SERO
GORA
HANG
MUDE
Species

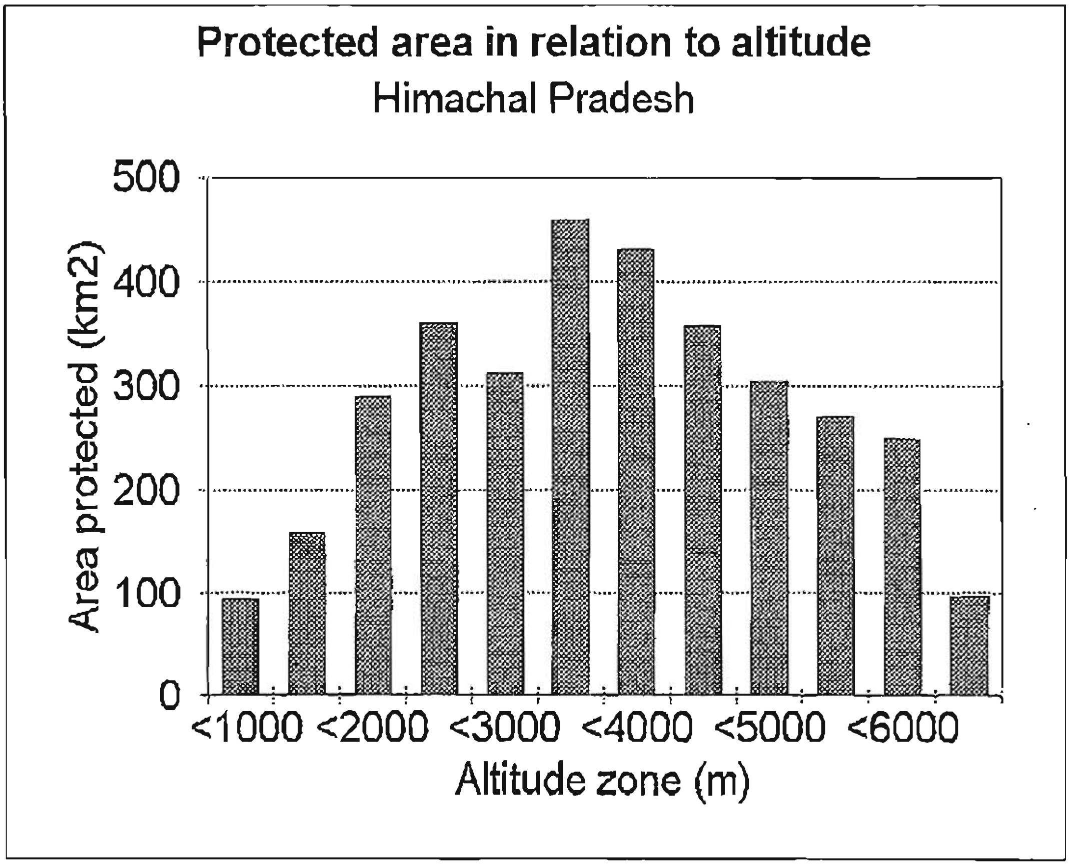


Mountain ungulates
Occurrence in PAs by area
Area of PAs occurring (km2 * 1000)
20
15
10
5
0
IBEX
MARK
HITA
BHAR
SERO
GORA
HANG
MUDE
Species



National Park/Sanctuary Area
India vs N. America (from Newmark)
Number of sanctuaries
20
15
10
5
0
<100
2-400
8-1600
>3200
Sanctuary area (km2)
India
N. America


Protected area size in mountains
Number of PAs/PA clusters
20
15
10
5
0
<100
1-200
2-400
4-800
8-1600
16-3200
>3200
Area (km2)
Pakistan
India
Nepal
Rockies


Protected area in relation to altitude
Himachal Pradesh
Area protected (km2)
500
400
300
200
100
0
<1000
<2000
<3000
<4000
<5000
<6000
Altitude zone (m)

Environmental Ethics and Biodiversity Prioritization in India

George A. James

ABSTRACT

This essay argues that while philosophy is not occupied with the gathering of scientific facts, it nevertheless has a role to play in the development of policy and priorities concerning biodiversity conservation. It has this role because it is occupied with the fundamental values that justify biodiversity conservation. This essay discredits the claim that ecology is capable of generating ethical commitments independent of value judgments. It examines the principal approaches to the valuation of nature that have dominated environmental ethics in Western Europe and the United States. It questions the viability of views of the value of nature generated independently of the cultural history of the community it seeks to inform. It calls attention to the understanding of nature embodied in India's cultural history as an effective and persuasive grounding for an ethic concerned with the preservation of biodiversity in India.

When I was invited to participate in this conference the first question that entered my mind is the question, what does a person trained in philosophy have to contribute to a discussion of biodiversity conservation in India? Biodiversity prioritization has to do with science, with biology, with ecology. The subject matter of philosophy is sometimes caricatured as having little or nothing to do with the world in which we live. If a tree falls in the forest and there is no one to hear it, is there any sound?

On the other hand, it is evident that issues of ecology and biodiversity conservation are not matters of purely scientific concern that can be resolved simply by reference to scientific facts. The appearance of the word prioritization in the title of this workshop indicates that an explicit concern of this conference is priorities, and embedded in priorities are values. If an entire forest is felled and no one is able to protest, is there any moral objection? A project of prioritization will necessarily proceed upon explicit or implicit value judgments concerning the importance of nature and the relationship of nature to humanity. A more faithful characterization of philosophy would acknowledge that philosophy is concerned not just with metaphysics, the study of being, or with epistemology, the study of knowledge, but also, and today perhaps more than ever before, with the study of values, with aesthetics and ethics. The role of philosophy in discussions of biodiversity prioritization, therefore, will have something to do with the clarification of the values that justify priorities, with making explicit what are often implicit in the judgments we make concerning nature in general and biodiversity conservation in particular. While philosophy cannot supplant the rigorous research of ecology, it nevertheless can scrutinize and clarify the rationale for conservation that are offered in discussions of environmental issues. While biology, and ecology in particular, explore the relationships within ecosystems, environmental ethics is engaged with questions concerning the justification for biodiversity conservation itself, with the question of why biodiversity should be preserved at all.

It is generally recognized that purely scientific research is not sufficient in itself to generate ethical conclusions. It is a basic point of logic that it is not possible to derive an ethical prescription from a purely scientific observation. We cannot derive an ought from an is. We cannot derive an obligation that should govern human behaviour merely from a fact or set of facts that are concluded from scientific research. From the fact that we are able to alter genetic materials in human beings and other species, it does not follow that we ought to. From the fact that we can now clone sheep and could probably clone human beings, if sufficient efforts were expended, it does not follow that we should. This is not to say that there are not benefits to be derived from genetic research or other scientific endeavors. The question whether the benefits of expected discoveries are significant enough to justify the cost of genetic or other kinds of scientific intervention are generally understood to fall outside the realm of purely scientific research. Science and technology tells us what we can do. Ethical inquiry questions whether we ought to do it. This principal applies to strategies of biodiversity conservation just as it applies to genetic engineering. The claim that ethical considerations can be resolved purely by means of scientific research can be supported only on the assumption that the benefits and costs of biodiversity intervention can be reduced to quantifiable considerations, that can reduce the entire discussion to matters of calculation. If this were the case, then we could say that science tells us what we can do, and economics tells us how much it will cost. Reflection suggests, however, that costs are never purely monetary and that costs and benefits rarely accrue equitably to all persons involved. The assumption that ethical issues can be reduced to quantitative cost benefit analysis veils the deeper questions of benefits for whom, costs for whom. It evades the fundamental question whether there are realities, human lives for instance, that have value in and for themseves.

Most scientists have little difficulty in acknowledging the distinction I have made between fact and value, between the results of scientific research and the results of ethical inquiry. Nevertheless the field of ecology is sometimes seen as the exception to this widely accepted rule. It is sometimes suggested that a thorough understanding of the nature and fragility of the world's ecosystems imposes upon human beings certain moral obligations. For one thing, the obligation to preserve biodiversity is sometimes thought to arise from the predictions of ecology concerning the consequences for ecosystems of the extinction of species.[1] A genuine understanding of ecology here is thought to imbue the individual with respect for complex, interrelated ecosystems, and the benefits they provide. Such knowledge is thought to lead to a new awareness of the place of humanity in nature. It is thought to culminate in an "ecological awareness," that will be expressed in an "ecological attitude." It is thought to instill in the individual the will to preserve such systems and their functioning parts, an "ecological conscience." A person who has acquired this attitude will recognize the importance of protecting the integrity of the earth's ecosystems and will understand the importance of saving the species of which they are composed. Moreover, the great diversity of the world's ecosystems is thought to represent an enormous treasury of important information. If species are extinguished before they are named, described and catalogued, the human race will have lost forever this valuable storehouse of biotic information. It would be like the burning of a massive library of rare books.

Such judgments, however, are not based upon ecological considerations alone. They reflect fundamental value commitments that are often embedded in scientific research. The knowledge that is threatened by the extinction of species is usually thought of as knowledge that relates to human ends. The knowledge that the venom of the Malaysian pit viper acts by thinning the blood of its victim might appear merely as an interesting scientific fact. It is more likely to be valued when it is understood that the viper's venom could be used to develop a life-saving anticoagulant medication. Even when knowledge is regarded purely as information it is valued because it is interesting, rare, unique, and threatened. Such knowledge is regarded as having value for its own sake. It is a value judgment. The attitude of respect for the intricacy of relationships within ecosystems that ecology is supposed to evoke is also based on embedded value judgments. We live after all on a planet in which countless numbers of species have been extinguished in the past. The fact that ecosystems are endangered does not in itself entail the obligation on the part of human beings to protect them. Recommendations for human action rest upon evaluative judgments.

In the field of environmental ethics, justification for the preservation of natural diversity has normally proceeded upon one of two differing lines of thought. On the one hand natural diversity has been valued because of the benefits it brings, or can be expected to bring, to human beings or conversely because of the human misery that the preservation of biodiversity can be expected to prevent. Such justification for natural diversity is usually called anthropocentric. The objective of biodiversity conservation for this approach is the well being of humanity. Nature is seen as having instrumental value. It has value because it serves human interests and needs. The other kind of justification for biodiversity conservation is usually distinguished as nonanthropocentric. Here human beings and their well being are not the direct focus of ethical attention. The interests of human beings are not privileged above that of other species. Such theories are sometimes distinguished further as zoocentric, biocentric, or ecocentric. Zoocentric views center upon the welfare of animals. They sometimes argue for the rights of animals to be free from cruelty by human beings. Biocentric views center upon the value of life. They often articulate arguments, for the extension of human ethical considerations to other species. Ecocentric views center upon the wholeness of ecosystems. They sometimes argue for the preservation of ecosystems on the basis of their biotic integrity. For nonanthropocentric approaches to environmental ethics, human beings are one among countless numbers of species that inhabit the biosphere, and their ethical importance is to be determined from an understanding of their significance in the context of this larger matrix of life. They are usually developed in terms of arguments for the *intrinsic* as opposed to the merely *instrumental* or *utilitarian* value of nature.[2]

Critics of anthropocentric approaches to the valuation of nature sometimes claim that anthropocentric approaches leave nature vulnerable to the ravages of human demands. They sometimes point out that human beings have extinguished more life forms than any other species, and that human interest has abused degraded and now endangered the earth. Defenders of anthropocentric approaches often note that not all values that center upon human beings support the wanton consumption of the earth's resources. They argue that not all instrumental values endanger nature. They point out, for instance, that human aesthetic values support the limitation of the exploitation of nature.[3] They also claim that nonanthropocentric theories support biotic integrity to the neglect of the tremendous suffering of human beings and ethical issues of human environmental justice.

As a discipline environmental ethics is not committed to the one or the other approach to the valuation of nature. Environmental ethics is not a philosophy in the sense of an ideology committed to a single way of valuing nature. It is rather an inquiry into ethical issues concerning nature. It is an arena of discourse in which over the past 25 years such issues have been and continue to be discussed. In the United States the field of environmental ethics developed largely in response to the widespread recognition both that the environment in which we live is in peril and that Western philosophy and Western religious traditions had centered upon human beings to the neglect of nature. While exceptions could be cited, the majority opinion in the history of Western philosophy was that nature had value principally because of its utility to human beings. It was also felt that attitudes towards nature embodied in Western religious and philosophical traditions had actually contributed significantly to the degradation of the environment. The Judeo-Christian tradition came under attack as providing justification for the most exploitative attitudes towards nature. It was held that for this tradition (1) the focus of religious adoration is a singular divine being who transcends the realm of nature, (2) that man was uniquely created in the image of God, (3) that this uniqueness is the basis for his intrinsic worth, so that non-human others can have value only to the extent that they serve human purposes, and (4) that the human beings are seen as having been given dominion over nature by God.[4]

In response to these conditions, Western philosophers concerned with the ecological crisis sought to develop an understanding of nature as a reality to be valued for its own sake. They sought to develop a rationale to argue for *the intrinsic value of nature*. This search led quickly to a superficial examination of the understanding of nature in some non-Western traditions of thought. While Western thought had been largely anthropocentric, non-Western traditions, and especially the religious and philosophical traditions of "the East" were supposed to be unanimously biocentric, affirming the value of nature for itself. Such traditions as Hinduism, Jainism, Buddhism, Taoism, Shinto were conflated to represented one unitary "Eastern Wisdom."[5] What came to be widely known as "deep Ecology," was supposed to have proceeded beyond the mere extension of traditional ethical categories to include the land and the animals with whom we share it, to a revision of the foundations for environmental ethics, and the generation of a new environmental ethic, that would be adequate to the present crisis.

Founded by the Norwegian philosopher Arne Naess, the tenets of the movement known as deep ecology were first articulated in an article published in 1973. Here Naess introduces this approach as a critique of what he understands as shallow ecology. He explains that in shallow ecology opposition to pollution and resource depletion is centered on concern for the health and welfare of people, particularly of people in developed countries. Deep ecology, on the other hand is committed to an "equal right to live and blossom," that is not restricted to human beings. It is also committed to the fight against economic and cultural domination, and opposed to the annihilation of human tribes and cultures as much as to the annihilation of seals and whales.[6] He points out that shallow ecology values natural diversity as a resource for human beings. Deep ecology values natural diversity for its own intrinsic worth. While shallow ecology holds that plant species should be saved because of their value as genetic reserves for human agriculture and medicine, deep ecology holds that plant species should be saved because of their intrinsic value.[7] Later, his interpreter David Rothenberg specifically identifies deep ecology as an ecocentric approach to the environment. For deep ecology, nature has value in itself. "Gestalt entities in nature are things to be respected for their own sakes, simply because they are there and near to us. Like friends -- we should never use them only as a means to something else. To do so is superficial, seeing only surface interactions."[8] Here deep ecology does not specifically support the notion of the "rights of endangered species and unique landscapes," but it advocates "thinking of the landscape first, before human needs, and then devising technologies and management, that stem from a rootedness in place and nature."[9]

The concern of deep ecology is perhaps most manifest in its critique of what it calls the present resource conservation and development ideology. It claims that for this ideology the problems of resource management are usually perceived as technological, economic, or political issues. Personnel trained in this ideology see themselves as being value free, and perceive the encounter with opposition to this ideology as matters centering on the subjectivity of special interest groups. They argue that for managers trained in this ideology the earth is simply a natural resource to be exploited and consumed by human beings.[10] Against this ideology, deep ecology supports an ethic whose objective is the maintenance of the integrity of the natural process: "the land -- birds, plants, soil, etc. -- is included in the community along with humans, and consideration of vital human needs is placed in the context of the needs of others for self-realization. Both individuals and collectives of organisms and ecosystems are considered when making decisions."[11]

It is the view of some specialists in environmental ethics that the task of *managing* natural environments and the task of *protecting* natural environments can be distinguished in terms of the dichotomy between regard for human interests and the inherent value of nature. It is argued that the management and the protection of nature make very different demands on ecology. These demands reflect the difference between enhancing the productivity of nature for satisfying human needs, and the protection of nature from damage, especially the damage which human beings inflict upon it. The American environmental philosopher, Mark Sagoff, argues that ecologists can apply their science to either one of these tasks but not to both (at least not effectively to both, at once).

First, ecologists may apply their science to maximize the long-run production of goods and services which consumers demand, industry needs, and nature provides or may be made to provide if it is maintained in appropriate ways. Second, ecologists may apply their science to maintain or restore the "natural" process by which ecosystems function or which we would find in living systems if they were relatively undisturbed.[12]

For the first of these applications of ecology, environmental health is not an end in itself but only the means to the health and welfare of human beings. For the second, the health of ecosystems is of concern because these systems are themselves regarded with admiration, wonder, and respect. Sagoff holds that utilitarian arguments based upon scientific research are effective as justification for the management of ecosystems for human benefit. He argues that scientific arguments are not effective in advancing arguments for the protection of ecosystems for their own sake.

He illustrates this point by means of a discussion of what is perhaps the most influential of utilitarian arguments for environmental protection, the argument that biotic diversity supports biotic stability. In its most popular form, this argument is expressed in the claim of Barry Commoner that "the more complex an ecosystem, the more effectively it can resist a stress." Sagoff traces this argument to an idea suggested by R. H. MacArthur in 1955, and from which according to Daniel Goodman writing in 1975, there developed the fairly persuasive theory that predicts that "complex trophic systems will be more stable than simple ones, or, in general, that more diverse communities will be more stable than less diverse ones." Sagoff observes that since its appearance this theory has been subjected to variety of observational objections. He claims with Goodman that today no serious case can be made for stability-diversity models in ecology.[13]

Sagoff argues that the justification for the protection of ecosystems should be based not upon utilitarian arguments derived from ecological science, but upon aesthetic and ethical ones. Such arguments would proceed not from theories such as that connecting diversity and stability, but from the recognition that nature is a part of our national and cultural identity, and that it should be protected for the same reasons that we would wish to protect any other part of our national and cultural heritage. Along a similar line a recent book by David Takacs (1996) deconstructs the idea of biodiversity to reveal the value judgments beneath the seeming objectivity of its scientific discourse. In this perspective, conservation biologists committed to the maintenance of biodiversity are no more objective in their presentation of facts than the scientists employed by the Tobacco Institute. Ironically, Takacs finally gives back to conservation biologists what he seems to take away. He argues that because they are the experts on biodiversity, on what endangers it, and what is necessary for its protection, the recommendations of conservation biologists should carry special weight in the generation of environmental policy. Their prescriptions for the health of ecosystems like the prescriptions of a physician concerning the maintenance of one's personal health should be taken seriously.

The difficulty with this analogy, as one of his reviewers has pointed out, is twofold. In the first place, by comparison with the physician's knowledge of the widely accepted prescriptions and treatments for an enormous range of diseases, the conservation biologist's knowledge of the requisites of biosystem health is in its infancy. Secondly, even if the knowledge of health professionals and conservation biologists were comparable, it would not follow that the recommendations of conservation biologists or of physicians, for that matter, should have special authority when the urgency of competing concerns have to be adjudicated. The key issue here is not simply the scientific facts, but the fundamental values that determine our actions.[14]

I am not certain whether Mark Sagoff is completely correct in his view that scientific research is totally irrelevant to the task of preserving nature for its own sake. I am certain, however, that we are quite mistaken to rely exclusively upon scientific arguments either for the management or the protection of nature to the neglect of the cultural history of India, in which, over the past 5,000 years, nature has been the subject of admiration, wonder, fear, love, and respect.

The fact that environmental ethics has derived insights from its knowledge of India for the development of its understanding of the intrinsic, as opposed to the merely instrumental, value of nature provides no guarantee that these insights will prove especially relevant to environmental issues in India. It is questionable whether the insights of an environmental ethic developed in Western Europe and the United States in the encounter of this philosophical tradition with its own cultural resources and in the philosophical evaluation of these resources can have any direct relation to the ethical issues presently facing India. Ethical concepts, such as the intrinsic value of nature, that have become part of the discourse about environmental issues in the United States and Western Europe cannot be presented as principles that are valid in every context in which environmental issues are debated. What does seem relevant is that environmental problems and their proposed solutions in Western Europe, in the United States and in India have profound ethical dimensions. In India the fundamental question is not whether nature has value because of the human interest it serves or because of its inherent worth. In the cultural history of India nature has clearly been admired, respected, feared and loved both for its instrumental and for its intrinsic value. The question is not whether nature is valuable because it serves human interests but whose human interests it should serve. The question is not whether nature has inherent value, but whose perception of the inherent worth of nature should carry weight in the development of environmental policy, and who should bear the cost of its protection. What is likely to be relevant to the discussion of ethical dimensions of environmental problems in India is the insight to be derived from India's own encounter with the understanding nature embodied in her own cultural, religious, and philosophical traditions.

In the cultural history of India, nature has a significance very different from what it has in the West. Among the remains of the Indus Valley civilization that flourished between 2800 and 1800 B.C.E. we find steatite seals with inscriptions in a language still obscure. These seals, sometimes called the first documents of Indian culture, often depict trees in relation to water and to what are evidently goddess figures. On others we find images of the earth as mother giving birth to a tree, and scenes composed of animals, trees, human beings, usually interpreted as revealing the common rhythm in animal, vegetative, and human life. This relationship is also found in later visual images of the Ganges as a goddess depicted beneath a tree.[15]

In various parts of India today we find sacred groves dedicated to a deity that is understood to reside within it. In such spaces, sometimes twenty hectares in area, the vegetation of the entire grove is understood to be protected by the resident deity. The removal of even dead wood or twigs from such areas are taboo. Such groves are ancient natural sanctuaries wherein all forms of living creatures are afforded protection. Recent research in villages in the Western Ghats, in which these sacred groves still flourish, indicate that local beliefs support the protection of such groves. Villagers in the region regard the violation of taboos concerning the protection of these spaces to be fraught with dangers. The breaking of taboos protecting the sacredness of such places are understood to cause serious sickness or death. Such groves probably constitute the only remains of the forests that once flourished on the hilly terrains of the Western Ghats.[16]

Even when they are not designated as sacred groves, forests have had a significance for Indian history that is absent in the dominant traditions of the West. In ancient times villages were responsible through their *panchyat*, their committee of five elders, for maintaining the forests in their region. Forests were utilized by villages who valued them as the source of their prosperity.[17] Other forests were the dwelling of the *rishis*, the mythical authors of the Vedas. They were also the dwelling of those teachers whose forest hermitages were intended to be places set apart from the preoccupations of worldly life, a place pervaded by the sense of the presence of God. In ancient times, the shade of a tree was the proper place for a disciple to receive spiritual instruction from his guru. From such places there arose the profound literature that was the source and background of the *Upanishads*. They were called the *Aranyakas*, the forest books. Near the places where the sages lived no animal or tree was to be harmed. Even kings were forbidden from hunting in regions close to these dwellings.[18]

In the Vedas themselves religious life centers upon some thirty-three *devas* most of whom are the symbolic form and personification of various features of nature: the sky, the dawn, the sun, the storm, the earth, the wind, the rain. The Vedas lavish praise on such rivers as the Yamuna, the Sarasvati, the Indus, the Ganges. Indian religious traditions regard all rivers as sacred, and on the banks of such rivers as the Yamuna, the Indus, the Ganges, the Narmada we still find ancient temples in which a deep piety toward the river is expressed.

Nature is also featured prominently in the great narrative traditions of India. It was in the great forests of India that Lord Rama and Sita spent the years of their exile and it was with the help of the forest animals that Ram succeeded in the rescue of Sita from Ravana. It was also in the forest that the sons of Pandu spent the exile that led up to the great battle that is the climax of the Mahabharata. Lord Krishna spent his childhood in the twelve forests of Vrindavan. They are the context of the many *lilas* in which his teachings are set. In many cases animals are symbols of the deities that are featured prominently in Indian religious life. They are the *vehanas* or vehicles and therefore the symbols of the gods or among the *dramatis personae* of the narratives in which the stories of the gods are told: the bull, the elephant, the snake, the peacock, the monkey, the cow.

In the Vedas we also find the origin of the idea of the universe as an organic whole, an idea that is developed more thoroughly in later Indian philosophy. In one of the hymns of the Vedas, the creation of the universe is depicted as the sacrifice of a colossal anthropomorphic deity known as *Purusha*:

From his feet came this earth; from his torso the mid-region of the sky, stretching as far as the blue extends; from his head came the heavens above the sky. . . . From his eye came the sun; from his mind, the moon; from his mouth were born the gods Indra and Agni; and from his breath came the winds. (Rig Veda 10: 190)

As many scholars have observed, the universe here is understood as a living organism in which each part is related to the life of the whole. Later there develops the idea that all of life is sacred because all living beings reflect the One ultimate reality from which all of life has come, and the ethical injunction against the injury of living things reflected in Jain, Buddhist and Hindu philosophies.

It would be beyond the scope of this paper to develop any one of these examples. There is now a steadily growing literature in which many of these subjects are discussed. From these examples I am not suggesting that there are not elements in Indian thought which have been interpreted as support for the transcending of nature. The point is that while in Western philosophical and religious traditions nature is all but absent, India stands at the end of a very long and illustrious tradition in which the importance of nature is recognized, celebrated, and valued. It could be argued, that even those philosophical traditions of India that have tended to minimize nature, and seek salvation in liberation from every kind of earthly bondage, are themselves dependent upon a fundamental appreciation of nature that made the development of such philosophy possible.

To recognize the importance of these traditions is not to minimize the enormous environmental problems that India faces. It is to recognize that India has a rich tradition that contains important resources for ethical reflection that we do not find in the dominant traditions of the West. An ethic that is rooted in a living cultural tradition will be inherently more viable, more persuasive, and more effective than one generated by metaethical theory divorced from the lived experience of the community it is intended to inform. While this paper cannot present the rudiments of a developed environmental ethic, it is worth noting that this tradition does not conceive of human welfare as an interest that can be extracted from the interests of nature, nor is it a tradition that elevates biotic integrity above concern for the welfare of human beings.

To reflect upon the method appropriate to the task of an environmental ethicist working in India today it might be appropriate to reflect upon the method pursued by an ancient philosopher who belongs exclusively neither to the West or the East, and whose contribution to ethical reasoning has not been exceeded since he walked the streets of Athens some 2400 years ago. In Plato's famous dialogue, called *The Creto*, the philosopher, Socrates, is in jail. After the better part of a lifetime spent in philosophical dialogue, Socrates has been arrested, unjustly tried, and unfairly convicted of impiety. He has been sentenced to death and is awaiting his execution when he receives a visit from Creto, a friend of long standing. Creto admires Socrates. He is tortured by the news of his conviction and he informs Socrates that he has a plan for his escape. He implores Socrates to flee with him to a distant state where he will be able to live out the remainder of his life in peace and security.

It is interesting that to determine the morality of the proposal Socrates does not engage in dialogue about the justification which Creto offers. Instead he begins by asking Creto about the principles that he, Socrates, has always held. What is it that I have been saying on the streets of Athens all these years? What have I been saying by my teaching and by my example? With difficulty Crito remembers. Never do harm. Never do injury to anyone for any reason. Socrates then raises the question. Shall we continue to hold these principles? Or shall we abandon them now that the sword hangs over our head. He hears from Crito that he ought to continue to hold them. From these principles he finds his answer to Creto. Socrates refuses the offer of escape. He resolves to remain in prison to die.

This dialogue strikes us as artificially simple in the light of the complexity of environmental issues that demand our attention today. Yet it is with reasoning of a similar kind that we can address many of the moral dimensions of many of our environmental problems. What are the fundamental values concerning the environment that we have always held. What is it that we have been saying about nature all of these years. Does the environment have significance merely as standing reserve, as a supply of material resources to be exploited to whatever extent and to whatever end the strongest economic interests of the society determine? Or does the understanding of nature embedded in India's cultural history entail the obligation to protect it? What is it about nature that we have always been saying? From the Vedas, to the Epics, to the Dharmashastras, to the Puranas, to the messages of the great saints, and singers of Medieval devotional piety, to the teachings of Rabindranath Tagore and Mohandas Gandhi, what is it that we have always said? As this becomes clear in our minds we can proceed to the next question that Socrates puts to Creto. To what behavior towards the environment, to what kinds of policies and strategies concerning the environment, do these principles commit us? If biodiversity is to be protected, from what, from whom; for what, and for whom is it to be protected?

While I cannot here develop the details of the environmental ethic that these sources entail, I should like in closing to distinguish two extreme conceptions of biodiversity conservation that I believe are not supported by this cultural history. On the one hand is the view that India should develop a system of national parks on the model of the national parks system of the United States. As applied to India the main motivation of this understanding of biodiversity conservation would be to preserve wilderness, to preserve it either for its intrinsic value or for its aesthetic significance for those who love nature and are able to appreciate it for its beauty and biotic integrity. Its principal policy concern would be to preserve it from those who are thought to be its principal threat, the tribal peoples who have resided in such forests from time immemorial. This position would privilege the interest in establishing and maintaining the beauty and integrity of ecosystems over the interests of local people to hunt, to graze, and to gather fuel, from wilderness areas. It would privilege scientific knowledge over the knowledge of local people. It would advocate a policy of displacing such people from the region of protected areas altogether. This vision of conservation is not supported by the cultural resources of an Indian environmental ethic. The cultural traditions of India do not support the ideal of wilderness devoid of people that motivates the American idea of the national park. In the cultural history of India human beings have always been a part of nature, and concern for the preservation of nature has never excluded but always included their welfare.

At the opposite extreme is the view that so long as poverty remains the condition of a sizable sector of the Indian population, there is no justification for the preservation of biodiversity at all, and no justification for the preservation of India's many endangered species. This is the view that we are justified in attending to the problem of endangered species and engaging in the luxury of preserving natural diversity only after the problems of human welfare have been resolved. In its most extreme form it is the view that we have no justification for preserving natural diversity until the last homeless family is housed and until the last hungry person is fed, and can be assured of the material conditions of continued well being. The fallacy of this way of thinking is easy to see. No matter how successful the most effective program of social uplift or economic development, it will always leave some persons relatively poor by comparison with the relatively rich. In the mean time all hope of preserving nature for any legitimate reason will have been eliminated out of hand. Beyond that, the preservation of biodiversity is clearly in the interest of the poor, for the poor are usually the first to experience the effects of environmental degradation, especially in the form of the loss of biodiversity. If appropriately developed, biodiversity conservation can serve the cause of the uplift of those most afflicted with the effects of environmental degradation.

I am not arguing that anyone holds the views I have just distinguished. I have deliberately constructed them as extreme and unworkable positions. We should think of them as what Aristotle called the extremes of excess and defect between which the ethical path is to be found. It is clear that in the resources for an Indian environmental ethic there is strong support for the preservation of nature. But it is equally clear that for the cultural traditions of India the preservation of natural diversity does not surpass the need for attention to issues of environmental justice. Biodiversity and environmental justice are not two conflicting interests. They are aspects of one ethical concern that can be integrated within the purview of an environmental ethic that is developed in the encounter with Indian resources for environmental ethics, that pertains meaningfully to Indian environmental problems, and that serves the legitimate interests of all of India's people.

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Biosphere Reserves of India

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Introduction

The Biosphere Reserve Programme has now assumed an even greater significance than when it was initially proposed by UNESCO's MAB research programme as early as 1971. This is for two important reasons. Firstly there is an increasing awareness of the value of biological diversity as a whole, especially because recent scientific advances leading to biotechnologies have brought to focus the importance of conserving biodiversity even in groups of organisms that were earlier considered entirely insignificant. Thus for instance, there is a realisation now that a very large number of chemicals of considerable pharmaceutical importance may be discovered in the varied biota of tropical rainforests and coral reefs. This may include elements which have today no economical value as sources of timber or known sources of drugs, but whose value may be very substantial in coming years. Indeed a whole new range of activity which has been termed biodiversity prospecting has become increasingly important in the last few years. Thus in the rainforest areas of Costa Rica a major institution called INBIO has been set up for full-time screening of biodiversity of Costa Rica's forests. Similarly, the Japanese have set up an institute for marine biodiversity prospecting in Micronesia, again with a view to identifying the potential for biotechnological uses in coming years.

But biodiversity being simple conserved is not really of much use unless we know what biodiversity there is and what its uses are. Therefore developing a knowledge base on biodiversity is an important as the conservation of biodiversity itself from the perspective of its technological utilisation. The emphasis of the Biosphere Reserve programme from the beginning on investigation, scientific research, monitoring and inventorying in addition to conservation activities is of considerable significance in this context. The Biosphere Reserve programme from its inception has also emphasized the importance of humans as an integral part of the ecosystems and the necessity of involving, especially local communities, in a positive fashion in the conservation programme. Over years it has been increasingly realized that conservation of biodiversity and indeed a whole set of programmes of natural resources management and utilisation cannot be effectively carried out as state sponsored programmes in isolation from local people's aspirations, interests and their own development initiatives. Therefore this perspective of the Biosphere Reserve programme is also important as distinguishing it from the wildlife sanctuaries and national parks programme and renders it all the more significant in the present day context.

To summarize, Biosphere Reserve programme differs from the wildlife sanctuaries, national parks programme in three important respects:

1. its emphasis on overall biodiversity rather than some specific flagship species.
2. its emphasis on the importance of research activities and
3. its emphasis on involvement of broad based local people's participation as well as taking into account the overall developmental activities compared to the wildlife sanctuaries and national parks programme.

India's Biosphere Reserves Network

India's own Biosphere Reserve Programme was launched in 1979 with the setting up of the Indian National MAB Committee. The core advisory group of this committee then identified twelve unique biogeographic regions and 14 biosphere reserves were proposed to be set up covering these regions.

Today India has a total of—

(a) 54 National Parks, with an area of 21,003 sq.km or 0.6% of the land area and
(b) 372 Wildlife Sanctuaries, with an area of 88,649 sq.km or 2.7% of the land area giving a total of 426 protected areas with an area of 109,652 or 3.3%. These protected areas are not distributed uniformly

across the states or across the biogeographical zones or provinces of the country. Some states and zone are relatively well covered, others very poorly covered.

Seven biosphere reserves have been established in India beginning with the Nilgiri Biosphere Reserve and followed by Nandadevi, Nokrek, Great Nicobar, Gulf of Mannar, Manas and Sunderbans which cover a total area of 21,066.62 sq. km.

These Biosphere Reserves are really a very good sample of a wide variety of biodiversity rich habitats of the country. Therefore this network has a special importance in the efforts at biodiversity conservation. Being the nuclei of biodiversity rich areas of the country they would also obviously serve as areas where the future biodiversity prospecting activities and activities for ensuring sustainable utilisation for biological diversity would be importantly carried out.

It is obvious that though considerable progress has been made in conservation of biodiversity of the country there are clearly many possibilities of improving the quality of this effort. In particular we would like to stress that the quality of effort can improve in the three directions in which the Biosphere Reserve programme differs from the conventional wildlife sanctuaries and national parks programme, namely in (a) ensuring a broader coverage of the many differing elements of biodiversity, (b) in organizing more scientific effort and on documenting this biodiversity and finally (c) in resolving the conflicts between development efforts and conservation and ensuring increased participation of local people in the conservation efforts.

We discuss below a number of specific issues concerning biosphere reserves based on our field investigations.

Inclusion of P.A.s in Design of Biosphere Reserves

All the Biosphere Reserves have their areas overlapping with either National Park/Tiger Reserve or Wildlife Sanctuary or both. This indicates insufficient incorporation of scientific insights. Because of the overlap of Protected Areas, conflicts may arise in terms of management.

Some other important habitats are left out in an attempt to achieve this overlap of the areas e.g. in Assam, Kaziranga is one proposed Biosphere Reserve out of 13 in India. This has overlapping area with the Rhino National Park. This has left out some important wetlands in Northern Assam, which need conservation hand in hand with sustainable development of local communities (Pers. comm. P.C. Bhattacharjee).

In case of great Nicobar Biosphere Reserve the area overlaps with 2 National Parks viz. Galathea and Campbell Bay. This covers almost entire island of Great Nicobar. A group of islands just north of GN called Nancowry group is important from the viewpoint of conservation of an endemic subspecies of Megapode, which is left out (pers. comm. Ravi Shankaran, SACON) Ravi Shankaran proposes to declare the entire area including Nancowny group of islands as Biosphere Reserve also including the coastal townships of ex-army settlers into buffer zone, so that the important habitats could be managed under core zone and the habitations included in buffer zone. The settlers could be educated, awareness training programs could be conducted for them as a part of Biosphere Reserve program.

Grant

According to most of the forest officials concerned with the management of Biosphere Reserves the 'GRANT' assigned for the Biosphere Reserve is not received in time. They would receive it somewhere in February expecting to utilize it before March ends. Thus the grants are spent in meaningless work. Also the amount of grant being filtered at various levels from international - national - state - FD, very little reaches to the grassroots, which is the case in every government sector.

Another peculiar situation is the following:

The Biosphere Reserve manager has to submit a project according to the management plan of each Biosphere Reserve, to get the required amount sanctioned from MOE and F. Because of serious lack of awareness amongst the government officials, (esp. FD) about the concept of Biosphere Reserve itself, obviously the funds remain unutilized since they are unable to submit a project proposal to manage the Biosphere Reserve.

Ideally the distribution of funds should be equitable for the entire region considered as Biosphere Reserve. For this, one needs to work out the most convenient logistics. In case of Nandadevi Biosphere Reserve, which is distributed in a vast area of the order of 2500 sq. km. the headquarters are at Chamoli (Garhwal). Another part of Nandadevi Biosphere Reserve is in Pithoragad district (Kumaon), far away from the headquarters, some 250 km away, that too in a hilly terrain. Thus, this portion remains extremely neglected. The headquarters have almost no control over the core area in Pithoragad leading to illegal poaching of Musk Deer, musk being exported to Nepal.

Baseline Data

Baseline data could be classified into various subsets, viz. maps, checklists of various taxa, lists of other relevant parameters, counts, statistics, changes over time, most of which are available in district gazetters.

The relevant information from these data sets needs to be extracted, classified to prepare the baseline datasets for the concerned study area viz. the biosphere reserve.

These data are used to prepare management plans for the Biosphere Reserves. Out of 7 Biosphere Reserves in India, most of the Biosphere Reserves have these databases in varying degrees of precisions. The management plans also have been prepared, but rarely implemented.

Similar could be said about the integrated data on natural resources and the databases on socio-economic-cultural aspects.

All these data, along with their synthesis in form of a management plan are available on paper, but they are very 'remote' to be accessed. The authorities are not ready to co-operate, when asked about the management plan. The government departments are reluctant to disclose their reports, plans and maps for the general public, even the researchers, working in the area concerned have to pursue to the end of one's life to access these data.

Dissemination of Information

The information flow should ideally be from local → state → national → international level. But in the case of all the Biosphere Reserves it's exactly the opposite.

Because of foreign funded ongoing research projects, the international sphere of researchers is well aware about the Biosphere Reserve. They easily access all databases through international agencies. This information trickles down to national level research sphere. They are quite well aware of the ground truths, because of easy access to the area. Also, the decisions about Biosphere Reserves are taken at a national level and implemented by state. The state government is unaware of the concept of Biosphere Reserve itself, including the FD field implementors. They just know to implement the 'orders' from the Central Government and never understand the meaning behind it. The information finally trickles down to the grassroots - local level, where it loses the original content and the form and most of the times leads to the confusion of the local people.

Thus in Nandadevi Biosphere Reserve the confusing usage of wildlife sanctuary - national parks and Biosphere Reserve has confused the local people. On one hand they are prevented to enter into the core area and graze the cattle in age old pastures which in fact is their livelihood. On the other hand they cannot understand the relevance of development activities like construction of bunds, roads and plantations in the buffer zone area generating a part-time employment for them as labourers. They can see what's happening before them but cannot understand why it is happening (H.R. Negi and M. Gadgil in NDBR: a status report)

Local Population in Planning Management

The local people are absolutely unaware of the concept of Biosphere Reserve itself, because of poor dissemination of information till the grassroots. Their understanding of the Biosphere Reserves role is very poor.

In all the Biosphere Reserves of India, local people have been following the rich heritage of traditional nature conservation practices in one way or the other. They are well aware of sustainable, planned utilization and efficient management of their own natural resources. In Nandadevi Biosphere Reserve, when the local porters were asked about their idea of conservation, their answer was quite remarkable.

They say that the core zone area is like their HEART and the buffer zone is like the rest of the BODY. They further comment that even if the ban on them by the FD is lifted, how the officers suspect that local custodians will damage their own heart? (H.R. Negi and M. Gadgil in NDBR: a status report).

This exemplifies the attitude of the local people towards their resources. They have so far managed them very wisely for generations together. Still, no government department bothers to consult the local village committees, individuals as to what their ideas of resource management are:

The locals are considered as illiterate and are deliberately left out in the process of decision making, planning and implementation.

Local Culture - Research and Incorporation

Cultural practices/patterns of the local people are poorly studied in depth in all Biosphere Reserves. A few exceptions could be: an ongoing study on Bhotias - a shepherd (nomadic tribe) in NDBR by Ruchi Badola and Chandrashekhar Siluri of WII under the guidance of Dr. Satyakumar.

Another study, on shompens of Great Nicobar, undertaken long back and continued by one Dr. Rajan, is included by Dr. Avaradi in the management plan.

The government - implementors of Biosphere Reserve program are extremely uninterested to know the cultural practices going on in the Biosphere Reserve area and attempt to bombard some fancy ideas of conservation and development on local people.

An example in GNBR of government anarchy and apathy is quite illustrative.

Shompens are the local people in GNBR, along with Nicobarese, the coast-dwellers, who have trade relationships with outsiders viz. Thais and Indonesians. Shompens are aboriginese, forest dwellers, hunter-gatherers. They depend entirely on forest produce. One fine morning government decided to carry out a welfare programe for Shompens. A Shompen complex with a dispensary, a school and a community hall was constructed. Shompens were provided with ration, tobacco etc. This continued for a year and was stopped at once for unknown reasons. This made shompens to get addicted to tobacco and other modern amenities provided, which is not at all a part of their culture, and suddenly bombarded on them.

Another example is from NDBR, where the 'Bugyals' were closed for grazing and human interference, resulting in loss of traditional medicine practices because of no access to the 'medicine reserves'. This clearly indicates apathy towards cultural practices and their incorporation in Biosphere Reserve management.

Environmental Education - Awareness - Training

It could be categorized on the basis of beneficiaries, viz. local people, common-man, FD, staff and officers and researchers/scientists.

Local people, deprived of information about the Biosphere Reserve itself, obviously, receive very little education/awareness/training, and that too for names sake or for political interests in vote banks. An example from NDBR is illustrative for creating awareness amongst the local people, FD, once in a while screens some wildlife film in villages. For this a lot of money is spent on TV, VCR and all such equipment. But such efforts are reported to create negative impacts and the local people become confused.

The layman is in no way aware about the entity called Biosphere Reserve. Media do not much stress upon the issues concerned with conservation and development, because such news would not fetch them readers.

As compared to the above two, FD conducts a decent amount of training programs and awareness sessions for staff and officers. But, the attitude in these education packages is more of a conventional type, contrasting the broader objectives of the Biosphere Reserve. The staff, thus remains under a misconception that Biosphere Reserve has given them more policing powers than those due to wildlife sanctuaries and National Parks.

Researchers/scientists through self initiative are comparatively well-aware of the Biosphere Reserves. Government research bodies alongwith the non-governmental research organisation are found working hand in hand in many Biosphere Reserves.

Organizational Strategies to Coordinate

All the four categories of beneficiaries viz. local people, layman, FD staff/officers and researchers/scientists are in their own water tight compartments, leaving no scope to integrate the inputs from all these actors and further co-ordinate the activities.

FD could have been an ideal entity/strategy to coordinate the activities, being in touch with all these actors. Unfortunately, in no Biosphere Reserve, FD is seen to play such an interdisciplinary role.

In NOBR there is no co-ordination and dialogue between FD, district tribal councils, soil conservation department and the local farmers and tribals. All these government agencies are working at cross-purposes.

Employment Generation

Various activities in Biosphere Reserves do generate employment for the local people, but the major fear is the domination by the larger economic forces grabbing the opportunity and using the local people as labourers without giving them enough returns.

Still, the picture of employment generation is quite positive in Biosphere Reserves of India. E.g. SBR is trying to generate income sources like brackish water aquaculture and apiaries among the forest going families. These efforts, if succeeded, will minimize the entry of people into tiger and crocodile infested area (Silajan Bhattacharya in an article). Also in GBR, NGOs are trying to find suitable employment for the fisherfolk during the lean periods of fishing. This may prevent them from coral extractions.

Human Nature Conflicts
(With special reference to man-wildlife conflicts)

This is a much celebrated conflicting issue in case of protected areas right from sanctuaries, national parks, tiger reserves. The governments stand is as if they are to choose between 'ecosystem people' and 'wildlife', the latter always being favoured, and the former evicted from the Protected Areas. Biosphere Reserves were meant to find a midway between conservation as against development. In spite of that, because of the faulty design of Biosphere Reserve, at many a places the conflicts have continued and still is a major issue.

In GNBR, though large mammals are absent, a conflict arises because of the crocodiles inhabiting estuarine waters in all five rivers on islands. Of course the illegal trade of crocodiles by 'Thai' traders frequently visiting great Nicobar, brings another dimension to the picture.

In GMBR, apparently there is no conflict of man with the wildlife, still all the islands being declared as core zones of the marine Biosphere Reserve, people are completely excluded from consideration. This gives rise to a conflicting situation because they are deprived from their livelihood.

Manas is a famous tiger reserve, and obviously, is an example of the conflict between people and the tigers. Moreover, MBR has no buffer zone near the southern boundary and the fields start next to the tiger habitat. This intensifies the problem, because of frequent encounters of tigers around human settlements.

In NDBR, Bhutias, who are fond of wildlife, which does not harm them or their livestock, but they hate animals like monkeys, black bear, langurs, wild boar, because of frequent raiding of crops by these animals, snow leopard and black bear raid their livestocks. There are frequent instances of bear raiding honey bee hives and damaging flour grinder houses for honey and grain flour respectively. Unfortunately, both of these animals are endangered and this hatred among the local people for these endangered species is a direct conflict with wildlife conservation measures (Negi and Gadgil).

Nilgiris are one of the favoured areas by Elephants, alongwith other large mammals, some of them are carnivorous. The major conflict is between the people and the elephants. There are several instances of working men, mercilessly thrashed by elephants. In dry seasons, during non-availability of fresh grass, crop-raiding by the elephants is a common phenomenon.

In NOBR, no man-wildlife conflict is reported, but there should be some instances, where people fall prey to a hungry tiger from Balphakram Tiger Reserve just south of Nokvek.

Sunderbans is a classical example, which could be elaborated in much more details. Sunderbans is the only mangrove habitat with a tiger population still living in it, tigers have been wiped out from all other mangrove forests in the world (Silanjan Bhattacharya in conservation of a unique ecosystem). During British Raj, the landless people from Midnapur district of West Bengal and the border districts of Orissa were brought to Sunderbans from a strategic point of view, to earn revenue from the land. In 1973, project tiger was launched and several restrictions were put on the people without considering their biomass needs. Prawn fishing, became the major livelihood activity of the people. Still, during the lean period, they entered the tiger areas to collect MFPs and that's where the man-tiger encounters became frequent to the extent that the tigers turned man-eaters in scarcity of prey. Project Tiger, thus antagonized local people living close to the tiger reserves by restraining their access to their *traditional* natural resource bases within forests. Several measures like fresh water, electrifying dummies, masks failed. The real solution is alternative employment in lean period. Frequent crocodile attacks on fishing people is also a conflicting issue.

Legal Basis/Framework

Biosphere Reserves in India have no legal basis. They are designated, declared, notified as a part of National Biosphere Reserve Program by Ministry of Environment and Forests. These are not recognized by the MAB - International biosphere reserve program. Still the 7 Biosphere Reserves exist, their areas, overlapping with that of sanctuaries (declared by states, governments) and national parks, tiger reserves (declared by Central Government), these being legal entities. The laws about the Protected Areas are clearly mentioned in the Wildlife (Protection) Act, 1972 as amended upto 1991.

In most of the Biosphere Reserves the Protected Areas therein are designated as a core zone, with all relevant laws applying to it and the surrounding areas which may be of mixed ownership are the buffer zones. It may contain reserved/protected forests to which the relevant laws apply.

The laws compatible with the objectives of Biosphere Reserves are not formulated because Biosphere Reserves are not legal entities, according to any of the acts.

Management Plans: Existence/Implementation

According to the MoE & F document for the establishment of Biosphere Reserves, the boundaries, the zones of proposed Biosphere Reserve were decided. A management council was designated, along with a research committee and the institutions were identified to carry out the research, all these being government bodies with no involvement of voluntary sector. They came together to design management plans which still exists for almost all Biosphere Reserves.

But the major hurdle is their accessibility. Apart from that these plans were hardly implemented on field, remaining merely on paper. That is probably the reason of keeping them secret to avoid cross-questions.

Equipment and Infrastructure

To satisfy the various objectives of the Biosphere Reserve like awareness-training-education, research, protection of natural wealth, sustainable development of the local population, the infrastructure and the equipment is necessary.

The grants are made available by MoE&F through MAB program for the Biosphere Reserves. Most of the times these are frittered away, because of misunderstanding and lack of awareness amongst the implementors.

In NDBR, FD bought TV-VCR sets to screen documentaries for creating awareness amongst the local people about Biosphere Reserves. Unfortunately, the politicians misused the facility to screen some popular films for the local people as a continued recreational activity to bag their votes during elections (H.R. Negi pers. comm.).

FD was also provided with patrolling vehicles to prevent illegal poaching. The vehicles cannot reach the core areas, being in highly mountaineous terrain and the poaching of musk-deer for export of musk to Nepal still continues in Pithoragad area.

In the name of development, local shepherds, Bhotias, were provided with solar panels, fuel efficient chulhas, looms to make woolen cloth. Unfortunately these commodities were randomly distributed keeping some part of the population deprived of them, thus causing discontent amongst them. Moreover, while providing these amenities the local needs were overlooked, e.g. because of severe cold, people need to make a big fire, not only for cooking but for warmth, too. Without considering this, people were made to use Chulhas consuming less wood (obviously no warmth), so that the deforestation is checked. Actually people blame that FD cut forest anytime they want, mostly falling prey to the pressure of contractors, which is the main reason of depletion of the forest.

In case of almost all Biosphere Reserves overseer's housings are constructed, even the remotest places like GNBR, where the forest camps are built far away from the headquarters. But the problem is the overseers/guards are reluctant to live at such housings and prefer to stay back near towns. Thus all this system is very poor in terms of continuity and permanence of appointed personnel at the assigned place of their residence.

In terms of presence of research facility like a scientific station/outpost GMBR and NBR are the two having decent research stations. In GMBR, a marine biological research station is present at Kursadai islands, which is apparently conducting research on ways and means of increasing fish catch (Niraj Joshi in his report on GMBR). In NBR, Indian Institute of Science has a well equipped research station. CES is carrying out research on various aspects in NBR.

Control and Policing Powers

Because of the lack of awareness amongst the implementors of the Biosphere Reserve program, they do not act according to the objectives of the Biosphere Reserve program. They have no doubt, policing powers to control the exploitative activities in the core zones, but they try to apply the same rule everywhere even when the question of subsistence needs of the local population arises. Sometimes the locals are deprived from collection of fuelwood, MFP etc and unnecessarily punished/fined. This makes the local population bear severe grudge about the forest department staff.

In GMBR, FD still continues to keep out people from islands and surrounding seas. The fishing activity of locals is looked upon by FD as trespassing and they are caught and have to pay huge fines. On the other hand, boat loads of corals from the same islands are being carried to Tutikorin by big cement industries without FD even knowing about it.

Coordination Between Government Departments who Manage

All the Biosphere Reserves in India report extreme lack of co-ordination between different government departments. Each department has its own private agenda which is never disclosed to public, and hardly implemented, except for political reasons. No government department has an agenda compatible with the objectives of the Biosphere Reserve, again because of lack of awareness.

A classical example is from GMBR. An island, called Krusadai, being part of the scheduled core zone is occupied by fisheries department, removing natural vegetation and planting coconut etc. They also undertake oyster culturing on commercial scale. This island has not yet been handed over to the FD by the Fisheries Department even on repeated requests. (M. Gadgil and Niraj Joshi in Management Problems of GMBR).

In GMBR, the exploitation of timber continues for the supply to saw mills from the National Park Areas. Government also probably releases the permits to exploit timber at some places (one of the branches of FD itself) inspite of the forests, remaining as the last refuges of a very fragile ecosystem. Sand-exploitation from the coast especially for the construction of jetties etc continues by little contractors, and the sand ultimately is used by the 'Harbour Works' department of the government itself.

In SBR the government agencies are working in isolation from each other and even agencies with similar objectives do not co-ordinate. SBR directorate is not aware of various ecodevelopment and conservation measures carried out by the Project Tiger Authorities. Sunderban Development Board and the FD are having disputes over who should do planting of mangrove trees in degraded forest patches around the villages. The local villagers are not involved in programs like social forestry. Thus due to lack of co-ordination among different government agencies and lack of people's involvement integration of conservation with development has not occurred.

Traditional Conservation Practices/Efforts

Such efforts are reported from all the Biosphere Reserves in India, the local people have been conserving their own natural resources for ages together and they still continue with it. Sometimes one also finds a *de-novo* emergence of one such practice or the other in the community or sometimes the revival of the older ones. Because of lack of sufficient knowledge about the origins of Shompens and Nicobarese and their culture, traditions there is no documents of any such practices, but they should be following some.

The fisherfolk of GMBR are engaged in fishing activities using locally prepared small boats, nets etc. This activity is perfectly sustainable to the marine ecosystem. Moreover they also restrict themselves in certain season of the year, which very well coincides with the breeding season of many of the fishes. This ensures the contained supply of fish the next year.

Bodo tribals inhabiting MBR have their own traditional conservation practices. They protect the forest in form of sacred groves which very well harmonizes with the concept of supply and safety reserve. Some places also have sacred ponds, maintained to protect a variety of fishes.

Bhotias of NDBR have their own traditional medicine practices. They depend on the alpine meadows, where they graze their sheep and collect medicinal herbs as well. The grazing levels, obviously are maintained to optimum, so as to ensure the continued supply of medicinal herbs. Unfortunately, since the core zone of NDBR is closed to all human activities, Bhotias are deprived of their livelihood and also the supply of medicines to maintain health practices.

In NBR area, in all three states, viz. Karnataka, Kerala and Tamil Nadu the forests are protected by the local tribals in form of sacred groves, sometimes occupying some tens of hectares. They associate these forests with some of their deities and preserve them.

In NOBR area, the Garo tribals have been given autonomy and they administer the area through their own district councils. The land here, legally belongs to these district councils and they are very particular in protecting the forests therein. Garos have a community land ownership system, where communal land holdings called 'akhing' belong to matrilineal clans called Machong. These akhings have 'nokma' as their head, who is chief in charge of the land/group of villages. He lays down certain rules about the communal conservation of natural resources and places an order to the members of community. The breach of order makes the accused punishable. (Niraj Joshi in Nokrek Biosphere Reserve status report).

In SBR, the local villagers have realized the importance of protecting forests from economic point of view because the forest produce like firewood, sal leaves, seeds, poles had considerable market demand. Thus the idea of Joint Forest Management was born. This program has initiated formation of village forest protection committees (VFPCs).

Existence of Traditional Crop/Livestock Varieties

Various regions have a variety of different crops and livestocks traditionally maintained over the years. They are well adapted to the local conditions and bear some genetic peculiarities. GNBR does not have any, because the local people here are mostly hunter-gatherers. The ex-army settlers bring varieties similar to that of mainland. GMBR and SBR being marine-estuarine Biosphere Reserve, have some salt tolerant crop varieties especially rice. MBR and NOBR, being in N.E. Hills, have some varieties of crops and livestocks which have closer links with those in S.E. Asia. NDBR reports a lot many traditional varieties of different crops, as well as that of livestock like sheep, goats, cattle etc. The sheep/herds that are maintained by Bhutias have a variety of sheep. The local breed is preferred by them against the introduced Australian variety (by FD as a part of development program) because of the quality of wool that it yields, which is well-suited to local conditions, though it is rough in texture.

Use as an Open Laboratory

Incorporation of scientific insights is one of the prime objectives of Biosphere Reserves. Thus research is supposed to be one of the major activities in the biosphere reserve.

Indian Biosphere Reserves provide excellent sites for research in various aspects of biological diversity, India being one of the 12 megadiversity countries. The Biosphere Reserves occupy a variety of biogeographic provinces covering a large spectrum of diversity. Unfortunately, because of meagre research facilities available, not much research is carried out. The research committees and the institutions identified to carry out research in each Biosphere Reserve are not very active, with the exception of Indian Institute of Science in NBR. They never took interest in the program right from the beginning.

Other interested organizations, both governmental and non-governmental are trying to work in some Biosphere Reserves. The major problem faced by them is that of the 'permit to work' or carry out research in Biosphere Reserve area. This is quite peculiar, because the government does not take any initiative in research programs and it does not want others to do so either.

In GNBR, the problem of obtaining permit/tribal pass for the genuine researchers is very serious. They have to face non co-operation of the local government officers to the extremes, that too because of some internal quarrels between the two government departments.

Inspite of this, some research organizations like MSSRF, SACON, Delhi University are carrying out excellent research in the Biosphere Reserve facing all the difficulties of logistics etc.

GMBR has a research station in Krusadai island, mainly involved in the research on how to increase fish catch, collection, identification of fishes.

MBR, though an excellent site for research, being on the transjunction of 3 different biomes, is a very politically unstable area. One has to face insurgency problems created because of the demand of Bodo tribes to have an autonomous state.

NDBR is also a good research site, where Wildlife Institute of India, GBPIHED alongwith many other NGOs are carrying out a good research work, also on socio-economic issues.

NBR is doing the best in terms of research, because of the initiative of IISc especially CES. They have a well-equipped research station in Masinagudi. The research on vegetation, wild mammals, other taxa is being carried out.

The FD responsible for NOBR proposes to carry out the research therein, but because of the remoteness this Biosphere Reserve is not opted for by many researchers.

SBR is a good site to carry out research on man-wildlife conflict, especially man-eating tigers. Much of the research in SBR is on socio-economic aspects.

Centralized Data Bank on Biosphere Reserves

In case of Indian Biosphere Reserves no attempt seem to have been done to create a centralized data bank on all existing Biosphere Reserve. Still the individual Biosphere Reserve has much of its data kept together with the research organisation working in the particular Biosphere Reserve e.g. most of the data about NBR is with Indian Institute of Science, CES, WII have data on Nandadevi Biosphere Reserve and so on. All these individually form tremendous databases. But what is necessary is the integrated databases of all Biosphere Reserve and the development of management systems to handle these huge data.

Improvement in Living Conditions

One of the major objectives of the Biosphere Reserve is Local Development. The living conditions of the local population are to be improved in terms of Health, Education, Housing, Services, Production, Marketing. In all the Biosphere Reserves this seems to be the most neglected objective from the viewpoint of managers. The same old idea of hands-off conservation is seen being applied everywhere possibly because of poor understanding of the concept of Biosphere Reserve. Moreover, sometimes, in the name of development, certain amenities are unthoughtfully bombarded on local people, which they do not require. That too is for political interests to create a vote bank for the next elections.

In GNBR, Shompens the aborigine's who are forest dwellers were provided with ration, tobacco, cloth etc for an year and discontinued. They got addicted to tobacco, because they were not used to rice and dhal, they had upset stomachs and the clothes, they were made to wear them on the body but not taught to wash them, causing skin diseases. Thus, it aggregated the problem instead of the development objectives. A 'Shompen complex' with school, dispensary, ration store, community hall was constructed, without thinking of the original culture of the people. How can they swallow such a big change in lifestyle at a time? It would rather turn out to be a shock causing negative impacts.

In GMBR instead of providing these facilities and improving the living conditions of the people, the local communities were completely excluded from the islands and declared as core zone. The local people need to be made partners in the conservation efforts. Putting them away may not be the real solution. Ideally, the fisherfolk should be given some employment in lean periods, so that they will stay away from exploitational activities and contribute to constructive conservation efforts.

In MBR, Bodos have been living historically and they are naturally dependent on the forests and grasslands swamps for their subsistence needs. Because of the influx of the larger economic forces, they were deprived of collection of MFP from the forest. Moreover, the basic amenities like primary health centers, schools, proper roads and drinking water facilities were not provided to the marginalised people living on the fringe of the forest.

In NDBR, lot of funds seem to be poured in for the betterment of a pilgrim centre very close to the Biosphere Reserve. On the other hand in villages some 25 km away, no basic amenities are made properly available. In NBR and NOBR no attempts are reported from governments side to improve the living conditions.

In SBR, though not the government, some NGOs are actively working to improve the living conditions of local people.

Decrease in Local Livelihood Activities

This is in fact seen everywhere because of policing attitude of the Biosphere Reserve managers. Local people are deprived from carrying out their subsistence level activities like: Fishing in GMBR, SBR; collection of MFP in MBR, SBR; grazing livestock in NDBR and cutting fuelwood in NBR, SBR.

No attempts were made to provide them some alternative source of employment, either. Apparently, the local people are almost excluded from consideration by the managers of Biosphere Reserves.

Inclusion/Consideration of Biosphere Reserve Objectives at Higher and Lower Levels

Biosphere Reserve program has a certain objectives of its own discussed and decided upon by the International MAB program. Once this program is agreed to be implemented in India, the attempts should be made to satisfy these objectives. The ways would certainly be different, but the goals the same.

Unfortunately, no Biosphere Reserve in India was recognized internationally and the program remained in form of a national network.

The main problem in its implementation is the 'lack of awareness' about the concept, itself. That is the reason, why the management plans at state and national level are not made compatible with the objectives and management plan of Biosphere Reserves. Similarly, the objectives of Biosphere Reserves are not seen incorporated into lower level management/planning e.g. district councils, taluks, panchayats included in Biosphere Reserve area. There is a wide divergence between management plan and the plans at higher and lower level.

Traditional use of Natural Resources

The local people have been inhabiting the areas of Biosphere Reserves historically, except for SBR, where they were settled as landless labourers. People have been using local natural resources traditionally at sustainable levels, also being aware of the conservation of them alongwith.

The use has been mostly for own purposes. Sometimes it was also for sale in form of exchange/factor system to get the basic requirements fulfilled.

The problems arose, when larger economics started penetrating in the system and commercial use of resource started replacing the traditional ways of resource use.

External Pressures on Natural Resources

External pressures, especially because of larger economic forces is a major issue that creates challenges in the management of Indian Biosphere Reserves. It is the most well-represented and intense problem amongst all others and tricky to handle. Every Indian Biosphere Reserve is facing this problem in one way or the other.

Great Nicobar island, being the southernmost landmass of Indian territory is strategically very important. As well as, it is very close to the international oceanic trade route. A proposal for a 'free port' on this island was put forth by other countries and large shipping companies. Fortunately, the proposal was not sanctioned, but still, they keep demanding about transshipment port/refueling station etc developed on the lines of Singapore. The free port could have caused major environmental problems.

(1) Severe destruction of the coastal habitat, which is home for various endemic and endangered species like megapode, robber crab, giant leatherback turtle - breeding ground.
(2) It would have caused pollution of coastal habitats, because of oil spills, dumping of solid waste etc.
(3) Another major hazard to the coast would have been severe exploitation of sand for construction purposes which is also a problem faced by GNBR coasts today, leading to coastal erosion.

In GNBR, Nicobarese, the coast dwelling people have close trade links with outsiders viz. Thai's. Thais are instrumental in trading various biological products, illegally e.g. crocodile skin, read corals, sea cucumbers, edible swiftlet nests etc. which have very high demand in countries like China, Japan and also Western Countries who take fancy for these products.

GNBR

The major threat to this Biosphere Reserve is the extraction and mining of corals by cement industries which carry away the loads of corals from islands without notice of the Forest Department. Constrastingly the local fishermen are fined for so called trespassing in the core zone of the Biosphere Reserve. Fishing is a major livelihood activity of the people here, which is done in locally made boats. Sometimes the outsiders from India as well as SriLankans come in mechanized trawlers which are faster and can exploit more. This hampers the fish catch of the local people. The exploitation of sacred chunk, which has high demand from West Bengal, because it is used for worship and making bangles. There are numerous pearl beds and the activity of pearl fishing continues, because it has high market demand. White and black sea cucumbers are also exploited severely by outsiders because they are eaten as a delicacy in South east Asian countries. Similarly lot of exploitation of 'seafood' like crabs, lobsters takes place to supply to countries like Japan, USA.

Coastal industries pose a major threat of pollution and environmental degradation. Some islanders eat dugong - sea cow, if accidentally caught in their nets.

These activities by outsiders need to be regulated and stopped whenever required. Still, the possible alternative ways of employment, and income generation for the local communities should be given top priority.

MBR

In this Biosphere Reserve rural - urban conflicts are pronounced. A government sponsored seed farm is located in the core zone of Biosphere Reserve. The farm is engaged in developing and marketing seeds of high yielding varieties of crops and vegetables to the urban centers of Assam like Guwahati, Barpeta town and others in Brahmaputra valley. The farm employs urban people and caters to urban demands, without involving local population. This infuriates the Bodos and other people living on fringes, because their land has been invaded by this urban oriented seed farm. The seeds of problems like insurgency are sown here in such apparently small problems. In contrast the local people are deprived of basic amenities like PHC, schools, roads, drinking water etc.

Tea estates is another larger economy that influences the local people negatively and also creates conflicts with the wildlife. Earlier the refugees from Bangladesh and Nepal were settled in the Bodoland. Later the native Assamese were also settled by government. This made Bodo tribals to form militant groups and demanding evacuation of 'foreigners' from their land.

The poachers and timber smugglers took advantage of the insurgency problems and wildlife poaching and smuggling to outside countries started. Rhinos, tigers, other small cats were hunted, timber-cutting and export continued. The measures should be taken to correct injustice done to Bodos to solve the present problems.

NDBR

The area of NDBR has major pilgrim centers and the economy is much affected by the outsiders. The pilgrim centers also become tourist spots and the luxuries that they want at any costs create tremendous pressure on the local natural resources e.g. requirement of fuelwood, electricity in large amounts, other urban commodities and so on. This conflicts with the conservation efforts.

Trekkers have been visiting Himalayas since long. The trekking routes are in the core areas of Biosphere Reserve. Littering done by the trekkers caused solid waste generation leading to environmental hazards. However trekking was a source of income generation for local people. Since it was banned it hampered local economy. Something like eco-trekking could have been a solution.

In the areas, where NDBR management has a little control poaching of musk deer continues especially in Pithoragad region of NDBR. 'Musk' is smuggled to Nepal and further exported. Some river valley projects e.g. Rishiganaga which are meant to generate electricity (to satisfy the requirements of pilgrim centers) may affect the natural landscape in negative way. FD. proposes to form co-operatives to export the wool produced locally to Ludhiana on one hand (may be because of external pressures) and on the other, it bans grazing. How should Bhotias tackle this problem? Where should they feed their sheep? Such problems make the management tricky.

NBR

The major problems in Nilgiris because of outside economic forces are:

(1) Poaching of Elephants: Elephants are illegally poached for their tusks, which fetch a high market price. Peculiarly, on the other hand, because of increase in population of elephants and subsequent crop raiding by them makes some researchers to suggest culling of the elephants. A midway needs to be found out.
(2) Sandalwood smuggling: Sandalwood the schedule I species according to the Wildlife Act is smuggled because it fetches money.
(3) Kabini Major Irrigation Project has aggravated conflict between the protection of Biosphere Reserve and people.
(4) Illegal encroachments by outsiders.

NOBR

In Meghalaya, the district councils are very powerful as compared to other states. The land belongs to them, the chief being Nokma, Garos are very traditional society and follow shifting cultivation on their land as sustainable activity.

Bangladesh refugees keep frequenting the area being the border district. This brought about illegal border trade. Tanning and dyeing industries led to massive extraction of '*Oyoxylon indicum*' bark making them almost extinct.

Because of outside influence, the young Garo's prefer white collared jobs leaving traditional activities Garo girls started marrying outsiders, which affected traditional matrilineal system. These 'foreign' son in laws created a conflicting situation.

SBR

To start with the outsiders influence, initially landless people from Midnapur district of West Bengal and the border districts of Orissa were brought to Sunderbans. This was the first attack on the tigers habitat. These people were brought here by the Britishers as a means of revenue generation.

Tiger prawn-fishing has become a major activity in Sunderbans and has influenced the local economy greatly. Prawn has a high market demand and people go in for that for easy money. Unfortunately the thin mesh nets used for commercial prawn fishing also catch the other fish which is a 'waste'. Brackish water aquaculture is also an important activity recently. Because of large scale brackish water aquaculture agriculture is becoming increasingly unsustainable with the saline soils and yields are getting lower every year. Multinational also have discovered that the estuarine habitat of the Hoogley-Matla river delta is extremely rich in prawns and brackish water aquaculture has started on a massive scale, especially on Western and North-eastern areas where large landholding farmers have collaborated with them. They break embankments to let large amount of water come in, which affects landholdings of small farmers.

Tremendous exploitation of silt and mangroves as firewood continues for brick kilns owned by outsiders.

It is essential that larger economic forces acting in the Biosphere Reserve should be regulated such that the subsistence needs of the people are met with in a constructive manner.

Role of NGOs

NGOs have an important role to play in the Biosphere Reserves especially with respect to socio-economic research and activism. Most of the NGOs have a good rapport with the local people and can understand the problems faced by them, reaching to the grassroots. They also keep a check on the functioning of the government departments and if required pressurize them in case of misfunctioning e.g. in GNBR, 'Parivakshak' is an organisation which has taken up 'coastal sand exploitation' as an issue and trying to prevent it. In GMBR, there is an ample scope for involving NGOs to explore ways of finding suitable employment for the fisherfolk during the lean period of fishing.

In MBR, some nature enthusiastic and activists organisation like Natures Beckon are influential, because of good rapport with the local Bodo tribals, inspite of the insurgency problems. In NDBR many grassroot organizations are active and involved in motivating the local people to plant and preserve their own community forests. In NDBR, though not organizations, some groups of college going students have a good rapport with the local Garo tribes. In NBR, as well some NGOs are quite active in village ecodevelopment work. In SBR, many NGOs like Ramkrishna mission (sustainable agriculture), ecodevelopment, Tiger Society for Rural Development (provide alternative means of livelihood to local people) put forth a good example of voluntary sector's role within the Biosphere Reserve.

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Sacred Elements of Nature in India

Madhav Gadgil and Yogesh Gokhale

Introduction

Humans are by far the most dominant species of living organisms on the earth today. As a result people have dramatically affected, and often times greatly depleted the abundance and diversity of other organisms. But humans are also the only species endowed with foresight, with an ability to appreciate their impact on the environment, and a potential to take deliberate measures to bring under check what may be perceived as negative developments. When so motivated, people formulate rules of behaviour and organize social institutions to further their implementation. Our particular focus in this paper is on rules and institutions that promote long term persistence of communities or individual populations of living organisms, through imposition of restraints on human activities, such as harvesting. We may visualize in these context two broad objectives, namely conservation and sustainable use. These, of course, grade into each other, but conservation primarily emphasizes persistence for its own sake, while sustainable use pertains to maintaining long term harvests.

Rules and institutions focusing on conservation and sustainable use of living resources—as also non-living, renewable resources such as water—are known from societies at all stages of development. They change as societies have changed, primarily in response to technologies that have tremendously enhanced capabilities of production of food, harnessing of energy, material and informational resources, and of transforming and transporting them over the surface of the earth. Our focus in this paper is on systems of conservation of living resources, and how they have changed and continue to change in the context of these broader changes. These systems have passed through three major phases, namely (1) sacred sites, (2) hunting preserves and (3) wildlife sanctuaries and national parks. The sacred sites are characteristic of hunter-gatherer and horticultural, largely tribal societies; the hunting preserves are characteristic of agrarian states; and wildlife sanctuaries and national parks are characteristic of industrial nations. It is notable that the spatial scale of these conservation systems is correlated with the spatial scale of resource catchments - or area from over which are garnered the bulk of the material and energy resources employed by a society (Gadgil 1996)(Fig. 1).

The first category, that of sacred sites (groves, grasslands, pond, pools, stretches of streams and rivers, lagoons, coastal areas) is typical of small scale societies largely practicing subsistence economies (Johannes 1981; Ruddle and Johannes 1985; Gadgil and Berkes 1991). These may be characterized as self-organized conservation systems, as opposed to hunting preserves of the elite, or wildlife sanctuaries or national parks which are conservation systems organized by a state apparatus. Other self-organized systems of resource management include village woodlots, pastures and irrigation tanks (Ostrom 1990). The state societies, especially the modern industrial societies have tended to dismiss the self-organized resource management systems characteristic of small-scale, subsistence societies, as primitive, unscientific, and inefficient. A majority of such systems have indeed been swept aside, even deliberately destroyed by the growing centralized powers of agrarian and industrial state. However, times are changing and there is an increasing realization of the built-in advantages, especially of cost-effectiveness and adaptability to local conditions, of the self-organized systems (Singh 1994). This has prompted serious interest in the possibilities of persistence, revival or new emergence of such self-organized systems for managing irrigation water, woodlots and pastures. This has catalyzed a series of excellent studies, especially with reference to the irrigation systems, of the principles on which long-enduring self-organized systems of resource management have been designed, by different societies, in different parts of the world. These principles, best summarized by Ostrom (1990,1992) provide an excellent framework for viewing sacred sites as well.

Materials and Methods

We have been involved in a series of studies on sacred sites of the Indian subcontinent beginning in 1972 (Gadgil, Hemam and Reddy 1998; Berkes, Folke, Gadgil 1995; Chandran and Gadgil 1993; Gadgil 1985; Gadgil and Vartak 1981,1975,1976). These earlier studies, primarily

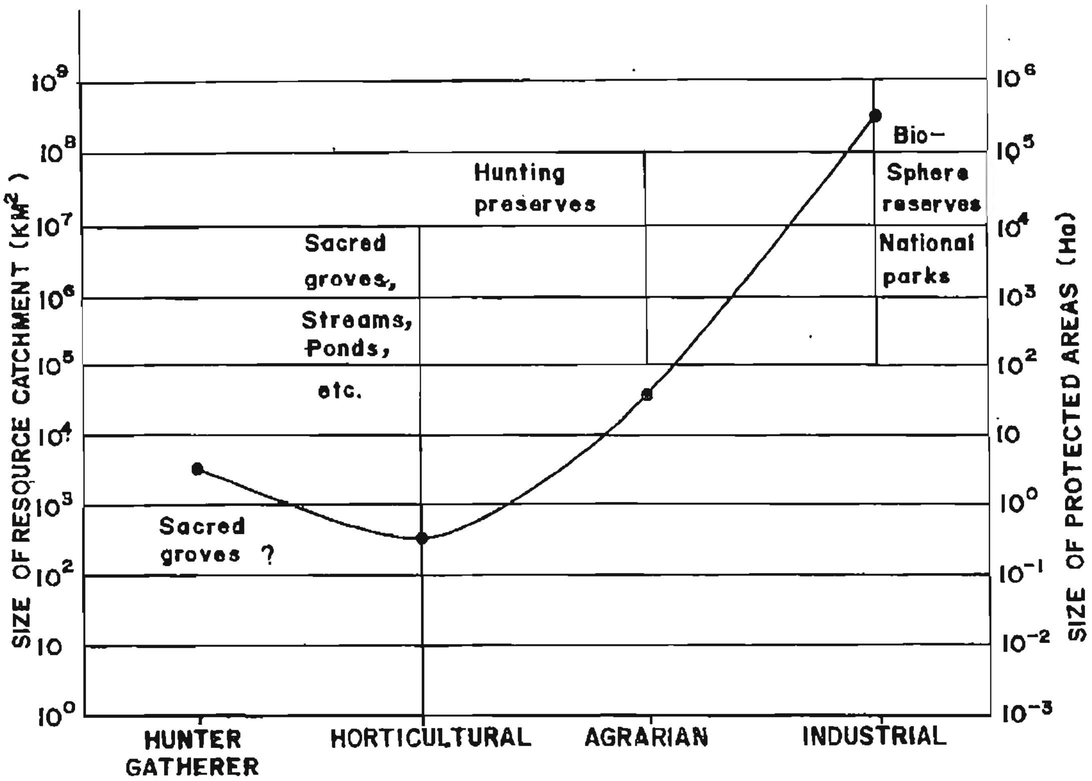

Fig. 1. Relation between sizes of resource catchments and sizes of protected areas. Pure hunter-gatherer societies have catchments of the order of 5000 km^2 It is not certain if they maintain any protected areas. Slash and burn and low input settled cultivators (i.e. Horticultural societies) have somewhat smaller resource catchments around 500 Km^2 and maintain protected areas ranging in size from around 0.01 to 100 ha. More advanced agrarian societies have larger resource catchments of the order of 50,000 km^2, and they maintain hunting preserves of the order of 100 to 100,000 ha in size. The modern industrial societies have resource catchments spanning the whole biosphere and concentrate on protected areas of a hundred to a million hectares.

focusing on the Western Ghats of Maharashtra and Karnataka and the Manipur hills, have recently been complemented by a project covering the states of Himachal Pradesh, Uttar Pradesh, Rajasthan, Bihar, Orissa, Assam, Meghalaya, Karnataka, Tamilnadu and Maharashtra. This study was initiated on basis of responses received to an invitation letter circulated to about 200 organizations and individuals to participate in a countrywide study of sacred groves. A total of 13 conservation oriented NGOs and NGIs finally collaborated in the study, locating a total of 150 sacred sites. They collected information relating to location, topography, vegetation, animal life, local human society, belief systems and practices pertaining to the sacred sites and the impact of outside economic, political and other factors on the pattern of these practices. This was supplemented by actual field visits to about 50 sites. This paper draws on the results of earlier published studies, as well as the current countrywide investigation (Fig.2).

Small Scale Societies

Till about 10,000 years ago humans everywhere were organized into small scale hunter gatherer societies with bands of 50-60 individuals making up endogamous tribal groups of 1000-5000 in numbers. This organization is largely preserved in horticultural societies, dependent primarily on low input, often shifting cultivation (or nomadic herding) coupled to extensive hunting and gathering (Lenski and Lenski 1978). Some hunter gatherer or horticultural societies continue to this day in India, as with Sentinelese islanders of Andamans. Most others have however been gradually brought under the influence of larger scale agrarian or industrial societies, beginning first with the Indus Valley civilization five thousand years ago, and at an increasing rate in recent decades (Gadgil and Guha 1992). The self-organized conservation systems of sacred sites originated amongst and have been characteristic of hunter-gatherer or horticultural societies largely insulated from the influence of larger scale agrarian or industrial societies.

Such societies tend to be largely self-sufficient in their requirements of biological resources, though some living resources such as honey, ivory or grain may be exported. Their own requirements of food, fodder, fuelwood, small timber, plant or animal based medicines are however almost wholly met from resources produced locally through low input cultivation or herding, or gathered from within a radius of a few, at most tens of kilometers. The catchments from over which these resources are obtained may often be under very firm control of local communities. In northeastern India, for instance, people may have had to risk their lives when venturing into territories of alien tribes in older times; and even today Jarwas of Andamans repel outsiders with bows and arrows. Elsewhere the traditional rights of local communities to prevent aliens from harvesting resources from certain well defined areas was widely recognized and respected, with other traditional rights assigned to groups like nomadic herders. With long standing familiarity with their immediate environments, such communities would have access to considerable information on how varied forms and levels of harvesting have influenced the local stocks of living resources. Such communities would have been entirely or largely self-governing with community level institutions permitting collective choice to prevail in a transparent fashion. Those violating community based norms of behaviour - including those pertaining to living resources - would be subject to sanctions, imposed flexibly, often in a graduated fashion.

Design Principles

Elinor Ostrom (1990, 1992) in an insightful analysis of self-organized systems of resource management suggests that many of these features of small-scale societies tend to favour long term persistence of such systems. These are captured in the seven principles of design of such systems suggested by her (Fig.3).

Design Principle One: The long-term benefits flowing from the restraints on resource use should be commensurate with the costs incurred by the community

The benefits could take many different forms: (a) Provision of ecosystem services such as watershed conservation. The villagers of Gani (Shrivardhan taluk, Raigad district, Maharashtra) wished to save their Kalakai sacred grove of 10 ha as forming the catchment of the only remaining perennial stream (Gadgil and Vartak 1975). Wingate (1888) noted that the Kans or sacred groves of district Uttara Kannada in Karnataka were of "great economic and climatic importance. They favour the existence of springs and perennial streams, and generally indicated the proximity of valuable spice gardens, which derive from them both shade and moisture." (b) Ecosystem services as firebreaks. These may be especially important in tracts otherwise under shifting cultivation where the slashed forest is burnt prior to cultivation. Indeed realization of benefits of sacred groves as firebreaks has led to the revival of protection to groves that had been destroyed in Churchandpur district of Manipur (Gadgil, Hemam and Reddy, 1998). (c) Other ecosystem services such as provision of shade. A sacred grove of goddess Shilai located amidst paddy fields at Supegaon (Tal Murud, Dist. Raigad, Maharashtra) is preserved for the shade it provides to people and cattle along with its religious importance. (d) As a refugium that helps reduce the chances of extermination

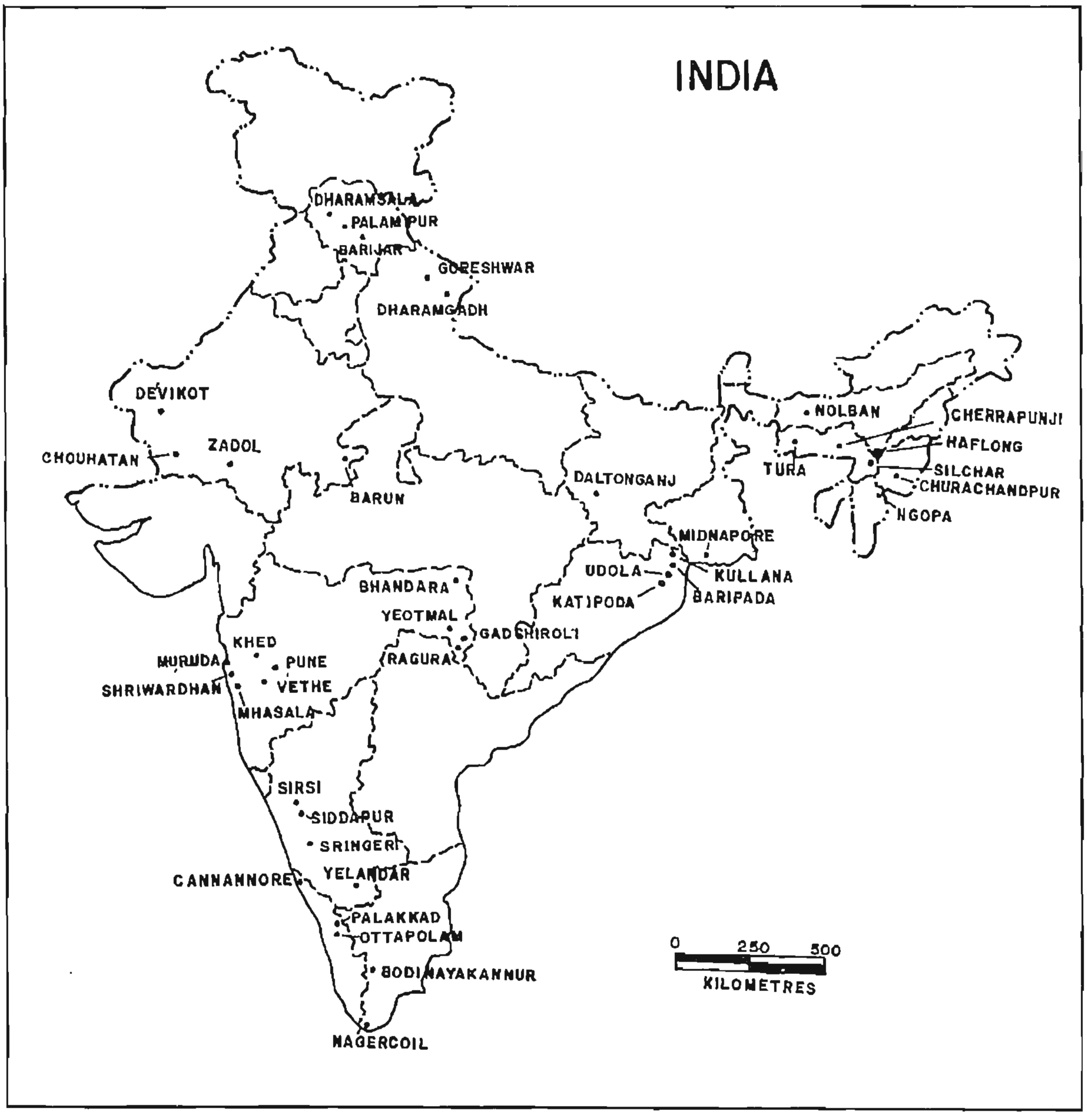

FIG. 2. Geographical locations of the full set of earlier and current study sites.

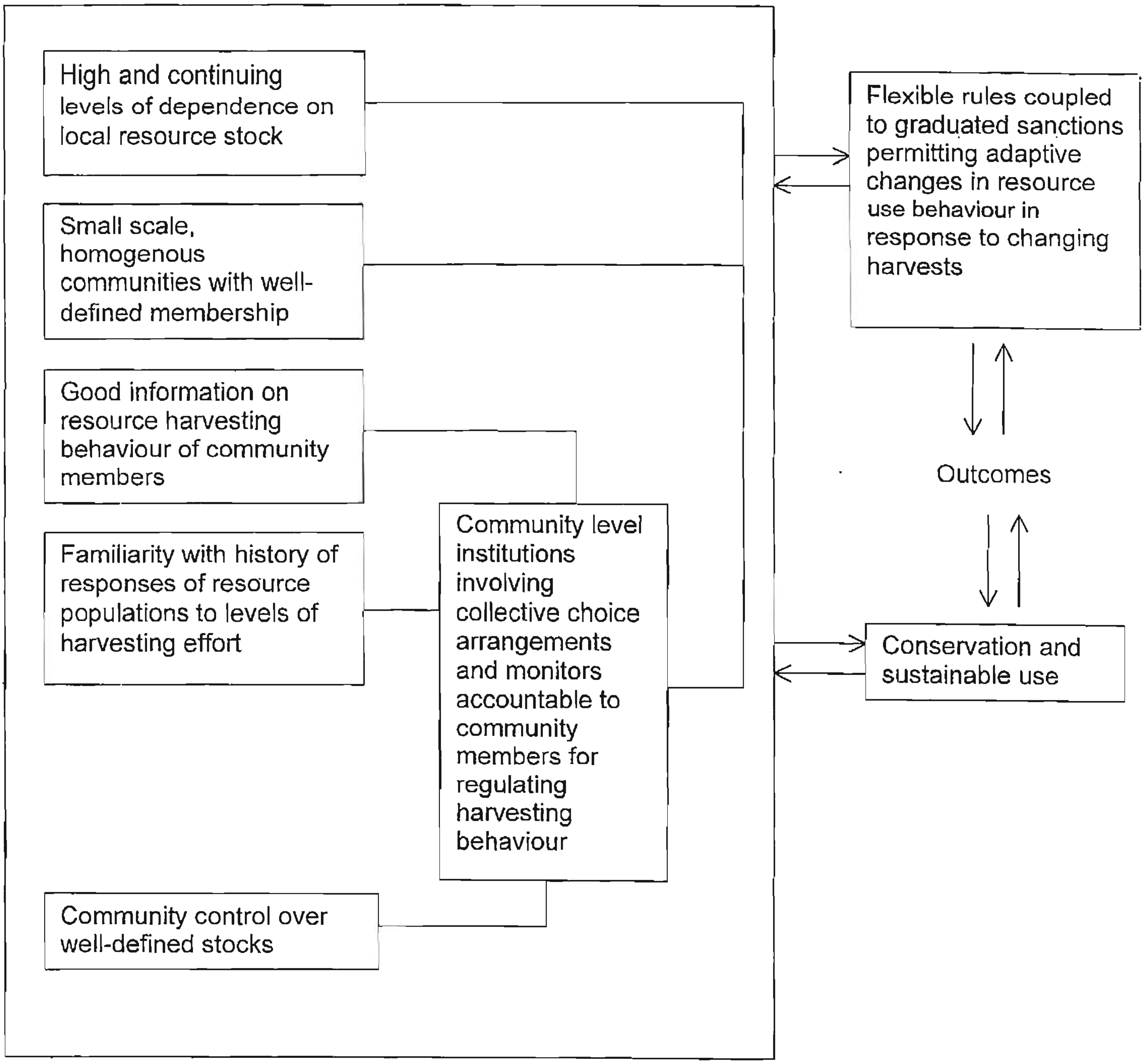

Fig. 3. The organization of resource management systems of small scale societies.

of resource populations. The chances of long term persistence of any exploited population are considerably enhanced by providing complete immunity to a part of such population in some protected habitats. Thus in the classic experiments of Gause (1939), on an experimental prey-predator system involving two species of protozoa, it was found that the predator population always overexploited the prey population leading to its extermination, followed by a crash in the predator population. This could however be averted by creating for the smaller sized prey species a habitat into which the larger predator could not enter. A certain level of prey population could then persist in this refugium. The predator had access to the prey population outside of this special habitat. Such a set up permitted long term coexistence of the prey-predator populations. Many sacred sites serve such a function. Thus in the Dharamshala district of Himachal Pradesh certain stretches of hill streams are fully protected against fishing, providing an excellent refugium for fish populations. These fish populations are then fished beyond a distance of 100 meters on either side of the sacred pool. Similarly in village Mangaon (Velhe taluk, Pune district, Maharashtra), barking deer are not hunted inside the Janni sacred grove of 10 ha; but hunted outside (Gadgil and Vartak 1975). The local villagers report that they have much better chances of hunting barking deer outside the sacred grove as compared to neighboring villages, which provided no such refugium. Apart from mobile animal populations, these refugia may also serve as seed sources that promote regeneration of plants outside the sacred sites. (e) As a biological community subject to much lower levels of exploitation than elsewhere and hence much more likely to continue to provide certain resources on a long-term basis. Sacred woods or grasslands need not be totally protected from all harvests. Thus in Aajivali (Taluk Mawal, Pune district, Maharashtra) villagers have revived protection to a sacred grove that harbours several *Caryota urens* palm trees that are tapped for toddy. A sacred grove near village Gani (Shrivardhan taluk, Dist Raigad, Maharashtra is valued as a source of *Entada pursaetha* used to treat cattle against snake bite. (f) As a resource that serves as an insurance to be exploited only in an emergency. Thus in Ghol, (Velhe taluk, Pune district, Maharashtra) the sacred grove is otherwise left undisturbed, but furnished timber for rebuilding after many huts were destroyed in fire (Gadgil and Vartak 1976).

Apart from these more tangible benefits, sacred sites may serve other aesthetic, cultural, religious functions. (g) A sacred grove of the B.R.T. hills (Yelandur Taluk, Mysore district, Karnataka) harbours a *Michelia champaka* tree of enormous proportions, famous over a large region, and once regularly worshipped by the Maharaja of Mysore as well. Humans may thus protect sacred sites that inspire awe and wonder. These mountain peaks such as Nanda Khat in Garhwal Himalayas. Several localities on way to this peak are treated as sacred sites with people maintaining strict norms such as on seasons during which certain flowers may be picked. (h) Other sacred sites may be set aside as a mark of respect for organisms disturbed by humans. Thus it was a tradition in Kerala to set aside a portion, sometimes reported as 1/7th of land being newly brought under cultivation and habitation as a sacred grove dedicated to snakes driven away from the remaining part of their habitat (Nayar 1987, Unnikrishnan 1995) (i) Humans may also protect sacred sites in the belief that this would please supernatural forces and attract bounties such as enhanced fertility of fields, or of humans themselves. This seems to be the benefit expected of sacred groves called saranas in many parts of Chhotanagpur plateau in states of Orissa, Bihar and Madhya Pradesh and the sacred grove called madaico by Dimasa tribe in northeast India (j) The Aasahpoorna Devi Ki Oran at Devikot, (Fatehgad Taluk, District Jaisalmer in Rajasthan) is believed to provide clues to the climate in the coming season through its condition at the time of the rituals. Local level management of crops and livestock was then regulated on the basis of these predictions.

The costs to be weighed against these benefits would be opportunity costs of diverting land or water to other uses, or of harvesting resources at greater rates. The balance would change depending on the values placed on different forms of benefits and costs, at the moment and in future. The balance would tend to tilt against conservation under a variety of conditions: (a) If resource scarcities mount, the opportunity costs of conservation would be considered to be higher. Thus as pressure on cultivated land has increased, sacred groves have been felled to make way for either cultivation, or habitation. (b) If values of resources being conserved go up, as with remoter areas being connected with roads, the opportunity costs of conservation would be perceived as having increased (c) If resources earlier valued are now obtained from elsewhere, or in other ways, as for instance, with use of medicinal herbs being abandoned in favour of allopathic drugs, or of leaf manure being given up in favour of chemical fertilizers the opportunity costs of conservation would be considered to have increased (d) Lastly, if future is discounted, with immediate interests being given more weight, the opportunity costs of conservation would be perceived to have gone up. In general, rapid technological progress has favoured such discounting of future value of resources, in the belief that technological solutions would always be available to deal with any resource scarcities.

Design principle two: The conservation system should deal with a well defined resource under reasonably secure control of a well defined social group

In India the tribal and the subsistence rural societies probably had considerable *de facto* control over a well-defined area near their settlements in pre British times, and therefore met this condition. To an extent such control continues to this day in parts of northeastern India such as in the state of Meghalaya. Thus the Siem of Sohra - the chief of Cherrapunji- has attempted to continue protection of the sacred grove by empowering the village darbar to do so. In the mainland India the recent extension of provisions of Panchayat Raj institutions to the Scheduled Areas is a move in the direction of re-establishment of secure control of local communities over local natural resources.

Design principle three: The group responsible for the conservation system should be effectively organized to administer the system

Traditionally tribal and caste groups had such social organization; there were also effective organizations at the multi-caste village community level in pre-British times. These community level organizations were largely dismantled during the British reign. They have further continued to disintegrate in the post independence time with further takeover of control over resources by the state apparatus. Thus, it is reported that during 1970 - 75 in Rajasthan, commercial extraction of gum of *Acacia senegelensis* and *Commifera wightii* was handed over to contractors. These contractors were allowed to exploit the Orans or sacred groves, now owned by the government as well. The contractors reportedly used some chemicals, which increased the productivity of the gum but often killed the trees. This practice badly affected both these species and the vegetation in Oran was substantially depleted. Since for many Orans, ownership of lands was with government, nobody could resist to stop this exploitation of resource. Similarly it is reported from remote villages around Haflong in Assam that the sacred groves, 'madaico' of Dimasa tribes were encroached by outsiders who did not have respect for the tradition. The local people were not organized to resist outsiders from encroaching on the sacred grove.

Design principle four: Existence of a monitoring machinery accountable to and respected by the actors

For the self organized conservation systems of sacred sites effective monitoring is done by the local deities, nature and ancestral spirits, as well as by the whole local community, especially the priests and leaders who take on the role of enforcing the will of the gods and the community. The earliest religious beliefs of humanity include belief in spirits specific to particular localities, the *sthaldevatas (sthala= locality, devata=deity)* concerned with the well being of nature and people in that locality. People tend to believe such deities to have the interests of the local environment at heart, as well as to be omniscient, so that no action, even intention can escape these monitors. These monitors are often believed to punish violators with a variety of undesirable consequences. But additionally, all members of local communities who tend to be intimately familiar with all local happenings also take on the function of monitoring. The priests and other local leaders are then expected to take appropriate action on behalf of the deities against any infringement of prescribed behaviour. The local community and leaders may also serve as monitors on their own, not necessarily on behalf of deities. Such monitoring tended to be quite efficacious in small-scale societies.

In case of Viratra Ki Aan or Oran at village Dhok (Chauhatan Taluk, District Barmer, Rajasthan) people and priests have themselves been monitoring the area. The Oran is spread on a huge area about 13 sq. km. People can graze their cattle and with prior permission are allowed to use deadwood. In 1971, the war refugees across the border from Pakistan came to settle in the village. They violated the traditional restriction of Oran against removal of wood, despite warnings from the local people.

After some years the refugee colony caught fire due to unknown reasons. People considered this as the wrath of goddess.

Design principle five: Collective choice agreements

The actors affecting the sacred sites would themselves be involved in relevant management decisions. This would be possible in relatively small-scale societies where the whole group would be directly or indirectly involved in the decisions.

Design principle six: Flexible rules relating to resource use patterns

Long term viability of conservation system is promoted by flexibility, accepting uses otherwise prohibited in emergencies; for instance extraction of timber for house construction in case of fire. In informal, community based systems of small scale societies such flexible arrangements are possible. In village Irani located very remote in Chamoli district of Garwhal Himalaya at about 2500 meters people have to face exacting climate. They have protected a small sacred grove, which can be useful to them for fodder to their cattle at the time of emergency in winter.

Hence, in cases of heavy snowfall in winter, they have access to fodder from a closer place.

Design principle seven: Graduated sanctions against violation of management rules

Community based management systems may incorporate flexible sanctions taking into account the overall record of the violator and circumstances of the violation, promoting long range endurance of such systems. In the northeastern state of Mizoram many villages still protect sacred groves even after Christianisation. These groves are now called as safety reserves and serve as fire breaks against burning operations related to shifting cultivation. To protect these safety reserves the local village councils in villages such as Hrianmum and Teikhang in Sialkal area of Aizwal district charge graded fines according to the nature of violation; thus, for big trees the fine is more, for climbers less.

Social Transformations

Fig. 3 attempts to depict the organization of resource management systems of small-scale societies. It is evident that the system conforms to the seven design principles discussed above, suggesting that the conservation systems such as sacred sites of these societies may have been both effective and long enduring. This is not to contend that there were no instances of extermination of living resources in such societies. Indeed there were many such accompanying the colonization of new territories such as Americas, Pacific islands and Madagascar (Diamond 1991). It appears however that as people settled down and acquired a deeper understanding of the living environment they developed much more effective conservation systems such as sacred sites (Gadgil and Berkes 1991; Gadgil, Berkes and Folke 1993; Gadgil 1995; Heywood 1995).

Such small-scale societies and their conservation systems have been radically altered by a whole series of technological developments that have absorbed them, first into agrarian states and subsequently into industrial nations. This emergence of larger scale societies is grounded in access to ever increasing levels of material, energy and informational resources. Thus productivity of agriculture is increased initially by input of animal energy through bullock and horse power and of water through irrigation systems, and later by input of fossil fuel energy for a whole range of agricultural operations and for pumping water, and by inputs of synthetic fertilizers and pesticides. This permits the production of increasingly greater levels of agricultural surplus by cultivators. Technological developments also facilitate transport of this surplus over long distances with the use of bullock power, wind power and then energy of fossil fuels. These possibilities of large surpluses of food being transported over substantial distances catalyse extensive division of labour and growth of towns and cities. The emerging occupational specializations include priesthood, bureaucracy, military, trade and artisanal activities. This new social organization creates larger scale social, economic, political units in the form of chiefdoms, kingdoms, nation states (Service 1975). These larger scale societies depend upon large outflows of natural resources from rural hinterlands; resources such as surplus grain, wild spices, timber, wood charcoal, bamboo, animal skins, ivory, coal and other minerals. These outflows are often against the interests of forest dwelling and rural populace, and require a loosening of the control of local communities over their territories. The centralized states therefore take measures to strengthen the authority of the state apparatus and their allied economic and political interests and weaken that of local communities.

The centralized machinery and its allies controlling the resources are not dependent on the resources of any particular locality. They always have other options if the natural resources of any particular locality are exhausted. Furthermore, the pace of technological developments also picks up, especially in the industrial societies; and new technologies open up the possibilities of substitution when a resource is exhausted. Thus, the West Coast Paper Mill at Dandeli (Haliyal Taluk, District Uttara Kannada, Karnataka) could successively bring in bamboo from further and further away, from Andhra Pradesh, Garhwal, Assam and Nagaland as these stocks are exhausted; as also switch to using *Eucalyptus* spp. as bamboo supplies dried up. These possibilities have promoted a pattern of sequential exploitation and exhaustion of resources, with commercial interests concentrating at any given time on the kinds of resources, and on the localities which yield maximal levels of profits; shifting to others as these are exhausted (Fig. 4).

Such exhaustive resource use does prompt corrective responses in large-scale societies, responses that are primarily guided by the recreational interests of the elite. In agrarian kingdoms they take the form of hunting preserves of aristocrats. The two thousand year old manual of statecraft, Kautilya's Arthashastra prescribes the maintenance of such preserves (Kangle 1969). The Mughal emperors also maintained huge areas as their hunting preserves. The British planters in Western Ghats set up similar game preserves. On independence, as populations of the larger wild animals and birds declined many of these hunting preserves have been converted into wild life sanctuaries and national parks. These tend to emphasize the preservation of flagship species like tigers, and concentrate on elimination of all demands of local tribals, herders and peasants through a guns and guards approach as their main concern.

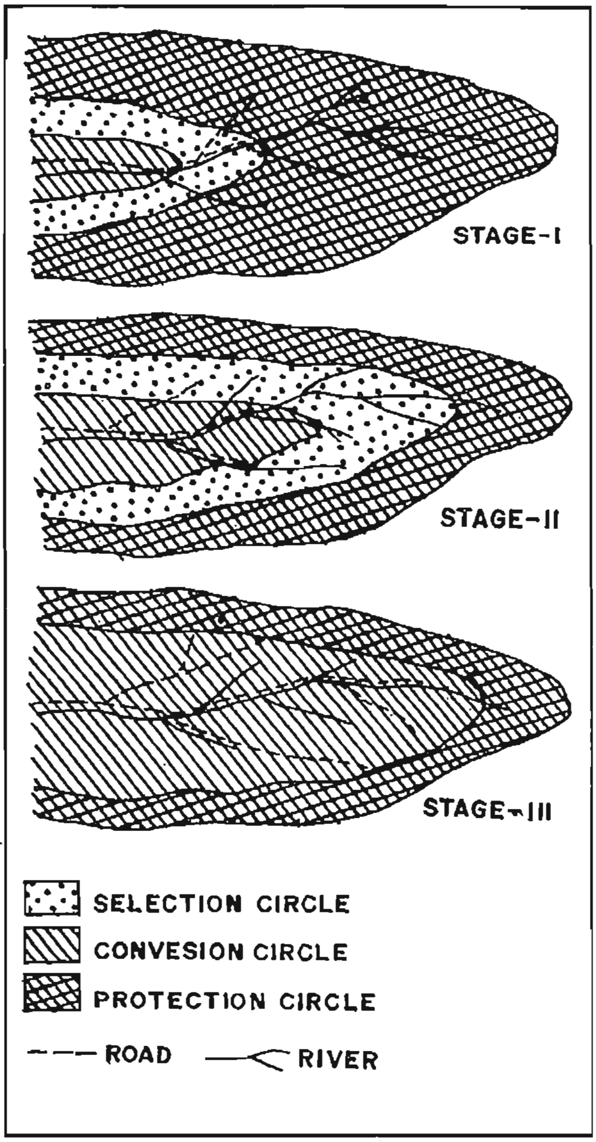

FIG. (4a)

a. Working plans of the Ranni forest division of Kerala, 1950-80. This Figure shows that the protection zone (set aside for watershed conservation), selection zone (earmarked for extraction of a limited number of trees on a sustainable basis) and conversion zone (devoted to clearcutting and raising of monoculture of commercial species) have kept on shifting in response to exhaustive resources use (after FAO, 1984).

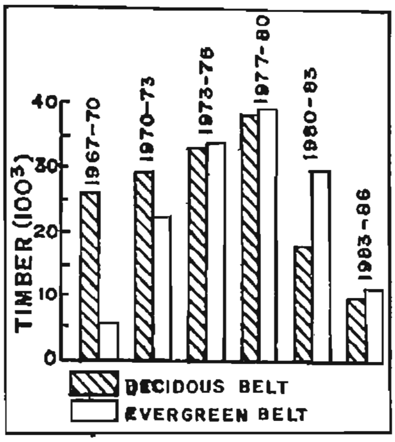

FIG. (4b)

b. Timber harvests by the plywood industry from the Uttara Kannada district of Karnataka State, 1967-85. It is evident that pressures of non-sustainable use have forced this industry to shift from more accessible deciduous forest tracts to less accessible evergreen forest tracts, and that timber supplies from both zones have falled off.

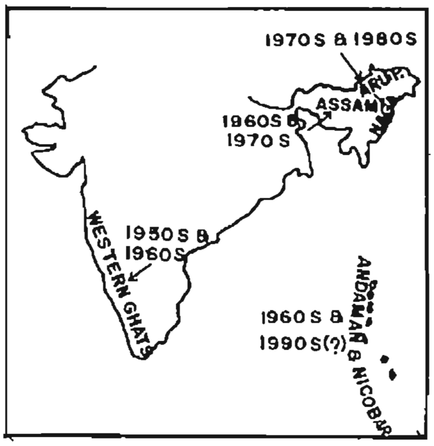

FIG. (4c)

c. Geographic shifts of the plywood industry in India. The non-sustainable resource use methods of this industry have kept it shifting over time to more and more remote areas of the country as resources from more accessible areas near exhaustion.

Fig. 4. Patterns of sequential exhaustion of resource use at different spatial scales.

Impact on Conservation Traditions

The process of absorption of small-scale societies into large-scale societies has progressed to different degrees in different parts of the world. It has gone farthest in countries of western Europe where industrialization was first set in motion over two centuries ago. It is just beginning to take off in countries like New Guinea. Within a country too the process may proceed at variable rates. Thus in India, it has gone relatively far in the industrial belt of Punjab and Haryana, the least in parts of northeast such as Arunachal Pradesh. India may indeed be remarkable in harbouring within a single nation state the greatest range of variation in terms of transition from small scale to large-scale societies. Thus, some 7% of the Indian population are classified as belonging to scheduled tribes. Hunting-gathering and shifting cultivation characteristic of horticultural societies still remain significant in the economy of these tribal populations. The tribal communities also retain many features of the social organization of small scale societies, including the role of community based decision making in prescribing norms of social behaviour in relation to the members of the community. However these tribal communities are no longer self sufficient, nor are they in full control of their own resource base, barring special exceptions such as Sentinelese islanders of Andamans. Almost everywhere they are now linked to the larger economy; the forest produce they gather (or fell with their axe) are largely for sale; they also buy many commodities from the market. They have variable, and rather uncertain, level of control over the living resources in their own localities. On the peninsula, this control has largely passed to the hands of state authorities; in the northeastern states it is still to fair extent vested with local communities, or individuals or tribal chiefs. Even here however there is a lack of clarity as to exactly who controls what resources, so that there is little of firm community control. The cultures, religions of these tribal communities have also changed substantially on contact with the large-scale society. These changes include conversion to Christianity or absorption into mainstream Hinduism. These tend to weaken the belief in '*sthala-devatas*', spirits, deities, rooted in particular localities. Other, non-tribal, rural communities have changed similarly, to a greater or lesser extent, beginning, in particular, with the British rule, and at an accelerating pace in recent years. These changes have by and large, tended to erode the self-organized systems of conservation, the systems of sacred sites, throughout the country. These processes of erosion may best be assessed in terms of their consequences for the seven principles of design considered above.

Design principle one: Balance of benefits and costs

The continuance of conservation systems would evidently be affected by the relative levels of benefits and costs perceived by local communities. The benefits may be tangible; as ecosystem services (e.g. watershed conservation, firebreaks) or as resources obtained occasionally or at low levels of harvest (e.g. grass rather than wood). They may also be intangible (e.g. respecting deities or gigantic trees). The value ascribed to such benefits would vary with how dependent the local communities, as well as others with access to the locality are on such resources.

For a variety of reasons values of these benefits have substantially depreciated in the perceptions of people with access to the sacred sites and their resources. Modern technological developments have prompted changes in resource use practices of local communities, as well as brought to them access to newer kinds of resources and reducing their dependence on local resources. Thus, Gangtes, a group of Kuki tribes of Manipur have traditionally depended on shifting cultivation. During the slash and burn operations involved fires may spread, and sacred groves surrounding the habitations have traditionally served the function of firebreaks. However, in villages close to towns, such as Koshbong (Dist Churchandpur, Manipur State), pineapple cultivation on terraced hillsides has replaced shifting cultivation. Sacred groves are therefore no longer of significance as firebreaks. In consequences the practice of protection to sacred groves has been discontinued, in part for this reason.

Yet another reason that has contributed to the disappearance of the sacred grove of Koshbong is that it would no longer serve the function of showing respect to the local deities. This is because the tribal animist beliefs are now replaced by acceptance of Christianity. Christianity prescribes faith in a supreme god who is everywhere. As a corollary the god does not reside in any particular locale, and cannot be associated with any particular patch of forest, or spring, or tree. In effect, religions like Christianity and Islam desacralize nature and eliminate the rationale for respecting a sacred site (White 1967).

Hinduism too does this, though to a lesser degree. It is a more eclectic faith based on absorbing the local deities of small-scale societies, as incarnations of deities of Hindu pantheon, particularly the god Shiva and the goddess Durga. Unlike Christianity, Hinduism can therefore accept the continuing veneration of sacred groves, or ponds, or of trees like peepal or animals like hanuman langur as a part of legitimate religious practice. However the more formal Hinduism, also tends to emphasize the worship of idols and temples over tree and forests. Hindu priests therefore often encourage the liquidation of a sacred forest to be replaced by a temple to the presiding deity. Indeed the priests may do so on behalf of timber contractors assuring the local people that they would perform appropriate rites to placate the deities of the sacred forests, who might otherwise be offended at the cutting down of the forest (Nayar 1987).

Escalation of perceived costs is, of course, the obverse of depreciation of perceived benefits. Contacts with large-scale societies in many ways contribute to such escalation of perceived opportunity costs of continued protection to sacred sites. These opportunity costs may involve foregoing uses of living resources, such as timber from sacred groves, or foregoing alternative uses of land or water, as for cultivation or aquaculture. Indeed the yields from arecanut orchards in Uttara Kannada depend on the availability of substantial amounts of leaf manure from forests. The clamour for leaf manure for arecanut gardens made the British allot sacred Kans as 'betta' or leaf manure forest, following forest settlement in Sirsi and Siddapur in early part of this century. Where individual bettas were not granted some of the kans were thrown open as commons for extraction of leaf manure and other biomass. In eastern Sirsi, according to Collins (1922) 769 ha of Kans were added to the minor forest. The demand for such manure has escalated with development of marketing facilities and higher prices for arecanuts. An arecanut orchard owner has therefore converted the sacred grove of Mensi (Taluk Siddapur, District Uttara Kannada, Karnataka) into a patch of forest dedicated to supply leaf manure for his orchard.

It is, of course, not just the opportunity cost of protecting the living resources for local communities that is of relevance. Often what is more relevant is the opportunity cost to the outsiders, including the government agencies and commercial interests. All over India state controlled forest resources have been made available to forest based industries such as plywood manufacture at highly subsidized prices. They have then been overexploited and sequentially exhausted. The plywood resources of Uttara Kannada district of Karnataka had been subject to such overuse and depletion following 1940's (Fig.4). With plywood resources of reserve forests largely depleted by early 1970's, some of the larger sacred groves of the district harboured the only surviving good stocks of well-grown trees suitable for plywood manufacture. Many of these sacred groves had been taken over as part of reserve forests in the forest settlements of late 19th century, but not subjected to extraction. In early 1970's the Karnataka Forest Department clearfelled several of the larger ones, such as a 21 ha sacred grove at Menisi in Sirsi taluk and planted them with Eucalyptus. The district Coorg of Karnataka also had several large sacred groves, commented upon as among the best he had seen by Dietrich Brandis, the first Inspector General of Forests of British India (Brandis 1897). Many of these were also felled by the forest department in early 1970's; as well as encroached upon for coffee plantation and habitation (Kalam 1996).

Sacred ponds, often attached to temples met the same fate when the technology of freshwater fish culture became available. The Government Fishery Departments then took over many of the larger sacred ponds, poisoned and removed the diverse aquatic communities that they supported and converted them to fish culture. The fish so cultured were auctioned to traders with revenue accruing to the Government. This for example was the way Devikere, a large sacred tank of the town of Sirsi (Sirsi taluk, Uttara Kannada district, Karnataka) was treated in 1970's.

Sacred sites may also be affected when the land or water bodies concerned have alternative uses that become more attractive with time. Population growth and commercialisation of agriculture have greatly increased the demand for land for cultivation. This has often led to encroachment on sacred groves, as for example, at Golgodu (Taluk Siddapur, Dist Uttara Kannada, Karnataka). In fact a farmer of Golgodu who has thus encroached on the sacred grove has done so against the wishes of many other members of the community. However the community is no longer in a position to enforce its will on the encroacher. Such pressures have also affected devara-kadus of Coorg.

Design principle two: Well defined resource boundaries and social boundaries

The development of larger scale agrarian or industrial societies demands dissolution of resource boundaries on smaller community controlled scale to facilitate extensive resource transfer. Along with the resource fluxes come migrations of people blurring boundaries between communities. Both these open up sacred sites to influences from outside and lead to their erosion. Thus fishing in the more hilly areas was earlier a monopoly of members of local community, especially those belonging to fishing castes. This is no longer so with the opening up of transport routes, so that fishermen from outside, and others such as army people may come and fish in streams everywhere. They may also employ highly destructive methods such as dynamiting.

The outsiders do not respect practices such as sacred sites either. Thus in village Machiyal (District Dharamshala, Himachal Pradesh) members the army reportedly have fished in the sacred pond. In another incidence, on 26 May 1996, tragedy struck the congregation of mahseer fishes (*Tor musullah*) at Shishila near Sulya, a small village in Dakshina Kannada District, Karnataka. The entire lot of fish, all mahseers, zealously guarded and protected by the local villagers in the river Kapila flowing by the side of Sheshileshwara temple was poisoned by fishermen with severe toxic compounds. The reason was that being a protected place, a temple sanctuary, where fishing has been strictly prohibited since 1938, the villagers reprimanded four outside fishermen for fishing illegally in the night. The fishermen in turn, wrought destruction on the fishes (Jayaram 1997). A similar incident also took place in Sringeri taluk of Chikamagalur district of Karnataka.

We have already mentioned above several instances of Government machinery intervening to take over sacred groves or sacred ponds, as local communities have lost their control.

Design principle three: Social organization competent to manage sacred sites

Through much of India local community based social organizations competent to manage sacred sites have given way to new social organizations subservient to larger polity unable to do so. On the mainland this process has gone on for well over a century; but in some of the more remote areas such as in Manipur it is more recent. Thus amongst the Kuki tribe called Gangtes in Churchandpur district of Manipur the traditional social organization persisted till 1950's. Over the last 40 years it has gradually given way especially in localities close to the market town of Churchandpur. Thus traditionally the Chief of any village was nominally the owner of all land and property, and was given a certain portion, about 5% of the agricultural produce by all members as the rent. The Chief however was expected to provide hospitality to all visitors and discharge other social responsibilities with the help of the supplies so received. The council of elders and others made all community wide decisions, including sanctions against members violating rules governing the management of sacred sites. This social organization has totally broken down close the market town, with the Chief asserting his ownership rights over all land and demanding that others buy it from him for cultivation and pay him royalty for cutting wood from forested patches. At the same time, protection to sacred sites has also fully eroded from these localities (Hemam 1997).

Design principle four: Monitors accountable to and respected by the user group

Traditionally the protection to sacred sites was maintained by belief in omniscience and powers of local deities complemented by enforcement of the deity's will by priests and leaders of local community. Just as the social organization has broken down, so has the faith in omniscience and power of the deities. This is particularly evident in the Christianised tribal communities of northeastern India, where protection to old sacred sites has been largely abandoned along with the belief in local nature spirits. But elsewhere in India too the belief in these supernatural monitors, the local deities is weakening, to be replaced by deities of Hindu pantheon, who may be worshipped in man-made temples without any association with sacred trees, or groves. This weakening of protection through loss in faith in local deities is greater, greater the proximity to market towns in predominantly Hindu state of Karnataka as well. Thus a comparison of an area close to the market town of Kumta and much further away in the district of Uttara Kannada in Karnataka shows a significantly lower level of association of deities with sacred trees and sacred groves in the area more exposed to market influences.

Design principle five: Collective choice arrangements

With the dissolution of local community control over resources, and local social organization decisions on resource use, including protection to sacred sites pass into the hands of more centralized state machinery with little or no scope for arrangements reflecting collective choice of local communities. On takeover with the Forest Settlement beginning 1880's, the British policy towards the Kans of Uttara Kannada was one of stringent protection. Yet there were many lapses. In Uttara Kannada sacred kan demarcation during the period of early forest settlement (1880 - 1920) was imperfectly done. Also some were converted into 'betta' (leaf manure forests) and some others into 'minor forests' open to all for exploitation which in practice was carried out in unregulated fashion during the British period itself (Collins 1922). Kans were, during post independent period included in forest working plans for selective felling of industrial timber and even fuelwood (Shanmukhappa, 1966, Thippeswami, 1963). All this has contributed to erosion of protection to sacred sites. In case of Oran in Devikot village in Jaisalmer district of Rajasthan, the Muslim community does not believe in the restrictions on cutting trees from Oran. They also graze their cattle in the Oran. But the villagers cannot take any collective action against the violators as the Oran land is under control of the government.

Design principle six and seven: Flexible rules and graduated sanctions

The centralized bureaucratic procedures pertaining to the management of natural resources are rigid and insensitive to particular local context. They are also unsympathetic to local traditions including those of sacred sites. This is evident in several examples of the state interventions leading to liquidation of sacred sites narrated above. Pressures for alternative uses from outside the local community may also affect sacred sites due to government intervention. These include construction of reservoirs for hydroelectric or irrigation projects, leading to submergence of lands, including sacred groves. A large number of sacred groves have thus submerged under the Panshet dam west of Pune city (Velhe taluk, Pune district, Maharashtra). Many other sacred groves that remained above the submersion zone were cut down by farmers whose cultivated lands were submerged and who expected to be settled in alternative sites several kilometers away (Gadgil and Vartak 1976). Similarly in Mayurbhanj district of Orissa, Subarnarekha Irrigation project has destroyed about 62 'Jahiras' -sacred groves recently. The main canal of the project is also going to threaten many more Jahiras.

Scale of Erosion

All the trends in recent past thus seem to militate against the seven principles for successful functioning of self-organized conservation systems such as sacred sites. There is indeed abundant evidence of the consequent erosion of such systems. Such erosion took place much earlier in Europe as Christianity spread buttressing states with concentration of power in the hands of the aristocracy and the church Hughes (1994) summarises much of the pertinent evidence. In India such erosion gathered pace as the consolidation of British rule after 1857 was followed by land settlements and forest reservations that denied the legitimacy of community control over land and water resources. Dietrich Brandis the first Inspector General of Forests (1864 - 1882) was a witness to this early phase of destruction of India's sacred groves (Brandis 1897). He records: "Very little has been published regarding sacred groves in India, but they are, or rather were very numerous. I have found them in nearly all provinces. As instances I may mention the Garo and Khasia hills.. the Devara kadus or sacred groves of Coorg ... and the hill ranges of the Salem district in the Madras Presidency .... Well known are the Swami shola on the Yelagiris, the sacred forests on the Shevaroys. These are situated in the moister parts of the country. In the dry region sacred groves are particularly numerous in Rajaputana..... In the southernmost states of Rajaputana, in Partabgarh and Banswara, in a somewhat moister climate, the sacred groves consist of a variety of trees, teak among the number. These sacred forests, as a rule, are never touched by the axe except when wood is wanted for the repair of religious buildings, or in special cases for other purposes".

This attrition continued through the British regime. Its pace picked up again after independence as rapid development of transport and communication networks and of forest based industries led to another spurt of deforestation in areas that were earlier much more difficult to access such as northeast India. In these areas the destruction of sacred groves took place primarily in 1950's and 1960's (Gadgil, Hemam and Reddy 1998).

Can we then estimate the extent of such erosion that has occurred ? Chandran and Gadgil (1993) attempted to do so for a limited area of 25 km² in Siddapur taluk (Uttara Kannada district, Karnataka). They constructed a landscape map labelled with local names of the landscape elements. These names provide clues to the historical pattern of land cover and land use. On this basis they surmise that 5.85% of the land was earlier under a system of sacred groves; this had come down to 0.3 % at the time of their field study in 1991. Gadgil, Hemam and Reddy (1998) conducted extensive interviews with Gangtes, a group of shifting cultivators of Churchandpur district of Manipur in 1997. Many of those interviewed were personally familiar with the system of sacred sites that prevailed prior to their destruction beginning in 1950's. Their accounts suggest that somewhere between 10% to 30% of land and waters were earlier treated as sacred sites. In Kerala there is a tradition that 1/7 of the land must be set aside as a sacred grove dedicated to snakes when bringing new forest land under cultivation. These findings suggest that it is possible that 10% or more of land and waters may have been covered under sacred sites in pre-British times. What may the total area of sacred groves be in present day India? The level of 1/3% noted above for Siddapur is an unusually highly level today. Such a level may hold for only a small proportion of the better forested tracts of India which cover parts of Western Ghats, Chhota Nagpur plateau and Northeastern India. These amount to less than 10% of the total country. In rest of the country the levels must be far lower. An estimate of the latter may be obtained from an admittedly incomplete inventory of sacred groves of Maharashtra prepared in 1973 - 74 Gadgil and Vartak (1981). The total area of sacred groves in this inventory amounts to 3570 ha, which is a mere (1.16 /100)% of the state of Maharashtra. The total area of the sacred groves of India as a whole is however more likely to correspond to this level; it would then come to 33000 ha. Malhotra (1998) reports about 39000 ha area based on the published work on about 4125 sacred elements in 9 states in India. If the original area of sacred sites amounted to 10% of the land and waters, then this amounts to a decline by a factor of 1000.

Persistence

Nevertheless sacred sites continue to be protected, albeit to a much lower degree in present day India. This may be because of (a) persistence i.e. continuation of traditional protection, (b) revival, i.e. resumption of earlier practices of protection that had lapsed, or (c) emergence, i.e. institution of protection on a site without an earlier tradition.

The seven design principles remain relevant in these cases of persistence, revival as well as emergence. An appropriate balance of benefits and costs is particularly relevant in cases of revival and emergence; persistence may be found in certain conditions, even in face of an adverse benefit-cost balance. Such, for instance, is the case with village Mathigar (taluk Siddapur, district Uttara Kannada, Karnataka). This village harbours a patch of pristine evergreen forest of 1 ha in size, rich in species like *Vateria indica* right next to paddy fields on level ground. There are fairly extensive stretches of *Acacia auriculiformis* and *Casuarina equisetifolia* plantations as well as degraded evergreen and moist deciduous forests and tree savannas in the neighbourhood, so that the sacred grove is by no means the only source of woody vegetation of the locality. In fact there is a taboo on the removal of any woody matter, including dead and fallen wood from the sacred grove. Neither is the grove important in providing any ecosystem services such as watershed conservation. There are thus no tangible benefits of the grove; retaining it does incur to the community substantial opportunity costs. These opportunity costs are in terms of income which may be accrued by felling the wood, income which is very large relative to their earnings from small-scale agriculture. The opportunity costs are also substantial in terms of the level land on which the grove stands and which may be converted to paddy cultivation.

The villagers of Mathigar are then maintaining protection to their sacred grove despite adverse balance of tangible benefits and costs. It is notable that this is happening in a single caste Karivokkaliga village. Karivokkaliga is a small community of erstwhile shifting cultivators who are still very poorly linked to the market economy. They retain strong community level organization for deciding on disputes amongst their own community members. They retain strong faith in the deities believed to be resident in the sacred grove and have community level ability to regulate the behaviour of their own members so as to ensure that they do not violate the taboos against interference with the sacred grove. The situation of Mathigar then does conform to several of the other six design principles for successful functioning of self-organized conservation systems.

The story of village Gani (Taluk Shrivardhan, district Raigad, Maharashtra) narrated by Gadgil and Vartak (1975) provides an illustration of a sacred grove maintained by the local community of Kunbis because of an attractive benefit/cost balance. These authors came across the villagers of Gani during the course of a survey of sacred groves of the Maharashtra Western Ghats. This village had a sacred grove of 10 ha dedicated to goddess Kalkai in the catchment of the only remaining perennial stream of the village, all the other forest in the neighbourhood having been liquidated earlier. The forest was also important as a source of shade to the cattle during the afternoons. The Maharashtra Forest Department had marked the trees in the grove for clearfelling. This felling would not have benefited the local villagers in any way, except through some temporary employment as wage labour. They were therefore very much interested in saving the forest, but had no way of influencing the remote central authorities of the forest department in any way. However a sympathetic local Range Forest Officer informed them of the authors' ongoing survey of sacred groves, suggesting that they may be able to help them out. They wrote to the authors who visited the village and the sacred grove and carried their request to the Chief Conservator of Forests of the state. This official agreed to the request on grounds of personal friendship, but remarked that he saw no merit in saving these "stands of overmature timber". It is evident that local ecosystem services, which the villagers valued were of no concern to the centralized authority focussed on wood as a commercial commodity.

Apart from an appropriate balance of benefits and costs for the villagers of Gani, several other principles of design were satisfied as with Mathigar. The local Kunbi community is socially homogenous and not strongly linked to market forces. It has community level decision-making machinery to regulate the behaviour of members of their own community. They believed in the monitoring power of their local deity. Importantly of course, the rules governing how to treat the sacred grove are no longer in control of this local community, but framed by a rigid, centralized authority with no accountability to local community. That is of course why the grove was about to be felled.

Revival

The tradition of sacred groves is not only being maintained in some cases, in other cases it is being revived. Such cases of revival seem dependent on local communities perceiving tangible losses of benefits on liquidation of the sacred grove of a level sufficient to offset the costs of revival of the tradition. Some of the most interesting cases of such revival come from northeastern states like Manipur and Mizoram where the once extensive network of sacred groves was largely destroyed in 1950's on development of a transport network and a lucrative market for timber coupled to conversion to Christianity. But in this tract where shifting cultivation prevailed, some of the sacred groves encircling the settlements served as firebreaks during the slash and burn operations. In several villages inhabited by Gangte tribals of Churchandpur district of Manipur such revival of sacred groves encircling habitation has taken place. Since now the community has embraced Christianity, the groves are no longer being viewed as abodes of deities. In communication with outsiders they are called "forest reserves", or as Malhotra (1990) reports for Mizoram "safety forests". The term used for the grove in their own language however remains as before 'Gamkhal'. Protection to these gamkhals continues to be organized through monitoring by local community members and implemented through sanctions for violation imposed by the community leaders. This is possible because in the more remote Gangte villages traditional community level organization is still functional.

There is however a clear pattern in the spatial distribution of villages where such revival has occurred. In villages close to the market town of Churchandpur the whole landuse pattern has changed with all land now belonging to individuals; terraced and bought under permanent cultivation of commercial crops like pineapple. In these villages the function of sacred groves as a firebreak is irrelevant, nor do these villages retain the community level organization capable of monitoring and enforcing protection. In such villages there has been no revival. The cases of revival become more frequent as one moves to the interior, away from the market town and roads, to settlements which continue the practice of shifting cultivation and retain more traditional forms of community organization.

Emergence

Finally there are interesting lessons to be learnt from new emergence of sacred groves in places where none existed earlier. One can see three types of contexts in which such emergence may occur. (a) It may employ religious beliefs, but serve a tangible function (b) It may relate to the traditional religious beliefs without serving any tangible function (c) It may relate to the state machinery attempting to ensure protection through the medium of traditional religious beliefs. The sacred forests newly established by people in the areas of Almora and Pithoragarh districts in Uttar Pradesh are instances of case (a), serving tangible functions. In Dharamgarh area, which is on the border of the two above mentioned districts, about 25 villagers are protecting extensive forest areas dedicated to the local goddess. The area is at around 750 m. from mean sea level in very remote hills of Kumaon Himalaya. All the economy is mainly dependent on agriculture and people are directly dependent on forests to meet daily requirements like firewood, fodder, timber etc. These forests were also under threat because of market demand for timber. Though the local panchayats owned the land they were unable to protect the forest. Finally villagers decided to hand over the forests to local goddess -Kokilamata who is supposed to be the goddess of justice. They prepared a set of rules for protecting the forest and offered it to goddess. Then in a ritualistic fashion they also marked the boundaries of forest offered to goddess. People were allowed to cut twigs of trees, collect firewood and deadwood. Nobody was allowed to cut any live plant; any violation would supposedly attract punishment from the goddess. The process was started around 1982 from the village Jakhani in Almora district and has spread to more than 25 villages around. In villages like Madigaon, Phanku, Dharamgarh people are getting tangible benefits from this protection in terms of their requirements of forest produce.

The initiative for the establishment of this sacred grove probably came from local people, although today panchayat members as well workers from a Gandhian Ashram at Dharamgarh claim credit for this experiment. Today people are permitted to harvest dead trees and green twigs as well as graze their cattle in the sacred grove. However there is no commitment to the goddess to protect animals. People hunt various animals for various purpose e.g. medicinal treatment, meat etc. This low level regulated harvest of living resources from the sacred grove is clearly providing sufficient tangible benefits to offset costs of protection.

Two other examples of recent emergence of sacred groves in villages Bada Bhilwada and Shyampura (Zadol taluk, Udaipur district, Rajasthan) also relate to adequate tangible benefits being available. Bada Bhilwada and Shyampura are situated in foothills of Aravalli mountains in southern Rajasthan. A new tradition has emerged in these villages for the conservation of forest; which they call as "Kesar Chirkav". This practice was started in a literacy programme by a worker of the NGO Sevamandir, based at Udaipur. The worker told the villagers about such a "Kesar Chirkav" reported from Sagwada village, Udaipur district because of the influence of the famous deity "Kesariyaji" situated about 80 kms. south of Udaipur. People also came to perceive about the tangible benefits following the new tradition and they decided to do the same in their villages, Bada Bhilwara and Shyampura coming under Panchayat - Bichiwada.

In both the villages Joint Forest Management had been initiated with the help of Sevamandir. Villagers then brought sacred saffron from the "Kesariyaji" temple. They then sprinkled the saffron water along the boundary to be protected under "kesar chirkav". They also included JFM land in "kesar chirkav". Since that day in 1994 there was total ban on cutting trees from the area, although harvesting of grass is allowed. With the help of forest department, plantation was done on "kesar chirkav" area. When the benefits in terms of biomass started being realized there were different experiences in the two villages.

Bada Bhilwada witnessed many cases of violation of the restrictions. A few times the Forest Protection Committee also asked for the help of forest department for legal action against the offenders. People here have faith for "Kesariyaji" but the belief of wrath due to violation of restriction is not deeply rooted. Unlike Bada Bhilwada, Shyampura villagers deeply believe in wrath of "Kesariyaji". The forest protection committee here has not used its powers since 1994. Today, grass harvest provides very tangible benefits available to the people. The Forest Protection Committee charges Rs.5/- per sickle per day. Villagers harvest the grass and can easily get around Rs.30/- for a headload in the local market. The villagers of Shyampura are thus happy with the present scenario, but their neighbouring villages are encroaching the land of "Kesar Chirkav" as some of the land was part of the resource catchment of those other villages.

We also have on record one case where a sacred grove has been established, by an individual farmer on his own land, apparently without any motivation relating to tangible benefits. This is a small grove of 750 m^2 dedicated to a local female deity, Yakshi: in village Mathigar (Siddapur taluk, Uttara Kannada district, Karnataka). But such cases are very likely truly exceptional at the present time.

Karnataka Forest Department, which in early 1970's, clearfelled large sacred groves, such as one at Mensi of 21 ha. to supply softwood to plywood industry, has also now programs of establishment of sacred groves called 'Pavitravanas', first initiated in 1988. The Pavitravana scheme is an initiative of the state forest department to create new protected sites with the co-operation of local communities. In 1988, Karnataka forest Department established a Pavitravana called as 'Sridhar van' in village Salkani of Sirsi Tahsil of district Uttara Kannada. The youth organization in the village took initiative in the process. They planted species used for ritual performances like yajnas on 1 ha land on the hilltop. Now in the same village people are demanding to afforest the other barren hill tops with useful species for NTFP, fuel, fodder etc. The later proposal is getting support from villagers because the plantation will serve as wind break and the Areca and Coconut gardens will be saved from heavy winds.

In another experiment in the village Bakkal in Sirsi taluka of Uttara Kannada district, state forest department has established a Pavitra vana spread over 28 ha. Earlier the forest department was planning to have an Acacia plantation on that area. But people opposed it; hence the Pavitravana was established with local support.

The idea of Pavitravana is based on Hindu scriptures. As a result we find in this garden growing together *Acacia catechu* (Mrigashira star) and *Calotropis gigantea* (Shravana star) from dry open on rocky habitats in the company of evergreens *Artocarpus heterophylla* (Uttarashada star) and *Mesua ferrea* (Ashlesha star) and *Pinus longifolia* (Jyestha star). They are intermingled with various deciduous tree species like *Butea monosperma* (Hubba star) and *Spondias mangifera* (Hastha star). This synthetic sacred forest is then no substitute for natural vegetation. Nevertheless these groves can be of educative value as well as re-emphasize man's bonds with plants.

Prospects

What then is in store for the sacred sites, sacred groves, ponds, grasslands in coming years? There are obviously signs of strengthening of community level institutions which would favour the persistence, revival or emergence of such self-organized systems. But there are also continuing trends of weakening of traditional religious beliefs, especially of small scale societies, of 'little traditions' of faith in sthaladevatas - deities rooted in particular localities. That means that intangible benefits flowing from respecting the sites where such deities reside are likely to continue to be devalued. Nor would such deities be relied upon to help local communities monitor adherence to prescribed norms of behaviour. If the system of self-organized conservation sites is to continue, then such sites must provide to local communities tangible benefits, be they as fire breaks or in terms of dead and fallen wood. But such benefits would often turn out to be as inadequate as gathering market forces lead to an escalation of the opportunity costs of maintenance of sacred sites. The larger society will then have to invest in augmenting tangible benefits through special financial or other rewards (Gadgil and Rao 1994, 1995).

Simultaneously with availability of appropriate tangible benefits, the prospects for such self-organized systems of conservation would depend on effective community organization and devolution of authority to communities. As discussed above, there are many encouraging trends in this direction. It is then entirely reasonable to expect that these self-organized systems of conservation would continue to play a role worthy of their history in years to come.

Acknowledgment

The authors are thankful to a very large number of people for their manifold help. Unfortunately it is not possible to mention all of them by name. Amongst the more notable of them are:

Rajeev Aahal, G.K.Bhat, Omprakash Bhat, Jethusingh Bhati, Ketaki Das, Soumyadeep Datta, Prahalad Dubey, Ajay Dolke, N.R. Hegde, K.Kamaraj, Devashish Kar, Iqbal Singh Kaundal, K.C.Malhotra, S.M. Mohnot, K.Murugan, Shubhu Patwa, Ishwar Prakash, D.S. Srivatsava, Sarvajeet Thousain, B.K.Tiwari, R.S.Tripathi, V.D. Vartak, PRAVA, Orissa, Sevamandir, Rajasthan, Vasundhara, Orissa, Young Mizo Association (Central), Mizoram.

We are also indebted to the residents of all the villages surveyed for patiently answering our questions. Thanks are also due to the State Forest Departments of the states of Himachal Pradesh, Rajasthan, Uttar Pradesh, Maharashtra, Karnataka, Tamilnadu, Kerala, Orissa, Bihar, West Bengal, Assam, Meghalaya and Mizoram. We thank WWF-India for making their funds available for this work.

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SOME BCPP PARTNERS

Academy of Administration, Nainital
Assam Science Society, Guwahati
Bharatiya Vidyapeeth Environment Education & Research Institute, Pune
Bombay Natural History Society, Bombay
Conservation Forum, Silchar
Environment Conservation Society, Ajmer
Forest Department, Government of Tripura
Foundation for Revitalisation of Local Health Traditions, Bangalore
GB Pant Institute, Almora
Gene Campaign, New Delhi
Guwahati University, Guwahati
Himachal Jan Vikas Sahayog Samiti, Darlaghat
Indira Gandhi National Forest Academy, Dehradun
Indian Institute of Public Administration, New Delhi
Indian Institute of Science, Bangalore
Institute of Economic Growth, Delhi
Jaiv Vividhata Sarvekshan Samiti, Kamla
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Jawaharlal Nehru University, Delhi
Karnataka Association for the Advancement of Science, Bangalore
Karnataka State Council for Science and Technology, Bangalore
Madras Science Foundation, Chennai
MS Swaminathan Research Foundation, Chennai
National Institute of Oceanography, Panjim
Nature Conservation Society, Daltonganj
Parayavaran Evam Gram Vikas Sanstha, Karsog
Paryavaran Parishad, Kota
Professional Assistance for Voluntary Action, Balasore
Research & Action in Natural Wealth Administration, Pune
Rural Technology Development Centre, Rajgarh
Salim Ali Centre for Ornithology and Nature, Coimbatore
Seva Mandir, Udaipur
Shivaji University, Kohlapur
Society for Advancement of Village Economy, Sainj
Society for Andaman and Nicobar Ecology, Port Blair
Society for Rural Development and Action, Thaltukhor
Society for Social Uplift Through Rural Action, Jagjit Nagar
Sri Aurobindo Institute of Indian Culture, Shillong
State Forest Research Institute, Itanagar
The School of Desert Sciences, Jodhpur
Vasundhara, Bhubaneshwar
Vidya Bhawan Rural Institute, Udaipur
Vivekananda Kendra, Jodhpur
Wildlife Institute of India, Dehradun
World Wide Fund for Nature-India, New Delhi
WWF-India North-East Region, Guwahati
Zoo Outreach Organisation, Coimbatore

Project Co-ordination: Shekhar Singh, Indian Institute of Public Administration, New Delhi
Micro-Strategies Co-ordination: Madhav Gadgil, Indian Institute of Science, Bangalore
Species Co-ordination: Ajith Kumar, Salim Ali Centre for Ornithology and Natural History, Coimbatore
Project Secretariat: World Wide Fund for Nature - India, New Delhi