WILD ANIMAL DIVERSITY
THEMATIC STRATEGY AND ACTION PLAN

PREPARED UNDER THE NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN - INDIA

FINAL REPORT

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EXECUTIVE SUMMARY

The conservation of wild animal diversity is an important component of NBSAP. The concern for a few animal species is what has driven conservation effort in India for the last many decades. A qualitative change in this effort is now in the making among the officials, forest managers and researchers following a better appreciation of wild animal diversity *per se*, especially following the Rio Convention. This also follows a better understanding and appreciation of the importance of species diversity in ecosystem functioning. The mandate given to the Thematic Working Group (TWG) on Wild Animal Diversity reflects this change of perception to a large extent.

The conservation of a few species such as the tiger and elephant, and the protected area network has been a subject of considerable attention for the last several decades, including focal species projects, special committees, reports and action plans. It was felt that the effort of the TWG was better spent on major issues that have not been addressed adequately till now, while accepting the various common recommendations and actions plans that already exist. This report is based on a review of these recommendations and action plans, mandates of ongoing major projects which address the conservation of Indian fauna, review of scientific literature and working papers, one workshop which addressed conservation issues of rainforest fauna, and discussions with individuals and at meetings.

KEY ISSUES AND STRATEGIES

ISSUE 1. Non-implementation of recent recommendations and action plans: During the last decade or more, several focal animal projects (Project Tiger, Project Elephant), special committees (*e.g*. Subramanian Committee on Prevention of Illegal Trade in Wildlife), and recently the National Wildlife Action Plan have made several recommendations for the conservation of wild animal diversity. The most important ones are common to all and pertain to providing adequate manpower, timely funding and other resources, control of poaching, extension of protected area network *etc*. The non-implementation of these recommendations and action plans would undermine all other efforts for conservation, including those that follow from NBSAP.

Strategy 1. Implement the important recommendations that have been suggested by several committees and action plans, some appointed specifically to address critical issues.

ISSUE 2. The lack of a legal framework for conservation of species: Although existing legislation protect individual animals of threatened species and their habitats, these are not sufficient to ensure the survival of species. As a result no worthwhile effort is being made to ensure the survival of several critically endangered species. It should be, therefore, mandatory for conservation actions to be based on a scientific assessment of the threat processes operating on the species.

Strategy1. Enact legislation making it mandatory to develop and implement threat reduction and recovery plans that are based on a scientific assessment of the threat processes operating on the species. It would be also necessary to have mechanisms to reassess periodically and scientifically the threat status of species and for such assessments to have legal validity.

ISSUE 3. Lack of species information and accessibility to information: There is at present a serious paucity of the most basic spatial and ecological information on a vast majority of species including several mammalian taxa. Such information is required for protected area design, preparation of management plans *etc*. Moreover, whatever information is available is not readily accessible in a way that facilitates decision making by various agencies involved in conservation. National institutions entrusted with the task of collecting and disseminating this information has seen a drastic reduction in manpower, expertise and funding in recent years.

Strategy 1. A systematic compilation of species data into national fauna database in a format that allows decision making transparent, and facilitates protected area design and management, environment impact assessment, conservation education, and scientific analysis *etc.* Existing data holders should be identified and strengthened so as to contribute towards this national effort. Several international databases could serve as models in this effort.

Strategy 2. Promote the collection of spatially referenced inventory data on small mammals, birds, lower vertebrates, and invertebrates. This would involve capacity building both in quality and quantity, increased funding, and mandating data collection in a format that allows easy compilation into a database.

ISSUE 4. Gaps in protected area coverage of species and populations: A protected area network that covers only about 5% of the country, and nearly 20% of the forested area, can hardly be expected to adequately cover all the wild species in the country. Preliminary analysis shows that even mammals and lower vertebrates may be poorly covered. Moreover, large populations of several threatened species occur outside the protected area network. It is necessary, therefore, that an effort is made to include as many wild species and as much populations of threatened species as possible within the protected area network. It is also necessary that each protected area be seen as a part of the network, each of them therefore with a unique role in the network.

Strategy 1. Make a systematic assessment of species occurrence in protected area network and outside so as to expand the protected area network wherever possible. A similar assessment of the populations of threatened species is also needed. Data that have accumulated in the last several decades on several taxa allow a meaningful gap analysis.

Strategy 2. The relative importance of each or a set of protected areas should be clearly stated with reference to the target taxa that they are expected to conserve. Management measures should then attempt to ensure persistence of these taxa.

Strategy 3. Evolve innovative measures to involve local communities (which might be locality specific) in protection and management in order to overcome shortages in manpower and funding, poor accessibility, and also to elicit local support.

ISSUE 5. Management of protected areas to ensure persistence of species: The management of protected areas to enhance the survival of target species is now mostly limited to protection of animals from poaching and habitat from loss and degradation. However, many species require management actions beyond this. Protected area management in the context of climate change is an issue that need to be addressed.

Strategy 1. Designate target taxa for each or a group protected areas so that management measures can be focussed on these taxa.

Strategy 2. Integrate climate change impacts into biodiversity conservation, especially the designation and management of protected areas for species conservation.

ISSUE 6. **Conservation of species in community and other lands:** Even if all the remaining forest land is enclosed within protected area network, major gaps would remain in terms of species and population coverage, and other aspects such as corridors. The major examples are the semi-arid grasslands that are privately or community owned, inland wetlands with highly complex ownership, and privately or corporate owned lands in the Western Ghats and northeast. All of these contain substantial or the only populations of several hundred wild species. They also form critical corridors in the seasonal movements of several species either within or between protected areas. There is thus an urgent need to devise ways and means of managing large, sometimes the only, populations of many species that are confined to these lands. The drastic decline in several species of common birds in rural and urban landscape is also a matter of concern.

Strategy 1. Promote conservation in corporate and private lands in the Western Ghats and northeast India through a combination of legal measures and economic incentives that would prevent rapid land use changes, for example from coffee to tea in the Western Ghats. There is sufficient scope for promotion of eco-friendly products such as natural shade grown coffee and eco-tourism in such lands.

Strategy 2. Strengthen community conservation in semi-arid grassland and inland wetland areas. Recent studies show that community knowledge on biodiversity and conservation efforts are rapidly declining and that governmental interventions in recent years have often served to accelerate the decline. These studies have also revealed the need for devising new contexts and framework (especially mechanisms for conflict resolution, and need for economic benefits) for community conservation to be effective. Any governmental intervention such as designating new ‘community reserves’ or ‘conservation areas’ (as proposed in the amendment to the Wildlife Protection Act (1998) should take into account the above findings.

Strategy 3. Inclusion of sites in the new categories of conservation areas has to be based on a set of clearly laid out criteria, including those on wild animal diversity. There are several hundreds of candidates for inclusion in the new conservation areas (currently proposed) or those eligible for other kinds of public support. However, resources available for this purpose are limited. Therefore, the occurrence of species not represented in the protected area network and substantial populations of threatened species should be important criteria in the selection of sites for inclusion in the new categories of conservation areas.

Strategy 4. Monitoring of indicator species in the rural and urban landscape. Long term monitoring and research are required to measure the extent of decline in several species (*e.g.*. birds such as vulture, house sparrow) and to identify the major reasons. This would also have major implications for human health.

ISSUE 7. The need for agreements, legislation, policies and action plans for the conservation of migratory species: India has for long been a signatory to several international conventions and treaties on the conservation of migratory species. All these conventions and treaties mandate bilateral or multilateral agreements among range countries on collaborative management, research and monitoring of migratory species and their habitats. The range countries are also called upon to have domestic legislation, policies and action plans for the conservation of migratory species and their habitats. However, India is yet to take any major measures in any of these, except for a recently signed MoU with Russia on migratory birds, and a belated MoU on the Siberian Crane. Although migratory birds and marine turtles have received some attention, some others like the marine mammals and the Gangetic dolphin have received no attention.

Strategy 1. Enter into bilateral or multilateral agreements with range countries so as to promote the conservation of migratory species including marine mammals, Gangetic dolphin and gharial, through collaborative research and monitoring.

Strategy 2. Develop action plans for species-groups and globally threatened species of waterbirds, including measures to effectively manage networks of sites that are internationally important for migratory birds, as recommended by the Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005 (AMWCC 2001). Substantial progress in this regard is expected by two ongoing projects.

Strategy 3. Promote studies of distribution, population, and threat assessment of marine mammals, the least studied among the migratory species in India.

ISSUE 8. Biodiversity assessment in relatively unknown areas: While a considerable part of India has never been surveyed (*e.g.*. in northeast and trans Himalaya), vast stretches of potentially species rich areas, including marine areas, have never been surveyed for invertebrates and lower vertebrates. The number of new species being recorded every year is an indication of this. It is therefore necessary to have mechanisms to rapidly identify areas of high species richness and endemism, especially among lower vertebrates and

invertebrates, while we await systematic surveys. Most of the indicators that are currently identified, besides being inconsistent, are useful only at scales larger than at which our protected areas are designed. It is therefore necessary that we identify indicators that suit our purpose.

Strategy 1. Promote scientific studies in order to identify biotic and abiotic indicators of high taxic diversity in India.

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AJITH KUMAR

PREFACE

Species are entities that are widely accepted by almost everybody, except curiously by the biologists who continue to lump, split and rearrange them. Also, among the many poorly defined and even more poorly measurable parameters that shroud the concept of biodiversity, species stands out as the best defined and the most measurable. It is perhaps because of such simplicity in concept that species, especially wild animals, still drive biodiversity conservation. It is perhaps more correct to say that a few charismatic species have driven conservation by the government (of any political hue); in contrast people at large have been concerned with a range of species dictated by their use and beliefs which vary widely.

The conservation limelight in India has been hogged for the last many decades by relatively a few animal species - elephant, tiger and few others. Interestingly, these species have been a problem as well as a solution. For example, elephant and tiger have been the major sources of conflict between local people, protected areas, sociologists and conservationists, but these two species have attracted resources, funding and otherwise, which have been of immense benefit to the habitats of thousands of other species. These two species are a source of conflict only in two thirds of India or less, but then more than two thirds of conservation resources especially in terms of funding and personnel have been also invested in them.

We often equate the direct conflict that surrounds the conservation of a few species with conservation of all species in general. This obviously is not true. Many, like fishes, are of proximal use to people. Many others are of value otherwise, in pollination, pest control *etc.* Many are loved by people even in their back yard, birds and butterflies for instance. This is biodiversity in the case of wild animals, and often there is no conflict.

This report, therefore, is about wild animal diversity and not about any particular species. Species are cited purely as examples or case studies to highlight an issue. Anyway, a species based approach is beyond the scope of this report, or any single report for that matter. The conservation of a few species, not in the hundreds, has been acrimoniously debated in the last many years in project steering committees, media, and other fora. The Thematic Working Group in its first meeting (and the only one till date) felt that no useful purpose would be served by re-examining the issues concerned with the

conservation of these few species. The major recommendations should be accepted as it is by the NBSAP. It was felt that the limited resources of NBSAP is best spent on issues that concern wild animal diversity *per se* rather than any taxa in particular.

An important event happened when this report was nearing its first draft (and delayed its final draft): the release of the Wildlife Action Plan for 2002-16 (NWAP), by the Prime Minister of India on the occasion of the 21st Meeting of the Indian Board for Wildlife on 21 January 2002. This Action Plan, prepared by a team of eminent people, obviously marked a major commitment by the Government of India. Yet another action plan prepared under the NBSAP might therefore seem a duplication of effort that is so typical of any government. We have made exceptional effort to ensure that this is not so. This we have done by: (a) Avoiding issues that address biodiversity conservation in general, which have been addressed in NWAP; (b) Not examining issues in wild animal diversity conservation which have been dealt with at length in NWAP; but the major recommendations are repeated in this report; and (c) By concentrating on issues that concern the conservation of wild animal diversity which have not been addressed till now, not only by NWAP, but also by several other committees.

A discussion meeting on man-wildlife conflict was held on the last day of September 2002, co-hosted by the Asian Elephant Research and Conservation Centre, at the Centre for Ecological Sciences. A report of the meeting is being considered separately by the NBSAP, and therefore is not included in this report.

Ensuring wide participation was not a means but a goal of NBSAP. This was not an easy task for the working group on wild animal diversity for several reasons. To start with, the coverage was very wide taxonomically and geographically. Many wildlife scientists and forest managers have their agenda with which they are busy, including NBSAP activities. Some refused to participate, disagreeing with the NBSAP process.

Coimbatore
30 January 2003

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CONTENTS

1 INTRODUCTION

1.1 THE IMPORTANCE OF SPECIES

Species are the building blocks of ecosystems. These are also the entities that the common man easily identifies among the confusing jargon of biodiversity. Recent experimental studies show that greater species diversity leads to greater plant productivity, nutrient retention, and stability. Greater stability results from species differences in their response to environmental variability, and also because species in a trophic level covary negatively since they are competitors. The energy and nutrient flow rates in an ecosystem are mediated by individual species. The loss of species slows down ecosystem recovery on an ecological time scale, and speciation on an evolutionary time scale. The above effects are further attenuated by the fact that species loss due to human impacts is often non-random "with related twigs on the same tree tending to share the same fate" (Purvis & Hector 2000, p 216). Thus recent studies show that the loss of individual species can have major consequences to ecosystem functioning (see Purvis & Hector 2000, Chapin III *et al.* 2000, for reviews of recent advances in the understanding the importance of species in ecosystem functioning).

The loss of individual species some times has major societal costs (Chapin III *et al.* 2000). For example, many species are harvested from natural ecosystems and these are of very high economic value (*e.g.* fisheries). In fact, the decline in the abundance of some of the harvested marine species has been a source of considerable friction among many countries (*e.g.* whales). Many species in natural ecosystems are of critical subsistence value to several human communities. The loss of pollinators such as bees would have major impact on conservation of biodiversity and stability of food crop yields (Allen-Wardell *et al.* 1998; Borges 2001). The economies of many countries are dependent on tourism centring on a few animal species. Many animal species have important cultural, aesthetic and spiritual values.

It is also important to recognise that the concern for individual species has been a major driving force in conservation in traditional societies, autocracies, democracies and other political systems. Several such species have generated considerable domestic and international funding. Till recently, the conservation needs of a few species have

influenced the allocation of limited resources of funds, land and personnel, some times at the cost of other components of biodiversity.

1.2 MANDATE: THEMATIC CONCEPT NOTE

The mandate of the Thematic Working Group (TWG) on Wild Animal Diversity was decided upon by the TPCG and was provided in a thematic concept note. This is given below.

The wild species biodiversity of India has a very wide taxonomic range, in proportion to the enormous diversity of ecosystems and geographical conditions which these species inhabit. This enormous diversity at the species, subspecies and variety level, is a result of evolutionary processes. However, in the last couple of centuries, and in particular in the last few decades, this diversity has faced increasing erosion. Habitat loss, hunting and over-exploitation, introduction of exotics, poisoning, and other factors have caused this loss. The dimensions of the loss are as yet unclear, as baseline data, research and monitoring are poorly developed in the country. Some elements of the loss which have remained undetected or severely under-studied, include erosion of the sub-species and varieties of a species. This silent erosion is not necessarily due to any anthrophogenic factor, but often due to complex and less understood environmental factors. While a number of conservation measures (notably legal protection against hunting and trade, and creation of protected areas) have been taken by the Indian government and NGOs in India, there remain critical deficiencies. The distribution of the wild biodiversity is not restricted to protected areas only, and the distribution does not follow any political or administrative guidelines. Hence, a true national approach is required, on the basis of the local and regional characteristic of the wildlife. Also, the focus for conservation work has to also be put on wild plants, and 'lesser' species of animals, as on the megafauna.

The Wild Biodiversity thematic working group's work should be based on the recognition that:

- the wild biodiversity which is physically protected in the PAs, continue to face threats from human sources and from factors such as isolation and fragmentation of habitats and populations, reduction in distribution range, and so on;
- a large number of wild species are distributed in non-protected areas and face severe threats to their future;

- a large number of flora and fauna are endemic to India in general and to specific ecological regions in particular, and need special attention;
- basic research and information on various aspects of wild species is still seriously deficient in India;
- wild species and their diversity are critical for the well-being of the country, in terms of the ecological functions they provide, the aesthetic, cultural and spiritual inspiration that humans derive from them, their economic importance including of the relatives of cultivated plant and domesticated animals species, and so on. In particular, a major section of the population in rural (including tribal) areas is dependent on and associated with wild biodiversity for their livelihood and culture.
- there continue to exist strong traditions of conservation of wildlife in many sections of India's population, which need recognition within the framework of official conservation programmes;
- there is need for a diversity of conservation strategies and approaches, including legal protection to species and habitats, countering commercial-industrial-biotic threats, collaborative management with local communities, economic incentives, ensuring equitable distribution of costs and benefits *etc.*
- Activities related to biodiversity conservation within a country have international ramifications and implications.

Given the above, the Working Group should identify the following giving due attention to the potential role of indigenous communities and their knowledge:

- critical research and information gaps, and measures to plug them;
- mechanisms of identifying wild taxa of importance (threatened, endemic to regions or biomes, 'primitive', high value for humans, and so on), and measures to conserve them;
- mechanisms of identifying relatively unknown locations of high wild taxa biodiversity;
- mechanisms of identifying important habitats for each taxa and measures to conserve them;
- measures to remove all threats to wildlife, in particular large-scale habitat loss due to commercial and ‘development’ projects;
- an inclusive and consultative process of prioritisation, at local, state, and national levels, of conservation actions related to wild taxa;

- steps to develop collaborative biodiversity conservation strategies with local communities living in, and knowledgeable about, wild biodiversity in their area;
- steps to develop collaborative biodiversity conservation strategies with neighbouring countries that share the same taxa;
- steps for the establishment of cross-boundary emergency response mechanisms, where not already existing, to address emergency threats to wild biodiversity;
- a process of prioritisation, at local, state, and national levels, of conservation actions related to wild taxa.
- possibilities of generating financial and resource support to neighbouring countries for biodiversity goals of common interest (*e.g.* for conservation of migratory species);
- biodiversity related initiatives in other countries, which India could learn from.

The measures being recommended should take into account:

- what is already being done by communities, NGOs, and official agencies for promoting conservation and sustainable use;
- existing official as well as community/civil society assessments on the subject, including of strategies to conserve elements of wild biodiversity that have failed or been successful, and possible reasons for such failure or success;
- the expertise and experience available, including among academic institutions at various levels, and among the women and men of tribal and other local communities with strong conservation ethics and cultural traditions;
- the gaps that need to be plugged through a range of actions at governmental, NGO, corporate, community, and other levels; and
- the resources (human, institutional, economic) needed for the above.

1.3 GOAL OF THIS REPORT

The goal of this report is not to critically evaluate, in the context of the above mandate, the ongoing attempts, new initiatives, and existing action plans for the conservation of wild animals, of which there are several. Among the most notable are the Protected Area Network (Rodgers *et al.* 2000), Project Tiger, Project Elephant, the Wildlife Action Plan 2002-2016, the Subramanian Committee Report in Wildlife Trade, Important Bird Area Programme, and the Inland Wetland Project. All of these have examined the relevant issues at great depth and with wide participation. Some of their recommendations and

action plans are being implemented at different levels. The need to implement the others is obvious; we have attempted to identify the ones that need to be addressed immediately. Instead, this report addresses some major issues in the conservation of wild animals that have not been addressed till now. More specifically this report addresses the following issues:

- The urgent need to implement some important recommendations that have been suggested by several committees and action plans, some appointed specifically to address critical issues.
- The need for legalisation that would ensure threat reduction and recovery plans for threatened species, other than protected areas and prevention of hunting which are the two major tools of species conservation at present.
- The need for periodic scientific assessment of conservation status of species, and legal acceptance of such an assessment.
- A systematic compilation of species data in a format that allows decision making transparent, and facilitates management, environment impact assessment, conservation education, and scientific analysis; and
- The need to device ways and means of managing large, sometimes the only, populations of many species that are confined to lands outside protected areas, in community and corporate land.
- The need for domestic legislation, policies, and action plans for the conservation of migratory species which is governed by several international conventions and agreements to which India has been a signatory for several years.

1.4 METHODOLOGY

The activity of the TWG was initiated by its first meeting in October 2000, at the Salim Ali Centre for Ornithology and Natural History. This meeting critically examined the mandate given to the group and decided that:

- We should examine the recommendations and action plans that already exist, from several committees, meetings and projects, especially those at the national level, which have addressed the mandates given to this TWG. Of particular importance in this regard were the National Wildlife Action Plan (2002), Project Tiger, Project Elephant, Biodiversity Conservation Prioritisation Project, and initiatives by the NBFGR in conservation of freshwater fishes.

- Since the problems of conservation of wild animal diversity are widely known, more importance should be given to support recommended strategies and action plans with quantitative analysis of data, however much preliminary this might be. Particular attention should be given to published papers and articles, following the guidelines circulated by the TPCG on Data Quality;
- Since time and resources were limited, the strategies and action plans can only be based on review existing information, and not on primary collection of data;
- The TWG members should provide information or prepare working papers which can be incorporated into the final report, although the Co-ordinator should take the lead;
- Other scientists, forest managers, NGOs, *etc.* should be approached as and when the need arises for critical information.
- The first draft of the report should be widely circulated so as to elicit comments, before finalisation.

This method has been followed, more or less. In addition, the information needs, conservation problems, and research priorities in rainforest fauna, which represent a major component of India's faunal richness, were examined during a two-day workshop held in Coimabtore in February 2001. This workshop, attended by about 100 researchers, forest managers, NGOs, *etc*. gave particular importance to invertebrates which have been neglected while setting conservation priorities. It is beyond the scope of this report to exhaustively cover this workshop; this would form another publication. However, the major issues have been incorporated into the relevant sections.

In summary, this report is based on:

- A review of the recommendations and action plans that already exist. A critical evaluation of these recommendations was not possible or desirable, considering that each of these has already involved detailed studies and consultations. Instead, the major gaps which have not been addressed till now are the focus of this report.
- A review of scientific literature, working papers prepared for this TWG, consultations on an individual basis and meetings; particular attention has been given for quantitative analysis wherever possible.
- A review of the State Action Plans which were accessible as of date.
- Literature on international efforts at conservation of wild animal diversity, including international conventions and agreements.

Limitations

- The issues that concern the conservation of wild animal diversity are several, and it is not possible to address all of them. A pre-prioritisation was therefore necessary. Among the most important was that this report should address wild animal diversity in general, and not any particular species. Species are used only as examples to highlight an issue.
- Although an attempt has been made to make each or a group of strategies independently implementable, this has not been always possible.
- Participation in the preparation of this report, despite considerable effort, has not been as much as it should have been, due to several reasons. Most of the wildlife researchers are busy with their agenda, including activities of NBSAP. Some had reservations about the NBSAP Project itself and refused to participate. However, their participation has been ensured to some extent through their publications, internet correspondence *etc.*, often without their knowledge.
- Wildlife conservation is often an acrimonious subject, with as many opinions as there are people; some times more. However, the emphasis in this report has been on opinions that are supported by information.

2 STATUS OF WILD ANIMAL DIVERSITY

2.1 WILD ANIMAL DIVERSITY IN INDIA

2.1.1 Status of faunal documentation

That India is a mega-diversity country is well known. This diversity is due to the geological history of India, its topographical and climatic diversity, and its current location overlapping with Indo-Malayan, Ethiopian and Palearctic biogeographic realms. An exhaustive review of the faunal diversity in India is beyond the scope of this report. The best comprehensive report on the faunal diversity of India is perhaps ZSI (1998). Revised checklists of some vertebrate taxa have been published since then, incorporating new species and new records (*e.g.* Nameer 2000 for mammals, Dutta 1997 for amphibians, Das 1997 for reptiles).

As admitted by several authors in ZSI (1998) the faunal documentation is far from complete for many invertebrate taxa. This is particularly striking in the case of several phyla that are primarily marine (Porifera, Cnidaria, Phoronida, Bryozoa, Sipuncula, Echiura *etc.*) and some major phyla such as Nematoda, Annelida, and Arthropoda. This situation is not very surprising since the described species on Earth form only a small part of nearly 10-30 million species that are estimated to exist (Pimm & Raven 2000). And most of the undiscovered species belong to a few terrestrial invertebrate taxa such as insects, which show relatively low local diversity but very high regional diversity. In contrast, some micro-invertebrate taxa show high local diversity ("everything is everywhere") and might not be so highly under-documented; *e.g.* ciliated protozoa (Fenchel *et al.* 1997).

It should also be noted that species inventory for India as a whole is incomplete to varying extents even among the vertebrates, except perhaps birds. For example, several new species of fresh water fishes have been reported in the last decade. Systematic surveys in the Western Ghats and northeast India have reported several new species of amphibians, with one survey in the Western Ghats reporting as many as 110 new species (Biju 2001). Even among medium sized mammals, there have been new records for India very recently; *e.g.* two species of barking deer from Arunachal Pradesh (Datta et al. *in press*). The small

mammals (murid rodents and shrews) and bats are taxa which have not been systematically surveyed for several decades and among which new species and records are likely.

In addition to incomplete documentation, taxonomic revisions and ambiguities often confound comparisons of species richness and endemism across regions. Following the popularity of the phylogenetic species concept in place of biological species concept, some faunal revisions have increased the number of species considerably *e.g*. that of non-human primates in India from 15 to 21 (Groves 2001). In contrast, some revisions have drastically reduced the number of species *e.g.* Porifera and Cnidaria. In some taxa, the application of species concept itself is questionable *e.g.* corals (Arthur 2000b).

2.1.2 Faunal species richness and endemism

Incomplete species documentation, taxonomic ambiguities, and recent taxonomic revisions are all constrains while comparing species richness in India with that of the world. Nearly 90,000 species of fauna has been reported from India, the share out of the world's species richness varying depending on the taxa (Table 1.1). Most of the 7 million or so eukaryotes of the world are animals and 85% of them are terrestrial. This predominance of animals and the importance of terrestrial ecosystem in their conservation also hold true for India.

There is considerable variation in the representation of different phyla and subphyla, the percentage of species in India varying from as low as 1% (Sipuncula) to as high as about 40% (Echiura). However, much of this variation is due to several minor phyla and subphyla, which are primarily marine, and might reflect inadequate species documentation than real differences. Among the more speciose phyla or lower taxa, India has between 4 and 12% of the global species.

Endemism varies considerably among the different taxa. It is generally very low or even absent among the phyla that are exclusively or primarily marine. This is understandable given the wide distribution of most marine species and their dispersal capabilities. There are important exceptions among some minor phyla; 12 out of 43 species in Echiura (28%), 7 out of 10 species in Kinorhyncha (70%), and 64 out of 98 species in Gastrotricha (65%) are endemic. Although this has been attributed to highly specialised microhabitat associations of these species, it is just as likely due to our highly incomplete knowledge of their distribution (ZSI 1998). Among terrestrial animals, the extent of endemism is relatively well established, and is highest among the lower vertebrates. This is especially true of amphibia (>50%) which are autochthonous to peninsular India. Freshwater fish and reptiles also show relatively high endemism (>30%). Endemism

among the mammals and birds is relatively low (<10%), reflecting the fact these are relatively recent intrusive elements. Endemism among invertebrates has been poorly quantified, at the level of phyla or class. At this level, endemism probably varies between 10% and 20%; however Hymenoptera has been reported to have very high levels of endemism, comparable to that in Amphibia.

The rich faunal diversity in India is not uniformly distributed especially the terrestrial fauna. There are two major centres of species richness, the Western Ghats and Eastern Himalaya. While the former also shows high levels of endemism, the latter shows low endemism due to shared international border with several countries. Species richness and endemism in the Western Ghats is well established in the case of vertebrates. With only about 5% of the geographical area of India, the Western Ghats has nearly 39% of freshwater fish (with nearly 50% endemism), 60% of the amphibians (>75% endemism), 50% of reptiles (>50% endemism), 40% of birds (4% endemism) and 33% of mammals (12% endemism). Species richness and endemism among invertebrates are poorly known, except for butterflies (27% of the Indian fauna and 11% endemism). Comparative data are not available for the northeast. However, there are localities with extremely high species richness in the northeast. Sikkim, which covers only <5% of the Western Ghats in area, has more species of mammals, birds, and butterflies.

Quantitative information on the distribution of fauna in different parts of India is not readily available. The best description of the distribution of fauna, although not quantitative, is perhaps the biogeographic classification of India, which formed the backbone in the design of the protected area network (Rodgers & Panwar 1988, Rodgers *et al.* 2000). Zoological survey of India has brought out fauna of several states in India, and the others are in the processes of publication (J.R.B.Alfred, *pers. com.).*

2.1.3 Values of fauna

The rich wild fauna is of immense value to people, although seldom appreciated. These values include subsistence food value to several human societies that are economically poor, commercial value to traditional as well as multinational communities (*e.g.* fisheries and wildlife tourism), and their role in ecosystem functions that are critical to human survival (*e.g*. pollination, Allen-Wardell *et al.* 1998; Borges 2001). Some of the values of different taxa are given in Table 1.1.

Table 1.1. Species richness in various animal taxa in India, compiled primarily from ZSI (1998, by various authors). The invertebrates are given mostly at the level of phylum, and the vertebrates at the level of classes. For Chordata other than vertebrates, data are given for sub-phyla. For arthropods, data are given separately for the most speciose Classes.

Taxa	World	India	% in India	Ende-mics	Direct use values or other importance
Ph. Protista (Protozoa)	31,290	2577	8.2	640	Several species are major pathogens; about 40% of the parasitic protozoa are endemic
Ph. Porifera	4,562	486	10.7	13	All endemics are freshwater species; major fouling agents; industrial use; medical use.
Ph. Bryozoa	4,000	200	5.0	None	Major fouling agents, indicators of marine pollution.
Ph. Cnidaria	9,916	842	8.5	?	Curio trade, source of calcium, pharmacology.
Ph. Echinodermata	6,223	765	12.2	None	Food (holothurians, echinoids).
Ph. Echiura	127	43	33.9	12	Academic research.
Ph. Kinorhyncha	100	10	10.0	7	Academic research.
Ph. Phoronida	11	3	27.3	1	Academic research.
Ph. Sipuncula	145	35	24.0	None	Academic research.
Ph. Acanthocephala	800	229	28.6	203	Parasite on domestic livestock and pets:
Ph. Gastrotricha	2,500	98	3.9	64	Academic research.
Ph.Platyhelminthes	17,000	1,650	9.7	N.A	Major parasites.
Ph.Nematoda	30,000	2,850	9.5	N.A	Major parasites.
Ph. Annelida	12,700	840	6.6	69?	Indicators of marine pollution (Polychaetes); medicinal use (leeches), vermiculture.
Ph. Mollusca	66,535	5070	7.6	575	Major food value, medicine, construction *etc.*
Ph. Arthropoda	988,000	68,389	6.9	23841	Pollinators, pests, trade (butterflies, moths and beetles), medicinal use, silk and lac *etc.*
Or. Orthoptera	17,250	1,750	10.1	~200	Pests, food value.
Or.Hemiptera	81,250	6,500	8.0	1335	Major pests; pest control, lac.
Or. Hymenoptera	120,000	0,000	8.3	~70%	Honey and beewax; pollination; pest control.
Or.Coleoptera	350,000	15,500	4.4	~20%	Major pests; curio trade; food and medicines.
S.ph.Urochordata	2,092	113	5.4	None	
S.ph.Hemichordata	120	12	10.0	None	
S.ph.Cephalochordata	24	6	25.0	None	Academic research
Class. Pisces	22,000	2,546	11.6		As food, medical and industrial products, manure; marine fisheries is worth Rs.10,000 cr/year. CMFRI
Freshwater fish	9,000	742	8.2	223	
Marine fish	13,000	1,804	13.9	None ?	
Class. Amphibia	5,150	209	4.1	128	Pest control; medicinal use; indicators of pollution, UV radiation, and global warming; Dutta (1997)
Class. Reptilia	5,680	484	8.5	214	Food, medicine, pest control *etc.*
Class. Aves	9,670	1,228	12.7	?.	Pest control, food, tourism *etc.*
Class. Mammalia	4,629	420	9.1	36	Nameer (2000)

2.2 REASONS FOR SPECIES LOSS

2.2.1 Habitat loss

Among the reasons cited for species loss, habitat loss is the most frequently cited; in fact the relationship is so strongly related that it is perhaps tautological to cite habitat loss as the reason for species loss; they are one and the same. What is meant by habitat loss often is, however, the loss of wooded forest. Forest loss in India predates that in most other tropical countries. For example, by 1950's most of the clear-felling of rainforest in the Western Ghats had already taken place, while several Asian and South American countries had a forest cover exceeding 75%. It has been estimated that between 1920 and 1990 (in reality between 1920 and 1980), the forest cover in the Western Ghats decreased by as much as 40% with a fourfold increase in the number of forest patches or fragments (Menon & Bawa 1997). The monitoring of forest cover by the Forest Survey of India (in terms of canopy cover) shows that there has been little loss in the last decade or more (Table 1.2). Although this estimate has been a subject of considerable criticism on methodological and ecological grounds, there are no other estimates even for one year. The current forest cover in the country is estimated to be about 20%, although other assessments report it as low as 10%.

Shifting cultivation or *jhum* has become a major threat to wild animal diversity in many parts of northeast India, especially with progressive reduction in the cultivation cycle length. In Manipur State, *jhum* covers nearly 1,800 sq.km or 8.2% of the geographical area of the State, and in Assam *jhum* nearly 2,600 sq.km (Choudhury 2001). *Jhum* and encroachment have been responsible for a substantial reduction of forest cover in most northeastern states; for example from 33.1% in 1980-82 to 18% in 1993 in Meghalaya (Choudhury 2001; FSI 1993, 1995, 1997). Parts of Andhra Pradesh are being subjected to *jhum* (Subba Rao *et al.* 1997).

Encroachment of forestland is also major reason for habitat loss; currently about 7,000 sq.km of forestland is estimated to be under encroachment which has especially high in Assam, Madhya Pradesh and Kerala (Singh & Vishwakarma 1997).

It is also noteworthy that there are important non-wooded habitats such as hot and cold deserts, and inland wetlands the monitoring of which has not been covered by the Forest Survey of India. India currently has about 58.2 million ha of wetlands (which forms nearly 18% of the country), of which nearly 12.8% is under paddy cultivation, and only

5.5% are typical wetlands (Gopal 1994). These wetlands support nearly 20% of species found in India, either exclusively or partly (Gopal 1994, 1995; Alfred & Nandi 2000). Unlike forested habitats, there has been a significant increase in the spread and number of wetlands in India due human activities; it is estimated that 2.5 million ha of wetlands are man made, either as large reservoirs (1550) or small tanks (100,000) (Gopal 1994). Even by the early 1980's nearly 45% of the natural inland wetlands in India had been threatened one way or the other (Scott & Pole 1986). However, the extent of loss of wetlands is not known. The loss of desert (for example to plantations of *Prosopis* or to agriculture following canal irrigation) has not been documented.

To what extent habitat loss has already caused species extinction is surprisingly little documented. Known extinctions are that of the cheetah, mountain quail and pink-headed duck. It is debatable whether these have been due to habitat loss *per se* or also because of poaching. Some species of mammals and several lower vertebrates, not to speak of invertebrates, have not been sighted for the last several decades, often after the type description. There have been several 'rediscoveries' in the last decade, the well-known ones being Jerdon's courser, Forest spotted owlet, Malabar civet (only from skins), and golden gecko. These rediscoveries suggest that lack of sightings might be primarily due to lack of effort.

That habitat loss has vastly reduced and fragmented populations of several hundred species is indisputable, although little quantified. For example, the Asiatic lion, reported from near Delhi in the mid-1800's and central India in early 1900's, is now confined to a single locality. Tiger, which numbered a few tens of thousands in the 1800's, is now reduced to less than 4000 animals. The Asiatic elephant has had a similar fate (Venkataraman *et al*. 2002). A simple application of island biogeographic theory suggests that species loss initially lag behind habitat loss. "The time delay before extinction makes more species threatened than have already become extinct" (Pimm & Raven 2000). Thus, the extensive loss and fragmentation of forested habitat have probably set the stage for extinction, rather than have caused it already.

The loss of species due to the loss or degradation of wetlands is little documented. The well-known example is that of the Siberian crane which has almost stopped its winter visit to India, although the reasons are as yet unclear. The loss of sea grass beds is reported to be a major reason for the disappearance of the dugong from most of its range in India.

Table 1.2. Forest cover (in sq.km) reported for five years between 1989 and 1997. Source Forest Survey of India, State of the Forest Reports, taken from http://envfor.nic.in/nfap/facts-index.html

STATE	1989	1991	1993	1995	1997
Andhra Pradesh	47,290	47,290	47,256	47,112	43,290
Arunachal Pradesh	69,002	68,757	68,661	68,621	68,602
Assam	24,832	24,751	24,508	24,061	23,824
Bihar	26,668	26,668	26,587	26,561	26,524
Delhi	22	22	22	26	26
Goa	1,255	1,255	1,250	1,250	1,252
Gujarath	11,921	11,907	12,044	12,320	12,578
Hariyana	513	513	513	603	604
Himachal Pradesh	12,480	12,480	12,502	12,501	12,521
Jammu & Kashmir	20,449	20,449	20,443	20,433	20,440
Karnataka	32,104	32,199	32,343	32,382	32,403
Kerala	10,292	10,292	10,336	10,336	10,334
Madhya Pradesh	135,541	135,541	135,396	135,164	131,195
Maharashtra	44,044	44,044	43,859	43,843	46,143
Manipur	17,685	17,685	17,621	17,558	17,418
Meghalaya	15,645	15,875	15,769	15,714	15,657
Mizoram	18,170	18,853	18,697	18,576	18,775
Nagaland	14,399	14,321	14,348	14,291	14,221
Orissa	47,227	47,205	47,145	47,107	46,941
Punjab	1,338	1,343	1,343	1,342	1,387
Rajasthan	12,884	12,889	13,099	13,280	13,353
Sikkim	3,041	3,041	3,113	3,127	3,129
Tamil Nadu	16,992	16,992	17,005	17,045	17,064
Tripura	5,535	5,535	5,538	5,538	5,546
Uttar Pradesh	33,627	33,609	33,961	33,986	33,994
West Bengal	8,015	8,015	8,186	8,276	8,349
A & N island	7,622	7,622	7,624	7,615	7,613
Chandigarh	5	5	5	7	7
Dadra & N. Haveli	206	206	206	204	204
Daman & Diu	-	-	-	-	3
Lakeshadweep	-	-	-	-	-
Pondicherry	-	-	-	-	-
GRAND TOTAL	638,804	639,364	639,386	638,879	633,397

2.2.2 Hunting, poaching, harvesting

Hunting or live harvesting of animals for local consumption or trade, rampant till the Wildlife (Protection) Act 1972, has been attributed to be the major factor for the reduction of populations of several species (large carnivores, some primate species, water birds, turtles, crocodiles *etc.*). Rangarjan (1996) gives a historical account of the central Indian region. Following the ban on hunting imposed in 1972, several species apparently bounced back, some with restocking (*e.g.* mugger crocodile). Poaching, however, was never under strict control, moving its focus from one part of the country to another like a spotlight. Although poaching is now feared to threaten the survival of even species such as elephant and tiger, quantitative data on the incidence of poaching and associated trade are non-existent (Anon. 1994). In 1996-98 at least 253 elephants were poached in India (Menon & Kumar 2001). The selective removal of tuskers over a short period have major impacts on the adult ratio of Asian elephants in the Western Ghats, affecting their reproduction for several years (Sukumar *et al.* 1998). Although small and isolated populations of tiger can survive relatively low incidence of poaching, this combined with poaching of their prey base (or reduction their density due to other reasons such as grazing) can drive same population to extinction (Karanth & Stith 1999). In fact, low prey density due to poaching is thought to be the main reason for the absence or low densities of tigers in many parts of its 300,000 sq.km of otherwise potential habitat (Wikramanayake *et al.* 1998; Karanth & Stith 1999). Carnivores such as the tiger and leopard with overlapping prey base interact in complex ways depending on the changes in the relative abundance of different prey species (Seidensticker *et al.* 1990; Karanth & Sunquist 1995). Such changes can come about through the synergistic action of poaching, habitat degradation and cattle grazing. Hunting is still a major pressure on wild animals in northeast India, for example Mizoram (Mishra *et al.* 1998). It should also be noted that small populations, resulting from habitat loss and fragmentation, are far more susceptible to local extinction from poaching, than large populations.

Many incidences of poaching have been attributed to intentional poisoning or snaring, to get rid of animals which lift cattle (large carnivores), raid poultry (small carnivores), or crops (elephants and pigs), and not necessarily for consumption or trade. For example, in Nagarjunasagar Tiger Reserve nearly 20 tigers were poisoned in the last few years due to rampant cattle lifting (WWF 1999)

In the marine ecosystem, over harvesting has begun to deplete the stock of many species of fisheries, especially in the west coast following the introduction of trawlers. This has been well documented in several publications of the CMFRI (homepage, Ventakaraman 2001, for a recent review). The CMFRI also maintains a database of marine fisheries statistics. The value of marine fisheries at the consumer level is estimated at Rs. 20,000 crores (1999-2000) and export earnings at Rs. 6300 crores (2000-01); 85% of the catch is for internal consumption. Marine fishermen household number about 0.5 million (in 1999). It is estimated that due to over-harvesting, the per capita production per active fishermen declined from 3250 kg in 1980 to 2240 kg in 2001 (source CMFRI homepage). However, decline in catch or conservation status at species or other taxon level has been rarely assessed. An example is that of sea horse. India is one of the largest exporters of sea horse, at least 3.6 tonnes (approximately 1.3 million animals) per year, contributing to about 30% of the global sea horse trade (Vincent 1995) although most of the sea horses in the Indo-Pacific area are in the IUCN Red List. This exploitation has led to a decline of the sea horse population by 25-75% (Sreepada *et al*. 2002).

Similarly, the over-harvesting has been well established in freshwater bodies. For example, there has been decline in total fish yield in the middle stretches of Ganga from 50.3./kg/ha/year in the sixties to 22/kg/ha/year (Paul 1998). Incidental catches and subsequent poaching has been a major reason for the drastic reduction in the population of dugong in the Gulf of Mannar. This also poses a threat to the marine turtles in the east coast. Freshwater turtles have also been affected by poaching (Bhupathy *et al.* 2000). The Gangetic dolphin, a fresh water mammal, is also threatened by incidental catch (Lal Mohan 2001)

2.2.3 Reduction of habitat quality

Species loss and population reduction due to reduction in habitat quality has been little addressed. Although degradation of forested habitats due to cattle grazing and fuelwood removal has been often reported to cause population reduction in ungulates, there are very few quantitative studies to support this. A drastic increase in wild ungulates and the Asiatic lion has been reported from Gir following removal of domestic cattle (Johnsingh & Ravi Chellam 1991; Singh 1997). The impact of pastoralism on wild ungulates and their habitat in the Himalaya has been a subject of study as well as debate (Saberwal 1996, 1998; Mishra 1997; Mishra & Johnsingh 1996; Mishra & Rawat 1998). These studies suggest that traditional landuse, including grazing, could enhance conservation objectives (Mishra

& Johnsingh 1996; Mishra & Rawat 1998). However, socio-economic changes have had major impacts on the traditional landuse and pastoralism, and these in turn have major consequences for conservation (Mishra 1997). Vijayan *et al.* (1999) reported that disturbed habitats in the Nilgiri Biosphere Reserve have low bird species diversity and fewer endemics. Vasudevan (2001) and Ishwar (2001) have shown that disturbance can drastically alter the herpetofaunal assemblage in rainforest fragments in the Western Ghats, with the endemics being adversely affected.

Changes in habitat quality and their impact on the freshwater fauna have been little investigated, although this is a habitat that has been the most adversely affected. For example, there has been a several fold increase in the use of pesticides in the Nilgiri district, the impact of which on birds and fishes is being assessed (Muralidharan *in prep*.). Preliminary results indicate no alarming residue accumulation in birds or fishes (Muarlidharan *pers. com.*). Pollutants in the rivers have been reported to cause chromosomal aberrations in fish (Sudarsanam & Ouseph, 1997). The decline in the abundance of several species of amphibians in several parts of the world has been reported to be at least partly due to pesticides, the other potential reasons being disease and increased UV radiation, and global warming. However, no attempt has been made in India to monitor amphibian populations.

Sand mining in rivers is a threat to several species *e.g*. Gangetic river dolphin (Lal Mohan *et al.* 1998).

In the marine ecosystem, the nuclear power plants located in the coast has led to biofouling which is a threat to both the biodiversity as well as to the power plant (*e.g.* Jesudoss *et al.* 1997 a & b). Similarly, proposed oil exploration pose a threat to the Olive Ridley turtle in the Orissa coast (Times News Network, March 06, 2002). Pollution in ports is reportedly the major reason for differences in the composition of several marine taxa (CMFRI homepage), although there are no quantitative data.

2.2.4 Dams and barrages

There are about 1550 large man made reservoirs in India (Gopal 1994), formed by damming rivers. This is reported to be a major threat to several species of fishes and at least one mammal, the Gangetic dolphin, by blocking their seasonal migratory routes. Nearly 16% of the freshwater fishes are threatened by damming of rivers (Molur & Walker 1998), including some popular game fish like hilsa, *Tenualosa ilisha* (De *et al.* 1994). In addition, damming is also reported to be a major reason for the possible extinction or

drastic reduction of population of several hill stream fishes due to the loss of their microhabitats. It is very likely that several species of amphibians would also have been affected in the Western Ghats, where most of the amphibians require running streams for breeding, and pond breeding species are very few.

2.2.5 Introduction of exotics

The freshwater fishes have been perhaps the most affected by the introduction of exotics not only in India but also elsewhere in the world. The introduction of exotics into the wild goes back to 1847, and five species of carps were introduced by the CIFA in 1939 and several other species in later years (Paul 1998). These introductions of exotics into the rivers and reservoirs have had a disastrous consequence on the native fish which is still to be documented. In the Western Ghats introduced fishes, often excessively stocked for improving fisheries production, have been a major reason for the decline in the population of several species of endemics in reservoirs (Unnithan 2000). In Thirumoorthy reservoir in the Anamalai Hills (Tamil Nadu), for example, the contribution of endemic species to fishery declined from 19.2% (4-5 kg/ha/year) during 1978-82 to insignificant levels by 1993-94 (Unnithan 2000). The loss of Schizothoracine fishes in the Kashmir valley and several native species in the Loktak lake due to the introduction of exotic common carp are other well known examples.

The intentional or accidental introduction of exotic plants such as water hyacinth, *Eupatorium* (*Chromolina*), *Lantana* and *Parthenium* has had major impacts on wild animals which are widely recognised, but seldom quantitatively documented.

2.2.6 Use of pesticides

Large-scale mortality has been reported in recent years due to the ingestion of pesticides, especially among birds such as peacock, Sarus crane (Vijayan 1991; Muralidharan 1993), and vultures. A recent survey reported more than 90% decline in vulture population throughout the country (Anon. 2000b). It is not clear whether the decline is due to pesticide contamination, disease, intentional poisoning or lack of food (see Katzner & Parry-Jones 2001). The drastic decline in some of the very common birds in India (and elsewhere) is a cause of serious concern. For example, the population of house-sparrow has undergone a 53% decline in UK over 25 years (1973-98); similar declines also have occurred in many other species (Hole *et al.* 2002; www.bto.org). Although the reasons are far from clear, it is suspected that decreased abundance of invertebrates due to pesticides,

vehicular pollution (possibly linked to unleaded petrol), and the lack of nesting sites in modern buildings are all responsible, probably in combination. A similar decline in several common rural and urban birds is now suspected to be occurring in India (Vijayan 2003). This decline is not only a threat to the birds, but also an indicator of serious environmental hazards that human beings are unwittingly facing.

2.2.7 Accidental mortality

There has been increasing incidence of accidental mortality of animals belonging to endangered species due to variety of reasons such as electrocution from high tension powerlines, train hits, road kills and trawlers and power boats. There has been no documentation of these except in newspapers or internet. Examples include (a) death of four elephants in 2001 in the Periyar Tiger Reserve due to electrocution from high-tension powerlines which pass through the Reserve; similar deaths have been reported in Nelliampathy hills. Deaths due to powerlines in the forest boundaries is also not uncommon, but rarely reported; (b) repeated train hits in the Delhi-Dehra Dun route which have led to the deaths of several elephants in the last decade; (c) apart from incidental catch in fishing nets, mortality due to propeller hits from ships, trawlers or power boats has been reported in the case of several species of dolphins and whale, dugong, and turtles; *e.g.* Irrawady dolphin in the sea as well as Chilika lake and Olive Ridley turtle in Orissa coast. According to Dr R K Sinha (chairman of Asian River Dolphin Committee), about 15 dolphins were killed in Chilika lake alone during the last two years, out of about 50 animals in the lake (*Pioneer* Newspaper report); (d) road kills are a major mortality factor in the case of several species of small mammals and herpetofauna, especially in the Western Ghats and northeast India where these taxa show high species richness and endemism. Such kills can have an unexpectedly high impact on the population since most of it occurs during dispersal (Kumara *et al.* 2000; Vijayakumar & Vasudevan 2001; see also Hels & Buchwald 2001).

2.2.8 Other factors

Several factors other than the above have had or are predicted to have major impacts on animal diversity. The most documented one in recent years is the massive bleaching and mortality of coral reefs due to El Niño effect (Brown *et al.* 2000), including in India (Arthur 2000a). About 19% of coral reefs of the world suffered massive mortality due to the El Niño of 1998 (Wilkinson *et al.* 1999). The El Niño Southern Oscillation (ENSO)

raised the surface temperatures of tropical oceans by about 3.5ºC above normal. The reefs in the Gulf of Kutch had 11% of coral bleached, but without any significant morality. In Lakshadweep and Gulf of Mannar, bleaching was as high as 82% and 89%, and mortality 26% and 23%, respectively (Arthur 2000). Reefs in other areas in the same region are also reported to have suffered a similar mortality (McClanahan 2000). By 2001, three years after the bleaching, the recovery of coral in Lakshadweep was variable and patchy (Arthur 2001).

Special mention should be made of climate change since recent studies have projected massive species losses very much within this century. Moreover, at least some of the predictions have been validated. For example, there have been early blooming of trees in Eastern Europe, northward shifting of range in butterflies in North America, and tropical birds have moved upslope (Hughes 2000). In South Africa, it is predicted that by about 2050, five parks would loose nearly 40% of their plant species (Rutherford *et al.* 1999). Similarly, the Great Basin region in the United States would loose 9-62% of the mammal species found there at present! An analysis of results from 143 studies has revealed that a significant impact of global warming is already discernible in several species ranging from molluscs to mammals, and in plants (Root *et al.* 2003). There is thus an urgent need to integrate climate change into biodiversity conservation (Hannah *et al.* 2002).

A related threat is the increased UV radiation due to ozone depletion to which some taxa are particularly sensitive; *e.g.* amphibians (Alford & Richards 1999; Dalton 2000; Houlahan *et al.* 2000).

The impacts of global warming and ozone depletion on India's biodiversity have not been addressed.

2.3 THREAT STATUS OF INDIAN FAUNA

2.3.1 Recent assessments

Considerable effort has gone into the assessment of the conservation status of Indian fauna in the past five years. As a result, India is among the few countries that have assessed the conservation status of most of their vertebrate fauna at the national level, although these assessments are based on scant information. The following are the major efforts at conservation assessment of Indian fauna.

2.3.1.1 Biodiversity Conservation Prioritisation Project

An assessment and prioritisation of species for conservation was an important goal of the Biodiversity Conservation and Prioritisation Project (Singh *et al.* 2000). The objectives of this part of the project were to:

- Provide an assessment of the conservation status of Indian species in selected taxa that is based on the best information available, published and unpublished;
- Provide information on the threats faced by each assessed taxon that form the reasons for their conservation status;
- Provide complete documentation of the information that form the basis of the assessment; and
- Provide an assessment of the lessons learnt during this rapid assessment of conservation status and of the reliability of the methods and process.

The number of species in the taxa, prior or ongoing attempts at similar assessments, information availability, and constraints of time were considered while selecting the taxa for assessment. Mammals, reptiles, amphibians and freshwater fishes were selected during the Project Design Workshop itself. Soil and aquatic invertebrates, and mangrove organisms were also selected later following discussion among the resource persons.

The Project Design Workshop also recommended that the revised IUCN criteria and categories be applied to evaluate the conservation status of species, since these 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 the most recent published and unpublished information, and participation of the relevant experts.

Six CAMP workshops (one each on medicinal plants; soil and aquatic invertebrates, Amphibians, Reptiles, mangrove organisms, and mammals) were conducted between January and August, 1997, and 1391 species were assessed (Kumar *et al*. 2000).

2.3.1.2 National Bureau of Fish Genetic Resources

NBFGR, independently of BCPP, held a CAMP workshop on freshwater fishes in 1998, when 323 species were assessed using the revised IUCN criteria (Molur & Walker 1998). About 400 resource persons from more than 100 organisations, participated in the assessment by BCPP and NBFGR, showing the wide participation the CAMP workshop process has been able to achieve.

2.3.1.3 Assessment of Indian Avifauna

Salim Ali Centre for Ornithology and Natural History (Coimbatore) coordinated an assessment of the Indian avifauna, under a project to assess the Asian fauna that was carried out by the BirdLife International. Although the revised IUCN criteria were used, an expert and literature consultation method was followed taking into consideration the vast literature that was available on avifauna.

2.3.1.4 Zoological Survey of India

The old IUCN criteria formed the basis of the assessment that the ZSI carried out during late 1980 and early 1990's (ZSI 1994).

2.3.2 Threat status

As was mentioned earlier, India is one of the very few developing countries that have carried out an assessment of most of their vertebrate taxa, although based on scant information. However, almost all the invertebrate taxa remain to be assessed. Moreover, there are several limitations on a species based assessment of the invertebrate taxa, such as very high species richness, severe lack of information, and taxonomic issues. A summary of the assessment carried out during the last five years is given in Table 1.2.

Table 1.2. Summary of conservation assessment of Indian fauna carried out by BCPP and NBFGR during 1997-98: 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). The list of species under different categories is given in Kumar *et al.* (2000).

Order	CR	EN	VU	LR-nt	LR-lc	DD	NE	Total evaluated
Soil Invertebrates	18	23	16	13	14	10	1	95
Amphibians	10	42	46	57	8	39	5	207
Reptiles	34	54	80	100	64	134	30	466
Mangrove Invertebrates	1	5	4	17	14	-	1	41
Fishes	-	1	9	41	-	-	-	51
Birds								
Mammals	22	33	60	76	64	115	21	373
Freshwater fish	45	91	81	66	16	26	-	323

The results from this assessment show that species in the lower taxa are at greater extinction risk (50% to 72%, for lower vertebrates), than mammals (41%) and birds (8%?). An assessment of their conservation status based on however little data has made us aware of the nature and magnitude of the problem. In general, the assessment brought to light the need for data that is appropriate for an assessment to be made, even for the relatively well-known taxa.

2.3.3 Reasons for endangerment

In amphibians and reptiles restricted distribution, habitat fragmentation, along with reduction in habitat quality were considered the reason for endangerment of more than 70% of the threatened species. The reduction in habitat quality 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.

Population decline due to harvesting was the reason for the threatened status of only five species of amphibians (*e.g. Hoplobatrachus tigerinus*), and of 17 species of reptiles. The latter included four species of marine turtles (*Dermochelys coracea, Lepidochelys oilvacea, Geoclamys hamiltoni* and *Handella thurji*) and nine species of inland 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, and for medicinal use in the case of *Uromastyx hardwickii*.

Among the 10 threatened fishes of mangrove, population decline from excessive harvesting was a major threat to six species. 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 were not available. There was also some concern that the available data might not be a good indicator of population change.

Restricted distribution and reduction in habitat quality were the major reasons for the threat status in fresh water fishes, especially hill stream fishes. Population decline due

to overharvesting was a threat to many species, especially those in the plains. The decline in habitat quality has been mostly due to damming, siltation, pollution, use of poisons *etc*.

In mammals, restricted distribution, population fragmentation and decline in habitat quality are the major factors for nearly 50% of the 94 threatened species, especially small mammals and bats. Hunting for trade (including animal parts) was a major factor in 21 species; 7 carnivores, 4 each of 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).

2.3.4 Comparison with global assessment

A comparison of the above assessment with that of IUCN (1996) is possible only for mammals, since birds were not 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 assessed as threatened under this project. There is thus considerable overlap between both the assessments. However, only 43.0% (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 categories 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 (45.3%) was higher than the assessment by IUCN for mammals of the world (30%). This is mostly due to the national assessment of many species, and also because of the inclusion of 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. A comparison with the most recent assessment by IUCN (IUCN 2000) is yet to be done.

Thus a quantitative assessment of the threat status and reasons for endangerment shows that most of the freshwater fish, amphibians, reptiles and small mammals are threatened due to their restricted distribution (which make them naturally vulnerable), habitat fragmentation, and reduction in habitat quality. The reduction in habitat quality results from the degradation of forest fragments, pollution, use of pesticides and fertilisers, siltation, and damming of rivers. In contrast, many of the larger mammals are also under threat from hunting (including for trade), although some of the reptiles are also under threat due to this reason. Accidental catch in fishing nets is a threat to some species such as dolphins and marine turtles.

Detailed information on individual species that were assessed as a part of BCPP is available elsewhere; fishes (Molur & Walker 1998a), amphibians (Molur & Walker 1998b), selected soil invertebrates (Daniel *et al.* 1998), mangrove organisms (Rao *et al.* 1998), mammals (Molur *et al.* 1998), and reptiles (Molur & Walker 1998c).

3 CRITICAL INFORMATION GAPS

3.1 THE NEED FOR EASILY ACCESSIBLE INFORMATION

Spatially and temporally referenced species data (taxonomy, locality, distribution, conservation status, and population to name a few) are critical to conservation. Availability of such data in a structured format and in public domain is equally critical, to enable verification, decision-making, conservation management, and scientific analysis to generate new information. It also facilitates the preparation of education materials, and environmental impact assessments. Taking these into consideration, several nations (*e.g.* ERIN of Australia) have developed species database which can be used together with other database on land use, socio-economics, protected area distribution, *etc.* Besides, several international agencies have also developed species database for specific purposes (*e.g.* SPECIES 2000, GROMS and FISHBASE).

The lack of such a readily accessible database has been a major constraint in the conservation of Indian species at every stage, especially in the following critical areas:

- Data on taxonomy, locality records, distribution, and population have been the single major constraint in assessing the conservation status and protected area coverage of species and populations.
- Data on habitat preferences and population trends and threat processes (*e.g.* trade-related) have handicapped conservation plans for species.
- The lack of accessible information on conservation status of species and their distribution data has also handicapped EIAs.
- The generation of public support for conservation has been constrained by the lack of compiled data in the public domain.
- Identifying and strengthening key information holders has also been severely handicapped due to the lack of compiled information in a common format.
- Finally, the lack of compiled data has been a severe constraint in evaluating the nature and extent of information that is available on species, and the major gaps on which research effort should be spent.

3.2 AN ANALYSIS OF INFORMATION AVAILABILITY

The availability of information was assessed with reference to 285 research projects on the wild fauna in the Western Ghats, the best studied biogeographic zone in India (Vijayan *et al.* 1998). As expected, nearly 50% of the projects have been on mammals, in fact on medium to large mammals, followed by birds (Figure 3.1). The lower vertebrates and invertebrates have received very little research attention. An examination of nearly 100 research projects on mammals shows that a disproportionately high number of research projects has been carried out in the Kerala, compared to its geographical area, where as in Karnataka very little research has taken place, considering its area. It is also evident that very few research projects have covered two or all three states (Figure 3.2). Even among the mammals, the most studied taxa, most of the research projects have been of a general survey nature (Figure 3.3). Only two species, the elephant and lion-tailed macaque, have received considerable research attention at the species level and accounts for most of the ecological studies.

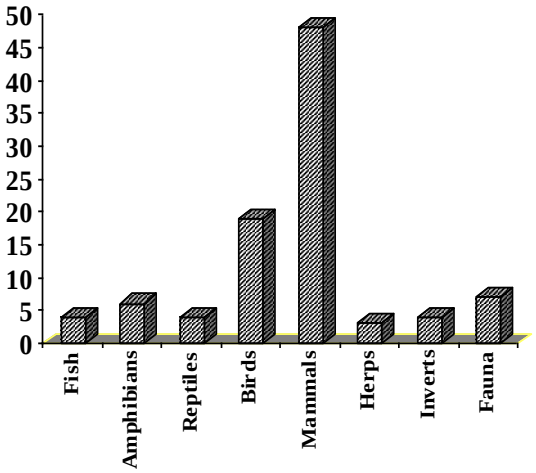


Figure 3.1. The percentage of research projects on various taxa in the Western Ghats during 1980-95 (source Vijayan *et al*. 1998)

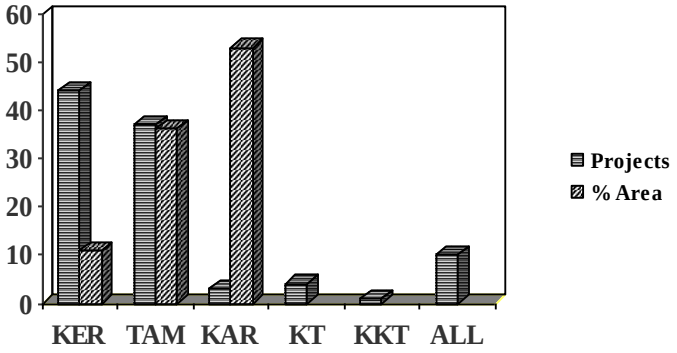


Figure 3.2. A comparison of the %age of research projects on mammals in three south Indian states, in relation to their %age area, during 1980-95. KER=Kerala, TAM=Tamil Nadu, KAR=Karnataka, KT=Kerala and Tamil Nadu, KKT=Karnataka Tamil Nadu, ALL=All three states. Data source (Vijayan *et al.*1998).

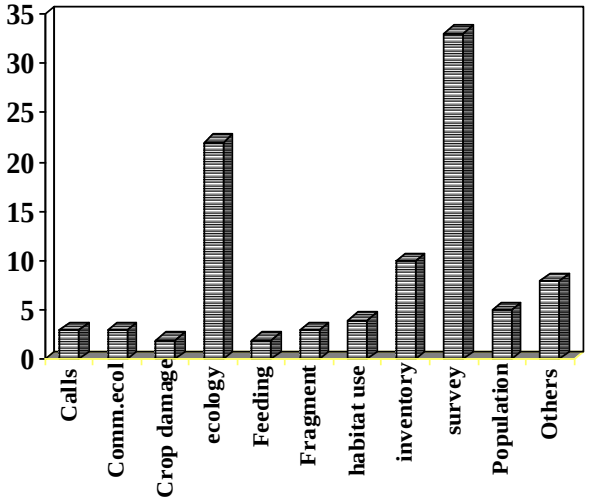


Figure 3.3. The %age of research projects on mammals in the Western Ghats in different subject areas, during 1980-95 (Source Vijayan *et al.* 1998).

A similar pattern emerges also out of the research projects carried out by the Wildlife Institute of India, of regional, taxa, and subject biases, in favour of Central India, large mammals, and surveys (including ecological surveys), but very few studies on invertebrates, marine taxa, islands and northeast India (source Research Projects, unpublished data).

There has been a considerable increase in the information available on freshwater fishes in recent years, especially of the Western Ghats (*e.g.* see Ponniah & Gopalakrishnan 2000). Considerable information also exists on annual harvest of marine fisheries, but not on the conservation status (see CMFRI publications, also review by Vivekanandan 2001a, b, c). Although a decline overall catch is obvious, species wise data are not available.

Studies on invertebrates have been primarily done by the Zoological Survey of India, often in the form of inventories at relatively large spatial scales (such as states) therefore containing no ecological information. The list of publications by the ZSI up to 1995 does not contain any publication on invertebrates of the Western Ghats (Daniels 2001).

A recent analysis of publications has shown that, globally, some mammalian orders receive more attention than what is due based on the number of species or percentage of threatened species. Moreover, geographic differences also often do not reflect conservation priorities (Amori & Gippoliti 2000). Thus research funds as evidenced by publications have been primarily focussed on very few taxa, reflecting neither endemism nor their threat status. This appears to be true for India also (see Sodhi & Liow 2000, for an analysis of Southeast Asia).

3.3 INFORMATION NEEDS: RAINFOREST FAUNA IN INDIA

An assessment of the information that is available on rainforest fauna in India and research priorities was undertaken during a two-day workshop on this subject in February 2001, held at State Forest Service College, Coimbatore. Nearly hundred researchers and forest managers attended the workshop, which was funded by the Ministry of Environment and Forests, Government of India. Particular attention was paid to the invertebrate fauna. The proceedings of this workshop are being published separately. A summary of the major recommendations of the workshop is given below. Many of the recommendations on identifying research needs and the incorporation of research findings are also applicable to fauna in other ecosystems.

3.3.1 Recommendations of the workshop on research priorities in rainforest fauna

- Lower taxa such as invertebrates and lower vertebrates are much more patchily distributed than the higher vertebrates such as birds and large mammals. Therefore, a protected area network and other conservation action modeled on the distribution of the higher vertebrates might not work for the lower taxa.
- There is considerable medicinal use of wild animals, especially lower vertebrates and invertebrates, which have been little documented.
- Some invertebrate taxa in rainforest with high levels of endemism (*e.g.* Agromyzidae) are highly sensitive to even moderate levels of disturbance, compared to vertebrates.
- More studies and discussions are needed on people-forest interface, especially on issues such as benefit sharing and sustainable use.
- Recommendations following research should be as quantitative as possible, rather than general statements.
- Internet is now accessible to most protected area managers. Therefore, database on scientists in different fields, species information (distribution, abundance, threats, trade *etc*.), and other conservation issues (*e.g.* relevant laws, policies) should be of great use to the protected area managers in taking decisions and implementing them.
- There should be mechanisms to disseminate relevant information to different protected area managers after periodic review of scientific literature.
- Research proposals and reports, as well as the preparation of protected area management plans should be discussed among scientists, forest managers and local communities.
- Forest managers should identify and prioritize critical information needs, and include them in the management plans so that researchers can include these into their research agenda. However, such prioritization should be accompanied with funding. To the extent possible, each protected area should fund its own research priorities. Otherwise, researchers' own agenda and the priorities of other funding agencies would drive research.
- The above prioritization of critical needs in protected areas should in no way hamper other research which may or may not have management relevance. It must be understood that research for understanding biological, ecological and other processes is one of the objectives of protected areas. Such research, therefore, needs to be promoted regardless of their management relevance.

- A separate centre for biodiversity research in rainforest should be established, considering the high species richness and endemism in this forest on the one hand and low research attention and funding that it has attracted till now.
- There is a need to encourage species documentation, ecological survey and inventorying with accurate spatial reference, for most taxa. This is the most fundamental information that is needed in many areas of conservation, and which is lacking for most taxa.
- Conservation of invertebrates has received very little research attention and funding, and publications have also been very few. This is in sharp contrast to the funding that invertebrate pests have received. It is perhaps better, therefore, to focus our conservation attention on invertebrates of importance to people.

3.4 CONSTRAINTS DUE TO LACK OF SPECIES INFORMATION

A rapid analysis of data shows that information availability might be a major constraint in species conservation. Some examples are given below:

- **Species documentation:** The most basic information about a species is a documentation of its existence. Various estimates have been reported on the number of species that remain to be detected in the world. In India, species documentation seem to be far from complete even for lower vertebrates! For example, several new species (may be as high as 110) have been or are being discovered in the Western Ghats (Biju 2001) and northeast India. An analysis of publications during the last 2 decades show that species documentation has been the major activity in species studies (unpublished data). In fact, most of the research projects in the Western Ghats have been of a documentation-inventory nature, the most basic form of research needed for species conservation (see above).
- **Locality records:** A rapid analysis of the data compiled for the conservation assessment of species as part of the BCPP shows that a vast majority of even vertebrate species are still known only from very few specimens. This shows that locality records are far from complete for amphibians, reptiles and even many mammals (Figure 2.4). Freshwater fishes also show such a pattern, while it might be worse for most invertebrates. The situation might be better for birds due to the availability of checklists prepared by bird watchers in many parts of India. What is surprising is that nearly 40% of the mammals are known only from less than 10 localities, primarily due

to the lack of information on bats and rodents which together form nearly 50% percent of the Indian mammalian fauna. This is a major constraint in developing species distribution maps, assessment of protected area coverage, evaluating changes in distribution *etc.*

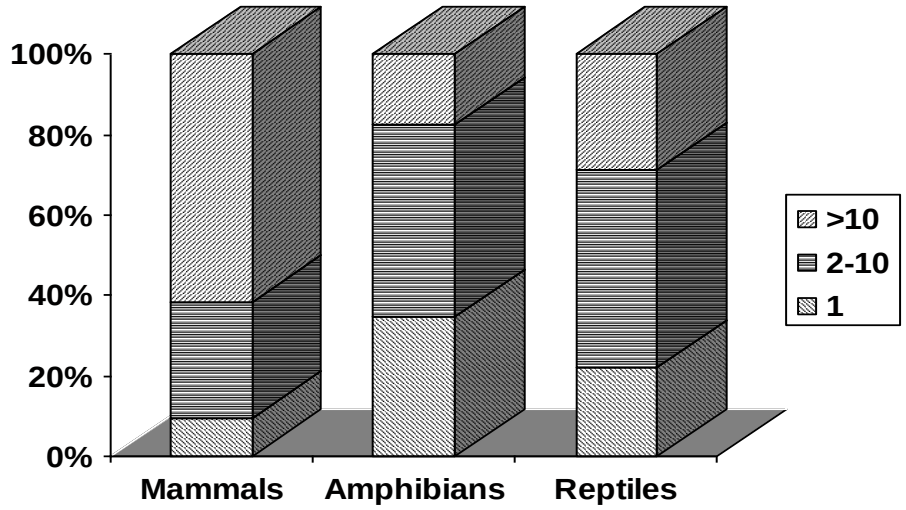


Figure 3.4. The number of localities from where different species of mammals, amphibians and reptiles have been reported in India (source BCPP).

- **Ecological information**: Higher order research dealing with habitat preferences, life history, feeding and population, either at the community level or species level have been very few even in the Western Ghats, one of the best studied ecosystems in India. Similarly, research on poaching and trade in wildlife parts has been virtually non-existent.
- **Research funding**: The allocation of funds for research by the Government (Central and State) in the three states in which the southern Western Ghats fall, has not shown any preference for this ecosystem well known for its species richness (unpublished data). It is not, therefore, very surprising that our knowledge base on Indian fauna is still in the most primitive state, that of documentation and inventory.
- **Conservation status**: Despite the above limitations, an assessment of the conservation status of most of the Indian vertebrates has been completed during the last five years,

using the revised IUCN criteria. The information constraint was to some extent overcome using the CAMP workshop process in the case of fishes, amphibians, reptiles and mammals. However, this was driven more by expediency than science, the best perception among scientists leading to hypothesis, in the hope that this would stimulate its testing by gathering appropriate information. The assessment of birds on the other hand was based on more quantitative information.

- **Threat processes**: Information on threat processes operating on a species is necessary to prepare and implement appropriate threat reduction and recovery plans. One of the advantages of using the revised IUCN criteria in conservation assessment of species is that the identification of threat processes forms an integral part of the assessment. Considering that the conservation status most of Indian vertebrates has been assessed using these criteria in the past five years, the threat processes operating on them have also been identified, although these are based the scant information that currently exist.

3.5 STRATEGY AND ACTION PLANS

Strategy 1: Develop a public domain database which would provide compiled information on faunal species critically needed for policy making, conservation assessment and management, other scientific analysis related to conservation, EIA, and education. Integrate this database with other database, for example on protected areas, socio-economics, and land use cover to name a few.

A variety of information on species is required at various stages of conservation. These range from the simple documentation of species (that it exists), locality records, distribution, and habitat preferences to more complex information such as life history, feeding ecology, demography, population trends, behaviour, and threat processes operating on them. The use of such information include assessment of conservation status and protected area coverage, habitat protection and restoration, control of poaching and trade, and captive breeding, to name a few. Currently these information do not exist in a form that allows an easy assessment of availability, identification of major gaps, and prioritisation of research agenda for filling these gaps. Moreover, identifying and strengthening key information holders have been severely handicapped due the lack of compiled information in a common format. A systematic compilation of these information, spread far and wide, is therefore a major strategy in conservation of species.

Ongoing activities: A variety of species data is, however, currently spread over numerous institutions, bird watchers' and nature clubs, and even more with individuals and local communities. They also exist in different levels of compilation and in different formats. The information needs also vary considerable among various stakeholders, for example politicians and other decision-makers, managers, scientists, and the general public. Thus, information needs (see Box 3.1 for information needs by the forest department), availability, as well as accessibility vary considerably among various stakeholders. Many institutions have recently developed computerised database of Indian fauna. The scope of such database vary considerably and includes single species (*e.g.* on elephants in Asian Elephant Conservation and Research Centre), protected area inventory (Wildlife Institute of India), district inventory (ZSI), invertebrate taxa (University of Agricultural Sciences, Bangalore), fresh water fishes (NBFGR), marine fisheries (CMFRI), wetlands (SACON), important bird areas (BNHS), Western Ghats (Centre for Ecological Sciences, Bangalore) *etc.* Most of these do not have a spatial reference that allows easy visualisation of data. Several international agencies also have database, some of them spatially referenced, which contain information on Indian species (*e.g.* GROMS, WCMC, IUCN, FISHBASE); many others are under preparation and include Indian species (Global Biodiversity Information Facility, GBIF; Global Amphibian Assessment, GAA).

More over, bibliographies on some taxa are also available, *e.g.* birds (Ashish Pittie *in prep*.), mammals (WII), bats (Zoo Outreach Organisation).

Action 1. *Develop a spatially and temporally referenced species database in the public domain, taking into consideration the need for easily accessible species data and the ongoing efforts at data compilation, nationally and internationally.* Such a database should be developed co-operatively among the major information holders, and in a common format. The database should allow integration with other database (such as land use maps, protected area and topography to name a few), easy visualisation of information, analysis of temporal changes, and storage of textual information.

The major activities would include (a) designing a common format and platform for the database, following discussions and consensus among major information holders and clients, to ensure that the database is demand driven; (b) sharing of responsibilities based on the relative strengths of different organisations; (c) compilation and digitization

of data, within a time framework; and (d) analysis of compiled data in order to identify major information gaps which should be addressed.

Several national and international database such as ERIN, SPECIES 2000, FISHBASE, GROMS, and GBIF provide us with a preliminary structure for the proposed database (see Riede 2000).

Strategy 2: Identify and prioritise major information gaps in species conservation, and develop and implement a research programme to address them.

Although several recent conservation assessments on Indian fauna have made a rapid evaluation of information availability and identified species with virtually no information (see above), a systematic assessment of these is necessary. The development of a national database on wild fauna (Strategy 1 above) would greatly facilitate a systematic assessment of information gaps and research priorities. The preliminary assessment reveals that simple ecological surveys and inventorying, the first step towards well informed conservation measures, need to be carried out for most of the lower vertebrates, invertebrates and marine taxa.

Action 1. *Develop and implement a research programme to address major gaps identified on the basis of current assessment.* These include spatially and ecologically referred faunal inventories of protected areas, reserve forests, coastal and marine areas, and other ecologically sensitive areas (Anon. 2000a). Such information should be in a format that allows easy entry into a database. This information is critical to the assessment of protected area coverage of wild fauna (see Chapter 5).

Action 2. *Capacity building in research institutions:* Last one or two decades have seen a drastic reduction in expertise (especially taxonomy) in quality and quantity, with no recruitment or capacity building in some of the leading organisations entrusted with the task of monitoring India's biodiversity (*e.g.* ZSI). This was seen as a major threat to conservation during the CAMP workshops held as a part of BCPP (Kumar *et al.* 2000).

Action 3. *Provide adequate funding for conservation related biodiversity research:* Although quantitative data are not readily available, conservation research has been only marginally funded by the Central and State Governments. The exception is perhaps Kerala

where state funding has substantially increased the availability of information on wild fauna.

Action 4. *Implement innovative ways of assessing biodiversity:* Given the vastness of the country and complexities in the distribution of species, it is impossible for a few research institutions to conduct surveys on the distribution and abundance of faunal species all over the country, although this information is critical to conservation. Therefore, innovative ways of gathering this information are necessary. There is considerable scope for involving the vast human resource available in schools and colleges for this purpose (see Gadgil 1996, for lessons from such a survey in the Western Ghats).

Action 5. *Identify critical information needs by various sections of the society that are involved in conservation.* The information needs of different sections of the society vary considerably depending on their responsibilities in conservation. For example, the information needed by policy makers might be on a large geographical scale, compared to that needed by a forest guard (Sale 1986). A preliminary assessment of the information needs of the forest managers is given in Box 3.1.

Action 5. *Make a systematic assessment of information gaps after the database on wild fauna has been prepared, so as to promote need driven research.*

Box 3.1. Animal species conservation: Information Needs of Wildlife Managers

The entire hierarchy of the Forest Department, from the Forest Watcher to the Principal Chief Conservator of Forests, can be considered Wildlife Managers. For any intervention concerning the conservation of a species, information of some kind is absolutely essential. This information need vary greatly with the different levels as the job tasks vary. Those at the senior level focus on the landscape level, while those at the basic unit level would be more concerned with individuals or populations, their immediate habitat, behaviour, threats and solutions.

The information needs would also vary with the kind of decision or action to be taken. The present level of information availability is inadequate to undertake serious intervention. Thus often wildlife management merely aims at reducing biotic pressure on the habitat. Five categories of information needed by the Wildlife Managers for efficient management interventions are given below.

Basic Inventory details

Often, the species inventory in an area and the basic details concerning them are not available. The basic questions related to the inventory details are:
What are the species available?
How to identify those?
Where are these found (distribution)?
What is the population size/density of the different species?
Information regarding the presence of sub-species and varieties.

Details of species

Before undertaking any management intervention, some details about the species is essential. Though the term 'behaviour' encompasses the details given below, these are listed to emphasise their importance:
Behaviour details of the species.
Methods to attract, repel, trap, tranquilize and treat animals involved in conflict with humans.
Habitat requirement
Kind of interaction and its level between species
Census technique for the species
Migration – When, why, how, where and how many

Status of species and Habitats

The conservation of the highly endemic and endangered species would be the top priority of any management. Hence it is important to know the comparative conservation status of the different species and habitats. It may also be necessary to know the role of different species in order to evaluate its importance in the ecosystem. Some important taxa to be conserved may be found in different areas and in order to concentrate the efforts in its conservation, the information needed for prioritizing the areas is needed. The list of information needs in this regard is provided below:
What is endangered and to what extent? International/National/State/Local level?
What is endemic? International/National/State/Local?
Are some species more important for the ecosystem (keystone)? If so, what are they?
How do we compare quality of habitats for taxa conservation? (Prioritization of habitats for conservation)

Threats

The identification of threats and its extent to an ecosystem as well the individual taxa is extremely important for undertaking conservation efforts.
Site/Ecosystem specific threats and its extent
Species specific threats and its extent
Likely impacts of threats on various species

How resilient are different species?

How do we assess change and factors? (*e.g.* fire, there are different opinions regarding its role)

Conservation

It is quite clear that any management intervention would favour certain species while being unfavourable to certain other species. Hence it important to identify quickly the impacts on other species when conservation measures are taken for a particular species. It is also important that the methods for evaluation of the conservation efforts on the target and other species are known.

4 IDENTIFICATION OF IMPORTANT SPECIES FOR CONSERVATION

4.1 THE NEED FOR THREAT ASSESSMENT

This is an important issue in conservation because there are several million species, while the resources for conservation are 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.

Several criteria have been used for identifying important fauna for conservation based on their threat status. The most widely accepted is the revised IUCN Red List categories. A major advantage of the Red List categories is that the threat processes are also identified during the assessment. During the past five years the threat status most of the vertebrate taxa in India have been assessed using the Red List categories, although the assessment is based on scant information (Kumar *et al.* 2000; BLI 2001). The CAMP workshop process followed in most of the above assessment has allowed wide participation of knowledgeable people, as well as the use of unpublished information. Thus the species important in the context of conservation, the threat processes operating on them, and the conservation action required have been identified for most vertebrates in India. Most invertebrates remain to be assessed, however. Moreover, periodic re-assessment of vertebrates is also required as more information accumulates and as the conservation scenario changes.

4.1.1 Strategy and action plans

Strategy 1. Assessment of the threat status of species.

In the above background, it is necessary (a) to assess the threat status of taxa which have not been assessed; and (b) to periodically reassess the threat status of all taxa. However, the sheer number of species in some invertebrate taxa (*e.g.* some insect Orders), taxonomic issues in some (*e.g.* corals), and almost complete lack of information might prove major handicaps in a species based assessment of threat status. Assessment of higher level taxa (*e.g.* genera), indicators, and ecosystems (*e.g.* coral reefs) are alternatives. However, the use of such surrogates has major theoretical as well as practical limitations.

Action 1. *Assess the threat status of taxa that have not been assessed.*

It is important that the threat status of those taxa (primarily invertebrates) which have not been assessed is assessed as early as possible. This is particularly important for taxa which have been under enormous pressure from harvesting (*e.g.* butterflies and sea cucumbers). More importantly, the assessment of vertebrates show that the lower organisms (fishes and amphibians in the case of vertebrates) are under far greater threat due to their highly restricted distribution, greater sensitivity to habitat changes, and, for many species, high harvest levels which are often unreported. This assessment should also address the theoretical issues of (a) dealing with extremely species rich taxa; (b) the use of indicators in assessment; and (c) taxonomic issues (*e.g.* coral reefs).

The ideal method would be a series of CAMP workshops, ideally coordinated by one agency in order to ensure uniformity in methodology and processes. CAMP workshops allow wide participation, sharing and rapid compilation of unpublished information, consensus, and joint ownership of the product. The participation of several hundred organisations and individuals (the assessment of vertebrates by BCPP and NBFGR together, for example, involved more than 100 organisations and 400 individuals) is expected in this assessment.

Action 2. *Establish mechanisms for periodic assessment of conservation status of taxa.*

The threat status of species should be periodically re-evaluated since the conservation scenario in the country changes with time. The information availability also changes with time. Such re-assessments would also be a very important tool for monitoring and evaluation of conservation measures. Therefore, it is necessary that mechanisms are put in place to ensure periodic assessment of the threat status of taxa, probably at 10 year intervals. Although some organisations, especially the Zoological Survey of India, are the major information holders in this context, information is also widely spread in hundreds of organisations and individuals. It is therefore necessary that the periodic assessments involve the participation of all information holders.

4.2 FRAMEWORK FOR CONSERVATION OF IMPORTANT SPECIES

Measures to conserve species and their habitats should ideally follow from the threat processes that operate on them. Assessment based on the revised IUCN criteria provides an ideal tool to identify the threat processes acting on each species. Some countries have given legal validity to the threat status based on IUCN criteria (*e.g.* Australia) or similar

other criteria (*e.g.* USA) and also made it mandatory for threat reduction and species recovery plans to be put in place. However, since a majority of species face similar threats (*e.g*. habitat loss and fragmentation, habitat degradation, poaching or over-harvesting and pollution), conservation strategies often deal with these threats in species groups (*e.g* AMWCC 2001). This is also inevitable given the large number of taxa under threat and the lack of species specific information. However, such strategies have major limitations since the response to a given threat is often species or taxa specific. For example, amphibians are now known to be highly sensitive to UV radiation, several pesticides and diseases to which the other taxa are not. The bleaching of coral reefs in recent years is another example where threats are taxa specific. Therefore, it is necessary that taxa specific threat processes are identified and addressed, even while conservation strategies also address broad threat processes such as habitat loss and fragmentation, and hunting.

4.3 STRATEGY AND ACTION PLANS

Strategy 1. Ensure that threat reduction plans and species recovery plans follow from threat assessment.

The major legislation in India that deals with the conservation of wild fauna is the Wildlife (Protection) Act 1972 (with amendments in later years). This Act addresses two major threats faced by most wild fauna; the setting of a protected area network to prevent habitat loss and degradation, and prevention of hunting and trade in a majority of animal species. Forest (Conservation) Act 1980 address forests even outside of protected areas, while Foreign Trade Act 1992 regulates external trade in animals and animal products in conformity with CITES. However, these legislation address only two major threats faced by wild fauna, that of habitat loss or degradation, and hunting or trade. A major, but untested, assumption is that protected areas cover species in need of protection (see Box 5.1). Moreover, there is as yet no legislation which makes it mandatory to identify and to have threat reduction and recovery plans for those species which are under threat despite the protection afforded by the above legislation.

Strategy 2. To enact legislation making it mandatory to identify and to have threat reduction and recovery plans for threatened species.

The various schedules in the Wildlife (Protection) Act currently afford different degrees of protection from hunting, while the protected areas (Wildlife Sanctuaries and National Parks) afford the protection of habitat. However, several other threats faced by species are

not addressed. For example, it is becoming increasingly clear that many threatened species might be confined entirely or largely to private lands (*i.e.* lands not under the forest departments, see Chapter 6), over which the government currently has no control. This has now been recognised widely; *e.g.* the Prime Minister in his speech at the 21st Meeting of the Indian Board for Wildlife on 21 January 2002, stated that nearly 60% of wildlife in India occur outside protected areas. Habitat degradation or land use changes in these lands, which might be forested (*e.g.* private estates in the Western Ghats) or agricultural-grazing landscapes (*e.g*. *vidis* in Western India), or wetlands (several hundreds) is considered a major threat to many endangered species (see below). Similarly, problems of small populations, loss of forested and non-forested (*e.g.* rivers and streams) corridors, and disease are major threats to many endangered species. In this background, it is necessary that conservation actions follow from an assessment of the threat processes operating on species, and that a suitable legislation addresses this issue. Three species from three different habitats highlight this issue (Box 4.1). The declining population of wild buffaloes in protected areas in Central India (Indravati National Park, and Udanthi and Pamed Sanctuaries), and the recently reported drastic decline in rural and urban populations of several bird species (which constitute their major population) also highlight the situation in which species can disappear despite existing legalisation.

This legislation should (a) enable and give legal validity to the scientific assessment of the threat status of species done at the national level, based on widely accepted criteria (*e.g*. IUCN criteria); and (b) make it mandatory to develop and implement threat reduction and recovery plans for species, on the basis of the above assessment. The objective of such plans should be to outline the actions or conditions necessary to promote the species conservation. Recovery plans should be based solely on biological considerations (not economic factors). In addition, recovery plans are to be site specific and to outline measurable criteria for compliance to the goal of species recovery.

Threat reduction and recovery plans have been implemented in a few cases in India, and these have had major impacts as well as considerable popular appeal. The well known ones are the Protect Tiger, Project Elephant in recent years, and crocodile breeding and release for mugger, gharial), and fresh water turtles.

Box 4.1. An issue that the Wildlife (Protection) Act does not address

The following three examples highlight an issue that the Wildlife (Protection) Act or any other legislation does not address, but is critical to conservation of species.

Siberian crane

The case of the Siberian crane is a typical example of how the absence of species recovery plans, in addition to protection of habitat, and delayed international effort can prove costly. The wintering population in Keoladeo National Park (KNP) numbered about 200 birds in 1964-65 (Vijayan 1991). Since then the population showed a steady decline, to 38 when KNP was formed in 1982, to none in 1993-94. Among the major reasons was the almost lack of information on their breeding grounds and threats there and on the flyway, and ecology in KNP. Attempts at understanding these using satellite telemetry, isolation reared chicks, and international collaboration came too late. Thus even today the reason for their absence from KNP is not definitely known.

The conservation of waterbirds such as the Siberian crane depends on institutions, expertise and tools that are vastly different from that required for forested habitats. International or cross border issues, landscape or watershed level processes, the need for active management, and extensive human dependency are all factors to be considered.

The Malabar civet

The Malabar civet (*Viverra civettina*) is following the same history to extinction, in absence of any recovery or threat reduction plans. We have no confirmed sightings of the animal. The only animal ever to be kept in a zoo (in Thiruvananthapuram) died in 1929. With no sightings for many decades, the IUCN Red Data Book (1978) listed it as 'possibly extinct'. This proved wrong when Zoological Survey of India obtained two skins in 1987 from the foothills of the Western Ghats in northern Kerala. Two subsequent surveys in northern Kerala and Dakshin Kannada district in Karnataka, produced two more skins, but no live sightings of the animal. Carefully collected secondary information reveal that the species is confined to the western foothills, mostly to cashew plantations in private land and under pressure from loss of habitat and hunting. Following the 'rediscovery' the status of the species rose from 'possibly extinct' to Critically Endangered (IUCN 1996), one of only two such mammals from the Western Ghats. The Wildlife (Protection) Act 1991 included it in Schedule I, the highest level protection that a species can get in India.

Thus, in 2002 the Malabar civet in known from a few 'inconclusive' evidences of its occurrence compiled by biologists, and several flaky reports of occurrence from the public. Recommendations for conservation of the Malabar civet were rejected or ignored as evidences of its occurrence were based on 'hearsay'.

The Dugong

The sea cow or dugong (*Dugong dugon*) is a species that is taxonomically very unique, but widely distributed along the coastal waters of from the Persian Gulf to Australia and is closely associated with sea grass beds. Although once frequently sighted and often poached or incidentally caught in fishing nets, it has not been sighted now for several years in the west coast. In the Gulf of Mannar, reportedly its major habitat, a recent survey by the Zoological Survey of India sighted three animals in as many years. Sightings in the Andaman and Nicobar Islands have also been very few. Although included in Schedule I of the Wildlife Protection Act, there has been no concerted effort to locate and protect the remnant populations. India remains the only habitat country which has not carried out an aerial survey of the species, the most effective way of locating remnant populations.

Where does the Wildlife Protection stand?

Where does the responsibilities of the Wildlife Protection Act figure in situations like this where an endemic or highly endangered unique species, has become extremely rare and/or occurs primarily in outside protected areas? Shouldn't it be somebody's duty to locate and ensure, to the extent possible, that they survive, by putting in place a recovery plan? This is what protection of species (rather than individuals) is in the real sense, and something that Wildlife (Protection) Act should address. Otherwise, we would continue to ignore species, such as the Siberian Crane, Malabar civet, and dugong in the twilight of their extinction.

5 CONSERVATION OF IMPORTANT SPECIES: GOVERNMENTAL EFFORTS

5.1 INTRODUCTION

The conservation of the amazing wealth of fauna in India has a long history. In recent years, however, this has centred on (a) setting up a system of protected area network representing different biogeographic zones, affording stringent legal protection to the habitat as well as animals in them; (b) extending legal protection to a wide variety of taxa both within and outside protected areas, from hunting, trade, and other forms of exploitation; (c) special initiatives for protection and management of some species on perceived need (*e.g.* Project Tiger, Project Elephant); (d) participation in international conventions and agreements; (e) an *ex situ* breeding programme for selected threatened species; and (f) implementation of environmental impact assessments in order to regulate or mitigate the negative impacts of developmental activities on threatened wild animal species.

The major legislation that enabled these are the Wildlife (Protection) Act 1972 (with various amendments), Forest Protection Act 1980, and Foreign Trade Act 1992. There are, however, several dozens of legalisation, policy statements, and action plans which influence the conservation of wild animals, either positively or negatively. A review of these is beyond the scope of this report. The occurrence of species of conservation importance is also a criterion in the declaration of Ecologically Sensitive Areas (Anon. 2000a). It also figures prominently in the recently passed Biodiversity Bill (2002).

There are several instances and a long history of community level attempts at the conservation of wild animals either as a part of local resource management or addressing individual species or species groups. The importance of integrating this with conservation measures mentioned above is being increasingly recognised. In recent years, several NGOs also have begun to take a more active role in the conservation of wild animals. Such initiatives is now being better accepted and facilitated. The need to involve local communities and NGOs in conservation has also become very urgent as the euphoria of success of two decades since the Wildlife (Protection) Act has changed into one of crisis,

due to several reasons. The need to involve local communities was reflected in the Prime Minister's speech at the 21st Meeting of the Indian Board for Wildlife on January 21, 2002.

In this Chapter the efforts by the Government in recent years for the protection of wild animal diversity are briefly reviewed to identify major gaps and strategies. The importance of wild animal diversity in community and other lands is examined in the next Chapter.

5.2 GOVERNMENTAL EFFORTS

5.2.1 Protected area network

Inclusion in protected areas has been the major strategy in the conservation of wild animal diversity in India. Although a few protected areas were set up for the conservation of wild animals pre-Independence, it was the Wildlife (Protection) Act 1972 which provided the legal framework and hastened the process. However, it was in the National Wildlife Action Plan (1983) that the urgent need for setting protected areas as a network so as to adequately represent the biodiversity was explicitly stated. The Wildlife Institute of India was entrusted with the task of designing a protected area network to meet this objective. A draft report was produced in 1988 (Rodgers & Panwar 1988) and a summary of the revised report two years later (Rodgers *et al.* 2000). Both the reports give the philosophy, process and recommendations. Important areas for inclusion in the network were identified on the basis of representativeness, using a combination of focal species and a new biogeographic classification of the country. The latter took into consideration the climate, topography, and vegetation types for classifying the country into 10 zones, which were further divided into biotic provinces, land regions and biomes. The process of designing the protected area network involved (a) identification of the biological values (species or communities) which required representation in the network; (b) identification of gaps in relation to the existing protected areas; and (c) recommendations for new areas to fill the gaps, either as new protected areas or as extensions to existing one. Species richness, endemism and biological viability of the habitat were important considerations in the selection of protected areas in each zonation. It was not always possible to find areas large enough to ensure biological viability, therefore, adjoining protected areas and corridors between them were also important considerations.

The above report has had a remarkable success, even though it has been implemented only partly. The total number of protected areas (including National Park and

Wildlife Sanctuaries) has shown a 33% increase (from 426 to 566) between 1998 and 2000; more importantly the area coverage increased by nearly 40% (from 3.34% to 4.66%) of the geographical area of the country. Proposals to increase the number to 858, which would lead to an increase in area by nearly 22%, were pending in different states in 2000 (Rodgers *et al.* 2000), some of which have been implemented in the last two years. There is considerable variation among states in the protected area coverage, from <5% (9 states) to more than 20% (Sikkim and Goa). There is also considerable variation among the ten biogeographic zones, from 2.2% to 18.5%. The details of the coverage are given in the summary report (Rodgers *et al.* 2000).

Some limitations have been recognised in the report (a) the basis for the assessment has been primarily biogeographical, therefore, ground surveys are needed for validation; (b) while representativeness of biodiversity was adequately covered, persistence of the biological values (*e.g.* long term survival of focal species or species groups) has been primarily addressed through maximising area, and inclusion of corridors. Identifying management measures for enhancing persistence was beyond the scope of the report; (c) there are 12 mammalian species of conservation significance which have no or significant populations in the network (compared to 18 in the 1988 proposal). However, many of these have subsequently been reported from one or more protected areas (*e.g.* rusty spotted cat, pig-tailed macaque, Phayre's leaf monkey); and (d) although coastal areas were considered in the assessment, inland wetlands were not, thereby leaving out substantial populations of waterfowls and other aquatic animals.

In its scope, coverage, and implementation the protected area network has been a major achievement in the conservation of animal diversity in India. However, the report also stressed the need for periodic reassessment and inclusion of new areas as and when situations changed or new information accumulated.

5.2.2 Prevention of wildlife poaching and trade

This is a subject that perhaps has attracted the most attention in recent years in the context of species conservation. This has been a major subject of discussion in virtually all officially constituted committees and meeting on wildlife conservation, and reports by several national and international NGOs in the last several years. Although the discussion has centred on more charismatic species such as tiger, elephants, and leopard the issues are common to a wide variety of species.

Apart from the setting up of protected areas and affording strict legal protection to the habitat, the Wildlife Protection Act also extended stringent legal protection to animals, the various schedules in the Act reflecting different levels of protection. Moreover, this protection was applicable to animals of several species outside of protected areas or even lands outside of government control, the fisheries being an important exception. This legal protection afforded to wild animal diversity is among the most stringent anywhere in the world. Subsequent amendments to the above Act have banned hunting and trade in all wild fauna and their derivatives (except in fisheries). India's ratification of CITES was another effort at controlling international trade in wildlife and their derivatives.

Although the above Act (and various amendments) virtually banned all legal hunting and trade, it did not stop them because of the lack of a framework for intelligence gathering and strict enforcement, especially outside of the habitat. There was no systematic gathering of data, therefore, illegal trade was often exposed only through sporadic seizures of wild animals or their derivatives. Equally important, although a ban was put in place the trade network was not broken. A stay order obtained by the traders against the 1986 amendment to the Act vacated only in 1993 (see WTI 1997), prolonged delays (decades in some cases) in settling court cases, lack of awareness and co-ordination among regulating authorities outside of habitat including international transit points such as air ports, were all reasons for the initial success to turn into one of failure in early 1990's. This resulted in the setting up of a Committee on Prevention of Illegal Trade in Wildlife and Wildlife Products which submitted its report (often referred to as the Subramanian Committee Report) in August, 1994 (Anon. 1994).

Apart from the Subramanian Committee Report, several other meetings have all addressed the issue of wildlife hunting and trade: Annual Meetings of Field Directors of Project Tiger, National Wildlife Action Plan 2002-16, Sub-Group II on Wildlife Protection, Planning Commission, 2001, Project Tiger Status Report, and CITES Tiger High-Level Mission, 2000. Although the recommendations by these committees might differ in detail (with Subramanian Committee report being the most exhaustive, with 56 recommendations), the most significant action plans in these reports are the same, and as follows:

- **Setup a specialised central task force to deal with wildlife crime**: There is an urgent need to establish a central unit (with regional offices) specialised to deal with wildlife

crimes and trade, similar to the Narcotics Control Bureau. This unit should be empowered to act across states, and in coordination with forest departments, police and other agencies as needed. (In response to this a Wildlife Trade Control Cell was set up in March 2002, eight years after the recommendation was made. Some states have already established joint forest vigilance cells with the police department to monitor and investigate wildlife crimes, especially the transport, storage, and use of wildlife products *e.g*. Rajasthan and Madhya Pradesh). Adequate cash rewards might be given to the personnel for major success, as in the case of Customs and Narcotics Control Bureau.

- **Strengthen physical security arrangements in protected areas**: Conduct professional security audits of each protected area so as to identify security gaps based on a threat assessment and design a protection plan that includes needs for equipment, vehicle, personnel and capacity building. Contingency plans to deal with emergencies should also form a part of this. Emergency Response Team consisting of well trained and armed personnel who are enlisted as Special Police Officers has been recommended.
- **Improve information availability and access**: There should be mechanisms to systematically compile statistics on mortality (of some target species such as tiger and elephant), poaching, seizures, culprits, enforcement actions and convictions. This information should be with spatial and temporal reference, and in a form that is readily accessible to enforcement agencies. Currently, this compilation is being carried out by several NGOs, within their constraints of resources and access to information.
- **Improve infrastructure and expertise:** Basic essentials such as radio equipment, modern weapons, suitable vehicles, and trained expertise are often not available in any protected area for effectively dealing with poaching and trade in wildlife. A substantial increase in the budget for prevention of wildlife crimes in therefore needed.
- **Filling up of vacant posts:** Most committee reports point out that 30% to 50% of the posts are currently vacant in the wildlife sector, and this as the major factor in the failure to prevent wildlife crimes. (Due to the lack of recruitment, the average age of the protection staff is more than 50 years in many states.) Filling up of the vacant posts with well-trained local youths is among the most urgently needed action for prevention of wildlife crimes. Despite an appeal to the effect by the Prime Minister in May 2001, no action has been taken by any of the states.

- **The use of police or paramilitary forces:** In the absence of adequately trained and equipped staff, the use of armed police or paramilitary forces (such as CRPF) has been recommended either to supplement regular forest protection staff or during emergency. (Some states have already started using them *e.g.* Orissa.). The use of paramilitary forces is particularly recommended in protected areas with insurgency problems *e.g.* Kaziranga and Manas.
- **Areas outside protected areas**: Anti-poaching effort is now confined to protected areas, that too a few well known ones due to limitations of resources and personnel. As a result little protection is afforded to areas outside protected areas, even in the case of species that deserve special attention such as tiger and elephant. There is thus great need to enlarge anti-poaching activities to areas outside protected areas.
- **Improve conviction rate:** The follow-up on seizures has been severely handicapped by several factors; lack of forensic support, poor understanding of laws, lack of awareness among the judiciary, lack of reference material for identification of species and parts, and poor coordination, if not open rivalry, among various agencies involved. The resulting poor conviction rate has had a demoralizing effect on the protection staff. The following are the major actions recommended:
  - **Special courts:** Setting up of special courts to try forest and wildlife offences to ensure speedy disposal of cases. This would also facilitate the development of expertise and the creation of awareness among the judiciary.
  - **Forensic laboratory:** Setting up of a national wildlife forensic laboratory, with regional centres to provide forensic support to investigation of wildlife crimes.
  - **Manuals**: Publication of the Wildlife Protection Act and identification manuals in local languages. Some effort in this direction *e.g.* TRAFFIC-India (1996) and (Menon & Kumar 1999).
  - **Training in legal proceeding**: Training of mid-level field staff in court and criminal procedures, skills at interrogation, investigation and report writing, legal limits to their authority, preparation of cases for courts, FIR, *etc*
- **Liaison with other agencies:** Better coordination and sensitization among various agencies potentially involved in detection of wildlife crime at different stages: poaching, transport within and between countries and use. Among the major agencies are forest department, police, customs, and border security.

- **Innovative methods for prevention and detection of wildlife crimes:** The forest department is most likely to suffer from a severe lack of man power urgently required for control of wildlife crime, for the coming many years. Therefore, it is necessary to device other innovative means of controlling wildlife crime. In recent years there have been some initiatives in involving local people (who often have passive or active knowledge of wildlife crimes) in patrolling (*e.g.* Forest Protection Committees, as a part of JFM), intelligence gathering, and resettlement of poachers. Greater employment opportunities for the local people in wildlife protection, cash rewards for information, *etc.* are tools recommended for this purpose. The participation of NGOs also needs to be encouraged in the prevention and detection of wildlife crimes, at all stages. The best hope for prevention of poaching lies in strengthening these initiatives.
- **Training of personnel at international transit points:** Improve crime detection at international transit points, through better training of Customs and border security forces**.** Training should cover identification of wildlife and their parts, provisions of CITES and Foreign Trade Act (1992) *etc.* The training that is now being imparted by the Wildlife Institute of India should be made a regular course.

5.2.3 Focal species conservation

The Central Government has initiated a few projects in order save species that were thought be in greater risk or in need of focussed conservation attention. It was also thought that these focal species would ensure the conservation of the associated fauna. Two well-known examples of focal animal projects are Project Tiger initiated in 1972, and Project Elephant initiated in 1992. Other efforts include restocking the wild population of crocodiles in the 1980's, which had been depleted due to poaching (Choudhury & Choudhury 1986), and recently on the marine turtles, focussed on the Olive Ridley turtle (see Section 5.2.3.3).

5.2.3.1 Project Tiger

Among the very few initiatives for the conservation of single animal species in India, the most widely known is Project Tiger. Initiated in 1972, it sought to set up several Tiger Reserves in India (now numbering 27, and covering nearly 38,000 sq.km, Table 5.1). The primary philosophy of Project Tiger has been that if habitat is restored through removal of all forms of habitat disturbance (including human settlements and cattle grazing) and

poaching, tiger and its prey base would in the long run be restored to natural equilibrium. The major emphasis has therefore been on strict policing, improved staff amenities and protection facilities, relocation of human settlements and their cattle, and regular monitoring of tiger and its prey base. The Project also recognized the need for relatively large contiguous habitats and hence included reserve forests around existing protected areas in the Tiger Reserves. The fact that large populations of tiger existed outside of Tiger Reserves was recognized through extending monitoring of tiger and prey base in other protected areas in later years.

Although Project Tiger has been one of the most successful attempts at threat reduction and recovery of a highly endangered species, in recent years there has been several setbacks. Among the major drawbacks of the Project are:

- Increased conflict with human settlements in and around protected areas, resulting from involuntary relocation, increased human and cattle casualties, and inadequate compensation for both. Increased conflict has led to poisoning of tigers; *e.g* in Nagarjunasagar at least 20 tigers were poisoned in two years (WWF 1999), and perhaps with increased collusion with poachers.
- The lack of consistency, statistical rigor, and transparency in the periodic monitoring of tiger population and its prey base (Karnath 1987, 1995; Karanth *et al.* 1999). For example, the spatial (Tiger Reserves, other protected areas, and reserve forests) and temporal (interval between census operations) coverage has been inconsistent, making population assessment impossible even at a regional scale, although the population might have increased in the Tiger Reserves (EIA 1996). The lack of independent monitoring and evaluation was also a major factor.
- The lack of a systematic compilation of data on poaching and trade in tiger parts and hunting of its prey species in various parts of the country and outside led to a failure in detecting the increase in poaching, arguably the major threat to the species at present.
- The concentration of funding to a few Tiger Reserves was at the expense of other and often important tiger habitats, which led to the decline in staff strength, facilities, and basic amenities in the latter. For example, in Madhya Pradesh, only 226 tigers occur in Tiger Reserves compared to 229 in other protected areas, and 472 in general forest areas (WWF 1999). In India as a whole, probably only 1600 out of 3500 tigers occur in Tiger Reserves!

- Project Tiger did not promote or facilitate any research on the life history, demography, ecology and behaviour of the tiger. As a result, virtually no scientific information (apart from natural history observations) critical to the conservation of the species could be available to deal with the present crisis. Instead, studies in Nepal had to be depended upon for basic information on the species. Recent studies, which have yielded us invaluable information on tiger densities, ecology, and behaviour, have been carried out independently of Project Tiger, although facilitated by it.

The annual meeting of the Field Directors of Project Tiger and the Project Tiger Status Report (2001) have recognised that many of the Tiger Reserves are in desperate straits due to insurgency, poaching, lack of staff, inadequate infrastructure, and poor fund flow, and even suggested that some Reserves may be deleted from Tiger Reserve status. Despite the apparent success of Project Tiger for nearly two decades since its start, there is at present a recognition of crisis, and a sense of urgency to deal with it among the Indian Government, State Governments, national and international NGOs, and several donors. Among the major initiatives are:

- Eco-development projects: These projects seek to improve management capacity, reduce negative impacts, provide alternative livelihood, and improve support for management through research, monitoring and education. For example, the GEF-India Eco-development Project attempts these in seven protected areas, six of which are major tiger habitats (including four Tiger Reserves). Similar eco-development projects are also supported in several other tiger habitats.
- Recognizing the severe constraints on government funding, several NGOs have stepped in to provide basic amenities, equipment (such as field uniforms, wireless sets, and vehicles), arms, field training and life insurance cover to protection staff, and adequate and rapid (often supplementary) compensation to local people for human loss or cattle lifting. Among the leading agencies in this regard are Tiger Conservation Project (TCP) of WWF-India, Ranthambore Foundation, Wildlife Trust of India, and Wildlife First!, to name a few.
- Gathering and compilation of intelligence data on poaching and trade by NGOs, such as Ranthambore Foundation, Wildlife Trust of India, Wildlife Preservation Trust of India, and TRAFFIC-India.
- Training of agencies that regulate international trade or border, such as customs *e.g*. by the Wildlife Institute of India and TCP.

- Evolving a common approach for tiger and its prey, among the 14 habitat countries, initiated by Global Tiger Forum.
- Better coordination between forest department and police in control of poaching and trade; for example, the setting up of a joint Tiger Cell in Madhya Pradesh.
- Conservation education of the general public around tiger habitats by several NGOs, *e.g.* Wildlife First! in Karnataka.
- Greater transparency in the periodic monitoring of tiger and its prey by involving scientists, NGOs and others in the census operations.

However, several problems remain which need to be addressed. The annual meetings of Field Directors of Tiger Reserves in the last two years (2000 and 2001) have highlighted many of these issues; so also have several officially constituted committees (*e.g.* Subramanian Committee 1994; Sub-Group II on Protection Aspects of Conservation, Planning Commission, 2001; National Wildlife Action Plan, 2002; Project Tiger Status Report, 2001). Some of these are applicable to wildlife conservation in India in general, but more so to the tiger:

- Declining field staff is a major problem in all states with nearly 30% to 50% of the posts being vacant. A drastic increase in the average age of the field staff has been another major fall out, being nearly 50 years in many states. It is necessary that vacant posts in Tiger Reserves be filled immediately, with young and well trained staff. However, despite a plea from the Prime Minister to Chief Ministers (letter dated March 29, 2001), no action has been taken in this regard.
- Another major issue is the lack of funds and delayed fund flow, which has seriously affected the functioning of all Tiger Reserves. The adoption of Forest Development Authority, on the lines of District Rural Development Authority, has been suggested as a solution to the problem of fund flow. The Planning Commission has recommended that Project Tiger and Project Elephant continue with increased fund allocation.
- Although several NGOs are providing emergency assistance at present, the sustainability of this is not assured in the long run. Moreover, their effectiveness depends critically on protection staff strength and age.
- The lack of a consensus on methods for monitoring tiger population and its prey, so that periodic evaluation is possible at some regional scale.
- The lack of scientific information on many aspects of tiger (such as prey base, home range, dispersal and demography) in most parts of its range.

- The lack of systematic compilation of poaching and trade information, with spatial and temporal reference.
- The failure to consider tiger populations on larger spatial scales, in order to identify critical corridors and satellite areas adjoining protected areas. Such an effort has been made by Wikramanayake *et al.* (1998). An effort has also been made by the Wildlife Institute to identify satellite areas around Kanha National Park. Similar efforts have to be made elsewhere also in order to retain critical habitat corridors.

Table 5.1. Tiger Reserves in India

Sl. No.	Year of creation	Name of Tiger Reserve	State	Area (sq. km)
1	1973-74	Bandipur	Karnataka	866
	1999-2000	Nagarhole – (extension)		643
2	1973-74	Corbett	Uttar Pradesh	1316
3	1973-74	Kanha	Madhya Pradesh	1945
4	1973-74	Manas	Assam	2840
5	1973-74	Melghat	Maharashtra	1677
6	1973-74	Palamau	Bihar	1026
7	1973-74	Ranthambhore	Rajasthan	1334
8	1973-74	Similipal	Orissa	2750
9	1973-74	Sunderbans	West Bengal	2585
10	1978-79	Periyar	Kerala	777
11	1978-79	Sariska	Rajasthan	866
12	1982-83	Buxa	West Bengal	759
13	1982-83	Indravati	Madhya Pradesh	2799
14	1982-83	Nagarjunsagar	Andhra Pradesh	3568
15	1982-83	Namdapha	Arunachal Pradesh	1985
16	1987-88	Dudhwa	Uttar Pradesh	811
	1999-2000	Katerniaghat – (extension)		551
17	1988-89	Kalakad-Mundanthurai	Tamil Nadu	800
18	1989-90	Valmiki	Bihar	840
19	1992-93	Pench	Madhya Pradesh	758
20	1993-94	Tadoba-Andheri	Maharashtra	620
21	1993-94	Bandhavgarh	Madhya Pradesh	1162
22	1994-95	Panna	Madhya Pradesh	542
23	1994-95	Dampha	Mizoram	500
24	1998-99	Bhadra	Karnataka	492
25	1998-99	Pench	Maharashtra	257
26	1999-00	Pakhui	Arunachal Pradesh	862
	1999-00	Nameri	Assam	344
27	1999-00	Bori-Satpura-Panchmari	Madhya Pradesh	1486
		Total		37761

5.2.3.2 Project Elephant

Under Project Elephant initiated in 1992, 11 Elephant Reserves have been identified for focussed conservation (Sukumar 1996). These Reserves encompass large landscapes that include protected areas and adjoining reserve forests and critical elephant corridors. Other activities include coordinated population surveys at regional scales, better control of poaching and ivory trade, compensation for crop loss, and acquisition of critical elephant corridors that are privately owned. The Asian Elephant Research and Conservation Centre (AERCC), at Bangalore has brought out a GIS database for 39 forest divisions comprising the four Project Elephant reserves in South India out of 10 designated Project Elephant reserves. The Project Elephant also addresses other critical issues in the conservation of elephants such as mortality due to train hits in the Delhi-Dehra Dun route, and conflict with people (see minutes of the Project Elephant meeting, February 2002).

5.2.3.3 Olive Ridley Sea Turtle Conservation

India has five species of marine turtles (the Olive Ridley, Loggerhead, Leatherback, Hawksback, and Green Turtle). The largest nesting site of the Olive Ridley in the world is the coast of Orissa. All marine turtle populations have been severely affected by poaching of eggs and adults and mortality due to trawlers, with Olive Ridley being the most affected due to its massive concentration in one area during the nesting season. A project initiated by the Government of India and funded by UNDP seeks to develop, during 2000-02, a sustainable model for conservation of marine turtles and restoration/conservation of their habitats along the Indian coastline. All 10 coastal states and union territories are covered under the Project which seeks to:

- conduct comprehensive threat and logframe analysis of Olive Ridley Turtles and their habitats and collate data for design of programmes/ management plans for conservation and restoration of degraded and threatened habitats.
- create comprehensive time-based spatial databases of Olive Ridley turtles populations, nesting sites and feeding patterns.
- build capacities of major stakeholders, such as state and central government, NGOs and CBOs.
- generate awareness amongst identified stakeholders towards the need for protecting the coastal ecosystem in general and Olive Ridley Turtle Conservation in particular.

A major outcome of the Project would be a management action plan to contain the mass mortality of Olive Ridley turtles along the Orissa coast as well as that of other coastal states/union territories. A protected area network covering the most important nesting sites of the Olive Ridley in Orissa would be another outcome.

5.2.3.4 Other projects

Apart from the above, several large projects have been recently implemented, or are being implemented, which address the conservation of wild animal diversity in general. Most of these are with funding from the World Bank or other such agencies. Some major examples are the India-Ecodevelopment Project, Joint Forest Management (JFM) Projects, Forestry-Biodiversity Project (in Kerala), Tamil Nadu Afforestation Project *etc.* JFM itself covers nearly 10.2 million ha as of 1998, with West Bengal covering as much as 53% of its forested area (see Ravindranath *et al.* 2001, for a review). While most of these projects address the conservation or restoration of habitat and benefit sharing with the local communities in areas outside protected areas, only few address the concerns about the protection of wild animal diversity *per se, e.g.* India-Ecodevelopment Project in seven protected areas. These projects have been reviewed periodically elsewhere (*e.g.* Ravindranath *et al.* 2001).

5.2.4 Legislation

Although the conservation of biodiversity is in the concurrent list, most of the legislation in this regard, especially that on wild animal diversity, has been enacted by the Central Government. Although the Indian National Parks Act was passed in 1934, the most important legislation which had far reaching impact on the conservation of wild animals is the Wildlife (Protection) Act 1972 (WLPA), which extended different levels of protection to animals of species (rather than species *per se*) from hunting, other forms of removal from its habitat, and trade. The Act also provides for stringent legal protection for the habitats of wild animals by including these in protected areas. The Wild Life (Protection) Act, 1972 lists species in the Schedules I to IV depending upon its status in the wild. Schedule I lists endangered species and is given highest degree of protection. Similar degree of protection is given to the species listed in Part II of Schedule II - it includes those species which are severely threatened by wildlife trade. Offences relating to species listed in these Schedules cannot be compounded since a minimum punishment has been prescribed for these offences and a criminal complaint has to be filed in all such offences.

Any gravely endangered species can be upgraded to Schedule I or Part II of Schedule II if it does not figure in them. This will provide highest degree of protection under the Act (Mahendra Vyas, *pers. com*.). This Act has been repeatedly amended to deal with emerging scenarios. Species or species groups have been added to the Schedules based on expert advice, often from Government agencies such as the ZSI and CMFRI (*e.g*. recent ban on shark fishing, and its subsequent lifting). Amendments proposed in 1998 (but not passed) to the Act would enable the setting up of protected areas in community lands or other lands under a different management regime than the existing protected areas.

The Environmental Protection Act 1986 afforded protection to habitats that were poorly covered by the WLPA, such as wetlands and coastal and marine areas. The Coastal Zone Regulation Act, provided further protection to the coastal areas.

The Foreign Trade Act 1992 enables the control of foreign trade in wildlife and derivatives and is the main tool for the implementation of India's obligations under CITES. Another legislation that has had profound impact on the conservation of wild animals is the Forest Conservation Act (1980) which prohibited the diversion of forest land for other purposes without the consent of the Central Government.

5.2.5 Policies and action plans

In addition to legislation, several policy documents and action plans prepared by the Central Government have influenced the conservation of wild animal diversity. For example, the design of a representative protected area network was an objective of the Wildlife Action Plan 1983. The Forest Conservation Policy (1988) recognised the rights and concessions of communities in and around forest areas, the need for benefit sharing with them, as well as the need for using these as tools in the conservation of biodiversity. Although of no legal validity, such policy statements and action plans have been used in public litigation cases to the benefit of wild animal diversity or their habitat. To quote a precedent, in T. N. Godavarman Thirumalpad Vs. Union of India (Civil Writ Petition No. 202 of 1995) in its landmark interim order of 12-12-1996, the Supreme Court enforced the National Forest Policy of 1988 by banning felling of timber in tropical evergreen forests of the northeast, especially in the Changland region of Arunachal Pradesh. Thus, the courts may invoke their extra ordinary jurisdiction to enforce not only the laws but even the Policies and Action Plans (Mahendra Vyas, *pers. com*.).

The National Wildlife Action Plan 2002-16 (NWAP 2002), prepared by an expert Committee after extensive consultation, was released by the Prime Minister of India on January 21, 2002. A summary of the Action Plan is given below.

5.2.5.1 National Wildlife Action Plan 2002-16

The National Wildlife Action Plan for 2002-16 (NWAP 2002) was released by the Prime Minister of India on 21 January 2002. This Plan addresses 13 major issues in the conservation of wild animal diversity, with action plans and time bound projects under each of them, along with institutions which can or should be involved in each project. Among the several reports in recent years on conservation of wild animal diversity, the mandate and recommendations this Action Plan overlaps most with that of NBSAP-Wild Animal Diversity. Therefore, the major action plans and recommendations for each of the 13 issues are given below. These have been selected based on their *direct relevance* to wild animal diversity, and thus not a comprehensive summary of all recommendations and action plans.

I. Strengthening and enhancing the protected area network:

Apart from national parks and sanctuaries new legal PA categories are required, namely "Conservation Reserves" and "Community Reserves". Together with these categorisations, we should aim to bring 10% of India under the PA network. PA network should adequately cover all biogeographic zones, forest types and wild species of flora and fauna, especially the endangered ones. Suitable amendments need to be made for this purpose in the Wildlife (Protection) Act, 1972 (emphasis in the original text).

II. Effective management of protected areas:

Prepare scientific, PA-specific management plans by a team of officials, experts and local community representatives, incorporating case studies of past management successes and failures.

III. Conservation of wild and endangered species and their habitats:

It should be the aim to conserve *in situ* all taxa of flora and fauna along with the full range of ecosystems they inhabit. Actions needed are (a) Identify endangered species, their conservation needs, and current level of security; (b) Periodic review and publication of conservation status of species; and (c) Undertake captive breeding and rehabilitation for critically endangered species.

IV. Restoration of degraded habitats outside protected areas:

Each State/UT should identify and prioritize degraded habitats outside PAs for restoration, especially corridors between wildlife habitats. Support community managed conservation areas like sacred groves and tanks, pasture lands *etc*. where endemic or threatened species may exist.

V. Control of poaching and illegal trade in wildlife:

- Provide forest department staff with expertise, weapons, communication and other equipment, and incentives to combat poaching and illicit trade effectively;
- Speedy settlement of court cases through training in legal process, and setting up of special courts and designated public prosecutors;
- Provision of secret funds for intelligence gathering;
- Better outreach with other enforcement agencies such as, police, paramilitary, customs, coast guard, and other intelligence agencies;
- Setting up and strengthening of wildlife forensic laboratories;
- Preparation of manuals for the identification of wildlife species and their derivatives;
- Specialised vigilance cells at international exit points for detection;
- Special cell to compile and disperse information about wildlife species and the products in trade, and
- Rehabilitation of individuals of local people who are involved in poaching.

VI. Monitoring and research:

There is a marked deficiency in baseline biological data needed to manage and monitor PAs. Applied research is also needed to overcome specific management problems in protected areas. The suggested actions include:

Integrated, multidisciplinary research in representative ecosystems;

- Research on indicators , endangered species and habitat conditions;
- Integrate research findings into management plans and monitoring systems;
- Understanding and application of ethnic knowledge in wildlife management;
- Monitor the impact of human activities on natural habitats, including the spread of disease, fire, grazing and NTFP collections within and outside PAs;
- Document and assess the damage done by large projects and intrusions, such as dams, mines, canal systems, roads and the use of pesticides and chemicals;

- Prepare research priorities for PAs which should be consolidated into a State Wildlife Research Plan (5 year period);
- Review present research approval procedures to ensure research in biological conservation is facilitated;
- Identification of wildlife corridor between important PAs harbouring endangered and long ranging species; and
- Establish a National Wildlife Research Coordination Committee to prioritize, monitor and coordinate research needs and monitor and co-ordinate policy, strategy and research programmes undertaken by institutions and universities, particularly those funded by government.

VII. Human resource development and personnel planning:

- Review and strengthen existing mechanisms for recruitment, training and career development of protected area personnel so as to sustain a professional wildlife cadre. Biodiversity conservation along with allied people issues need to be built into the training programmes of foresters at all levels, right from the IGNFA and IIFM to state institutions training frontline staff. Appropriate revision of syllabi in all training institutions should form a part of this.
- Reorienting rural development and allied activities to be compatible with biodiversity conservation.
- Cadre management in the forest department should ensure continuity of trained staff in the relevant disciplines (*e.g.* wildlife trained personnel in wildlife management).
- Fully centrally sponsored special scheme for capacity building of field staff from PAs. MoEF should monitor and pursue with defaulting States, linking if necessary the flow of Central assistance in the entire forestry sector with such compliance.
- Short-term courses and workshops for legislators, police officers, forest officers, district administrators and NGOs in integrating biodiversity conservation with development at eco-regional scale, prevention of poaching *etc.*

VIII. Ensuring peoples' support and participation in wildlife conservation:

- Integrate community knowledge, skills and practices into conservation research, planning and management, including benefit sharing. Preference for employment in

frontline staff as well as in ecotourism has to be given to local people, especially the landless Also involve local NGOs in the process.

- Scientific institutions and NGOs should be involved in assessing the success of such initiatives, and other conservation programmes.
- Hold annual public hearings in each PA, covering issues such man-wildlife conflicts, livestock grazing, encroachments, tree cutting and poaching. Prevention and control measures should be implemented with the participation of the affected people.
- Encourage people to conserve wildlife habitats outside PAs, including community conserved forests, wetlands, grasslands and coastal areas.

IX. Conservation education:

- Incorporate environment and forest conservation values in school curriculum. Also support non-formal nature conservation efforts through school systems.
- Launch mass awareness campaigns through print and electronic media.
- To generate a body of copyright-free, reliable conservation information and place this on the Internet through the MoEF website
- Set up a system that allows children from adjoining villages to visit PAs regularly for wildlife education excursions.

X. Tourism in protected areas:

- Develop tourism management plan for each protected area. Conduct carrying capacity studies to gauge the extent of tourism in 25-30 most visited PAs, covering all natural regions, i.e., forests, coastal and freshwater wetlands, desert (including cold desert), and mountains.

XI. Domestic legislation and international conventions:

- A comprehensive review of the Forest Act, 1927 in order to make it more conservation oriented and relevant to the present realities and to be made applicable to all states.
- Ensure that the Jammu and Kashmir Wild Life Protection Act, 1978 is at par with the Wild Life Protection Act, 1972.
- Monitoring and periodic evaluation to ensure timely amendments to the statutes so as to safeguard wild biodiversity.

- The fishing laws of the various States need to be revised into a central legislation, covering other aquatic life forms and ecosystems especially sponges, corals and shells.
- Certain areas surrounding PAs and areas of 'wildlife corridors' to be declared as ecologically fragile areas under the EPA, 1986.
- Enact a separate legislation for enforcing the provisions of CITES.
- Implement domestic legislation and action plans and bilateral agreements that are required to fulfil the conditions under various international conventions to which India is a signatory; *e.g.* CBD (1992), CITES (1973), Bonn Convention (1979), Ramsar Convention (1971).
- The Wildlife Protection Act should have overriding effect on the right of access to biodiversity provided under any other Act.

XII. Enhancing financial allocations and fund flow to the wildlife sector:

- About 15 percent of the forest budget to be allocated for wildlife conservation and related issues.
- Ensure adequate and timely financial allocations, perhaps along the lines of the DRDA.
- Develop documents for establishment of PA Development Authority for acceptance by State/UT governments.
- Ensure thrust-specific schemes that can use additional fund flows to address wildlife management imperatives.

XIII. Integration of National Wildlife Action Plan with other sectoral programmes:

- Land within 5 km of PAs to be declared special development areas with separate funds under the State plan.
- Evolve cropping pattern to minimise damage from wild animals, and adopt crop insurance to compensate for loss.
- Roads and railways to be planned in such a manner that all PAs and corridors are by-passed.
- Involve armed forces in census and survey of wild animals, and in controlling in remote border areas of the country, and to help apprehending criminals indulging in smuggling.
- Ministry of Finance to issue directions to state governments that like police and other law enforcing agencies, the field formations of forest department are exempt from all

financial and other cuts. Adequate funds should be made available for protection, prevention of poaching and protecting wildlife habitats through eco-development and other activities. Wildlife should be declared as a 'priority sector'.

- Ministry of Steel and Mines to exclude wildlife protected areas/corridors from their mining plans. Proper rehabilitation of degraded and abandoned mining areas should also be done. A programme to phase out all existing operations in wildlife areas should be prepared.

5.3 NON-GOVERNMENTAL ORGANISATIONS

The role of NGOs has been critical to the conservation of wild animal diversity and their habitats in recent years. The scope and geographic coverage has also increased substantially, such that a comprehensive review is not possible in this report. While several international NGOs have provided funding, NGOs in India have operated both at the national and local levels effectively on a range of issues that influence the conservation of wild animal diversity. The major activities that directly influence are given below, with examples which are by no means exhaustive:

- Provide equipment, vehicles, insurance cover, field uniforms *etc.* to protected areas especially for in connection with control of poaching (*e.g.* Wildlife Trust of India (WTI), WWF-India, Global Patrol, Global Tiger Forum, Ranthambore, Wildlife First!, and several others);
- Promote interaction among forest management, other government departments, local people, conservationists *etc.* (*e.g.* Conservation and Livelihoods Network, Tarun Bharat Singh, Indian Institute of Public Administration, Kalpavriksh, Wildlife Trust of India, Sanctuary Magazine, and several local NGOs);
- Legal intervention to protect endangered species or their habitats from imminent threats or governmental inaction, through public interest litigation petitions. Examples include vacation of a stay order on wildlife trade control in 1986, vacated in 1996 through PIL by NGOs; and more recently, the stopping by the Allahabad High Court (19th March, 2002) of the draining of five wetlands in Uttar Pradesh crucial for the survival of the world' s largest concentration of the endangered Sarus cranes.

- Provide expertise, training, and intelligence in control of poaching and wildlife trade (Wildlife Trust of India, WWF-India, Asian Elephant Research and Conservation Centre (AERCC), and others);
- Public campaign against the use wildlife products (*e.g.* by WTI against the use of shahtoosh, a major threat to the survival of the Tibetan antelope or chiru)
- Funding research on issues of immediate conservation importance, and for promoting alternate livelihood in and around protected areas (BNHS, WTI, WWF-India, and several others)
- Purchase of critical, but privately owned, forest corridors for inclusion in protected areas;
- Dissemination of information critical to conservation (Sanctuary Magazine, CEE, WWF-India); and
- Networking of researchers, assessment of conservation status of species, and dissemination of information (Zoo Outreach Organisation and CBSG-India).

5.4 STRATEGY AND ACTION PLANS

Strategy 1. Implement recommendations that are common to several committees set up by the government to examine issues in the conservation of wild animal diversity.

The recommendations of several committees and the Wildlife Action Plan (2002-16) address some issues which are fundamental to conservation of wild animal diversity. Without the implementation of these recommendations, all other efforts would be undermined. Among the most important actions required are:

Action 1. *Filling up of vacant posts among the protection staff in state forest departments:* With virtually no recruitment for last several years, there has been a drastic reduction in the number of protection staff in medium to low levels, the vacancies in some states being as high as 50%. Moreover, the average age of the protection staff has crossed 50 years in many states, making them highly ineffective in protection duties. The posting of more staff in prestigious protected areas has also left many others virtually unprotected. An increase in the protected areas without an increase in the protection staff is another issue. All the state governments were requested by none other than the Prime Minister to take immediate action in this regard. However, no substantial progress has been made.

Action 2. *Ensuring adequate and timely fund flow:* Several activities related to the protection of wild animals have been severely handicapped by the lack of adequate and timely fund flow. This issue has been widely debated and recognised as critical to conservation, but with no action in most of the states. Some states (*e.g.* West Bengal) have recently adopted the DRDA model to solve this problem.

Action 3. *Make the prevention of poaching and wildlife trade more professional:* Among the actions needed are the setting up of a central vigilance cell consisting of professionally trained personnel, improved intelligence and data gathering, easy accessibility to such information, better liaison with police and NGOs, better equipped and trained field personnel in adequate numbers, professional security audit of poaching hotspots, rehabilitation of local animal poachers or trackers, and better and timely funding.

Strategy 2. Ensure protected area coverage for all or at least endangered species.

Protected area coverage within government owned lands (with the Forest Departments as the custodians) has been the single most important strategy for the conservation of wild animal species in India. In fact, this has been recently shown to be the most effective means of conservation elsewhere (Conservation International publication). Various indicators such as biogeographic zonation and ecosystem coverage, and flagship and umbrella species (*e.g.* large herbivores and predators) have been used to design a protected area network for this purpose (Rodgers & Panwar 1988). However, the assumption that the above surrogates do in fact ensure the coverage of all or at least the endangered species has never been tested. Some of the important animals that have no or inadequate coverage in the network has been identified in the report (Rodgers *et al.* 2000). A rapid analysis of the data compiled during the BCPP in fact shows that nearly 30-40% of the endangered mammals, amphibians and reptiles are not known to occur in any protected area. While this might be to a large extent due to the lack of inventory of most animal taxa in protected areas, the patchy distribution of many taxa (which is becoming increasingly evident in India as well as in many other tropical countries) is equally important (see Box 5.1).

Action 1. *In the above context it is necessary that a systematic assessment of the occurrence of (at least) endangered species in the protected area network be carried out*. Such an assessment should identify major gaps in protected area coverage of endangered species, and suggest inclusion of further areas wherever necessary and feasible. This

should be an important criterion in deciding the required extent of protected area coverage, rather than the currently recommended 5% (Rodgers & Panwar 1988) or 10% (National Wildlife Action Plan 2002) based on coverage of biogeographic zones or ecosystems.

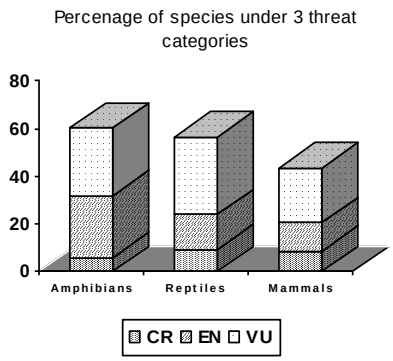
The major activities would include (a) compilation of locality records already available in various literature and museum collections (*e.g.* ZSI, BNHS), at the level of protected areas; (b) an iterative analysis of protected area inventories resulting from the compilation, to test the extent of species coverage and to identify major gaps; (c) identification of additional areas to meet the stated goal; and (d) identification and field survey of taxa which are not covered in the protected area network. (see Chapter 3).

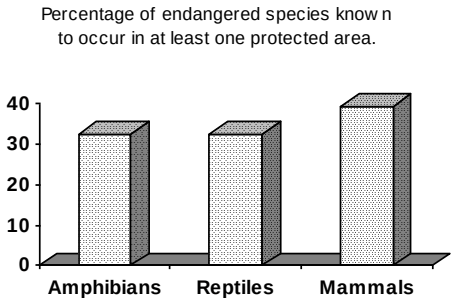
Box 5.1. How sufficient is our protected area network?

Nearly 600 protected areas in India cover about 5% of its land area. One goal of this network is to enclose viable populations of all wild species in India (National Wildlife Action Plan 2002). An analysis of the occurrence of endangered mammals, reptiles and amphibians reveals the network might be far from reaching that goal. The data for this come from Conservation Assessment and Management Plan (CAMP) workshops carried out under the BCPP. The assessment showed that amphibians and reptiles are at greater extinction risk than mammals and birds, due to their restricted distribution and greater sensitivity to habitat changes and fragmentation (see Figure). How many endangered species (Critically Endangered and Endangered together) are represented in at least one protected area? Answering is not easy since the information on distribution of species is very scanty. Locality records of many endangered species are decades old and do not refer to protected areas. Species inventories of protected areas are rarely published and often do not refer to lower vertebrates. Nonetheless, it is important to make such an assessment, at least to give us an idea of the magnitude of the problem. As evident from Figure below, only about 32% of the endangered amphibians and reptiles are known to occur in at least one protected area, and only 40% of the endangered mammals. The remaining species are not definitely known to occur in our protected area network.

Even after a systematic assessment we might find that our protected area network is grossly inefficient in its coverage of the lower organisms. The conservation of large herbivores and predators has been the major criterion in the selection of protected areas. This community was assumed to ensure the conservation of the lower organisms. However, the major centres of distribution of this community rarely coincide with the centres of distribution of the lower organisms. For example, in the Western Ghats the large prey-predators occur in very low densities in the tropical rainforest where species richness and endemism are highest among the herpetofauna and small mammals. Even when PAs are selected to represent biogeographic zones (Rodgers *et al.* 2000), the emphasis has been on a few relatively large areas so as to enhance persistence of species, covering at most 10-12% of the zone at best, *e.g.* Western Ghats. The assumption is that, like the large mammals, most of the other organisms of that region (*e.g* Western Ghats) would be represented in a few large protected areas. It is now becoming clear that this is far from true. For instance, the highly restricted distribution of many species of herpetofauna within Western Ghats is clear from data compiled during the BCPP as well as from recent field studies (Vasudevan 2001; Ishwar 2001). The very high species richness of amphibians and reptiles in the Western Ghats is, therefore, due to a high turn over of species, across drainage and altitude. Systematic collections in the Western Ghats probably reveal the existence at least 100 new species of frogs (Biju 2001), most of them from forest patches outside protected areas. Therefore, large protected areas in a few localities would not represent all the species in these taxa. What is perhaps more important is to have adequate geographical and altitudinal spread in protected areas. It is also important to consider habitats outside protected areas.

It should be a matter of great concern that the protected area network that we set up over the last 30 years at considerable cost may be far from reaching one of its major goals; that of harbouring at least all endangered species. It is very important, therefore, that we systematically reassess our protected area network in order to ensure that all our species are adequately covered. Conventional approaches such as using flagship or umbrella species (*e.g.* elephant and tiger), or a few large protected areas are not the answers to the problem of protecting a large majority of our threatened species.





Strategy 3. Ensure persistence of endangered species in protected areas.

In the protected area network (Rodgers *et al.* 2000), the representation of different fauna is addressed by using surrogates such as biogeographic zones, focal species *etc.* The persistence or continued survival of species is addressed by selecting large or selecting adjoining protected areas, which are likely to enclose large populations of the species that they contain. Inclusion of corridors was another strategy. For species which occur in low densities such as mega herbivores and large predators, the inclusion of large populations in protected areas should be a major strategy, since the remaining populations of these species are low. However, it is becoming clear that substantial populations of many endangered species occur outside protected areas; for example, elephant (30%) and tiger (30%, WWF 1999). Similarly, populations of many birds in the grasslands and wetlands, many of them endangered, outside protected areas are critical to their survival (see Box 6.3). The problem is poorly studied and perhaps more acute in the case of marine fauna and some riverine fauna such as dolphins. While a network of adjoining protected areas (or those connected by forested corridors) might be necessary for the large herbivores and predators, such protected areas might be widely separated in the case of migratory birds.

The management to ensure persistence of species was an issue that was beyond the scope of the report on protected area network (Rodgers *et al*. 2000). This is an issue that requires considerable attention because species differ considerably in their management requirements, and also because the protected areas in the network differ in the target taxa. Some habitats are typically transitional and require intensive management (*e.g.* grasslands and wetlands), strict protection alone in several cases have led to the decline of the target taxa. The case of Keoladeo National Park is well known. Other examples include the decline of the Great Indian Bustard from several protected areas (Box 6.3), blackbuck from Guindy National Park, and Nilgai from Dudhwa National Park.

Several other factors might influence the persistence of species in protected areas. The need for active management (in addition to protection) is also obvious from the relatively small size of most protected areas in India. The National Wildlife Action Plan (2002-16) has emphasized the need for (a) clearly stated mandate for each protected area, (b) the management plans to incorporate scientific and traditional knowledge, and (c) for scientists and local communities to be involved in monitoring the implementation of the management plan.

Action 1. *A systematic evaluation of the protected area network in order to assess whether large contiguous populations of important species are included in the protected network.* This should be another criterion while deciding the required extent of protected area network in India. Significant efforts have already been made in the case of tiger (Tiger Reserves), and elephant (Elephant Reserves or Ranges), although significant populations of these two still occur outside protected areas. However, a similar effort has not been made in the case of some predators such as wolf, wild dog (dhole), snow leopard, and migratory species (see below).

The major activities would include (a) compilation of data on population distribution, with a seasonal reference in the case of migratory species; (b) an iterative analysis to examine whether the large contiguous populations are included within protected areas; and (c) identification of major gaps. The preparation of a national faunal database would greatly facilitate this.

Ongoing efforts: A rapid assessment of the distribution of birds including large congregations is being carried out by the Bombay Natural History Society, while identifying the Important Bird Areas (IBA) in India. This shows that many of the IBA's might occur outside of protected areas (Box 6.4).

Action 2. *Protected area management plan should have a clearly stated mandate with reference to target taxa, and also reflect recent scientific findings on them.*

Recent years have seen substantial changes in the preparation of protected area management plans and as well as in its contents, especially due to the training in the Wildlife Institute of India. However, the fact that each protected area forms a part of a larger network and therefore has distinctive roles to play in the network (either as individual or groups of protected area) is yet to be recognised. As far as the wild animal diversity is concerned, there should be a clearly stated mandate on the taxa that form the focus of the protected area.

Even the findings from the very limited research on wild animal diversity often are not reflected in the management plans, due to several reasons. There is thus a need for mechanisms to incorporate recent research findings and local knowledge in the management plan. The need for involving local communities and researchers in the preparation of the management plan has been emphasised in the Wildlife Action Plan

(2002-16). It has in fact been practised in some protected areas recently (*e.g.* Kalakad-Mundanthurai Tiger Reserve).

Action 3. *Implement innovative ways of protecting species with local involvement.*
The importance of this comes in the light of declining protection staff at the disposal of most protected area management, and has been highlighted by the Subramanian Committee Report as early as 1994. Besides, the remoteness of some areas might also necessitate this. Such innovative programmes can often be used also to rehabilitate erstwhile harvesters of wildlife or their products. An example is given in Box 5.2.

Strategy 4. Integrate global warming into biodiversity conservation and protected area network.
It is now clear that global warming would bring about drastic changes in the survival and distribution of virtually all species, in the next few decades. Moreover, species would reassemble to form new communities and ecosystems. This is a phenomenon that no conservation strategy can ignore. Many countries have in fact attempted to project such changes and to incorporate these into biodiversity conservation strategies; *e.g*. South Africa (Rutherford *et al.* 1999), Canada (Scott & Suffling 2000), and United States (U.S. National Assessment Synthesis Team 2000). No such attempt has been made in India. Apart from strategies to limit the climate change to the extent possible, we also need strategies to deal with inevitable changes.

Action 1. *Modelling of biodiversity response to climate change in India.* This would require a multidisciplinary approach, and should address response of ecosystems and several indicator species.

Action 2. *A re-evaluation of the protected area network in the light of the above modelling.*

Action 3. *Incorporation of measures and guidelines for the management of protected areas to specifically address the fallout from climate change.*

Box 5.2. Conserving Edible-nest Swiftlet

While most swiftlets use saliva to bind leaf, moss or feathers into nests, the Edible-nest Swiftlet *Collocalia fuciphaga* builds its nest wholly of saliva. Ever since the 16th century, when swiftlet nests became important in Chinese pharmacy and cuisine, they have been exploited throughout their range. These nests are valued at US$ 2000-4000/- per kilogram in the retail market, ranking amongst the world's most expensive animal products. Collection pressures world wide have been excessive and uncontrolled resulting in widespread declines. In the Andaman & Nicobar islands, the western most limit of its distribution, the decline in population in most breeding sites has been over 80%.

Edible-nest Swiftlets roost and nest on rock facies in caves, tunnels, cracks or crevices in cliffs and grottoes. Several sites are on cliff faces that end in the sea, and the approaches to such sites are by boat. Most such sites are difficult, often perilous, to access. Nest collectors are highly skilled in rock climbing. Nest collection is often intense with collectors plucking the nests once every week or 10 days, even every day. As the swiftlets take about a month to build the nests and a further 70 days to lay and incubate the eggs and fledge the young, such intense collection has drastically reduced recruitment to the population.

The traditional conservation response to declining populations, that is protection, is not a feasible solution for three main reasons. First, the caves have to be vigilantly protected by having men at the mouth of the caves for 24 hours a day over a period of at least five months. As there are over 300 swiftlet caves in the Andaman & Nicobar Islands, this is clearly not feasible over wide areas. Second, most of the caves are at inaccessible locations making the placement of men at the mouths of the most caves impossible. Third, because of the high value of nests, the level of commitment and integrity of the protectors have to be of a very high order, and to maintain which they will have to be very intensely supervised. This too is not feasible over larger areas. Absolute protection, the traditional response to declining populations is therefore not a feasible solution.

The solution to the Swiftlet problem in the Andaman & Nicobar islands, indeed throughout its distribution, is the implementation of a scientifically managed system whose primary component is in the sustainable harvesting of swiftlet nests. Theoretically, this would mean that the swiftlet caves are `owned' by locals, who protect the caves from indiscriminate nest collection, whereby swiftlets can build nests, lay and incubate the eggs and fledge the young. On completion of breeding, the `owners' of the cave then can take the nests and gain monetarily.

Edible-nest Swiftlets can also be `farmed'. This entails the conversion of human habitation into cave like situation, attracting and establishing populations of swiftlets and then sustainably harvesting the nests. The farming of swiftlets is well established in Indonesia, where over 65000 kg of nests are produced from houses indicating a base population of over 5 million birds!

Is the exploitation of swiftlets ethical? Unlike exploitation of most animals, where killing for meat or skin is of primary importance, with Edible-nest Swiftlets the birds, their eggs or young are not harmed in any way, nor are they constrained. The birds are free ranging, and the nests are collected only when the breeding is completed. Thus the farming of swiftlets or the collection of nests from the wild can be compared to the milking of free ranging cows.

In the Andaman & Nicobar Islands, an *in-situ* and *ex-situ* conservation programme for the Edible-nest Swiftlet is currently underway. The programme commenced in 1999, and revolves around the protection of certain defendable swiftlet caves, primarily to build up seriously depleted populations. The majority of the protectors are erstwhile nest collectors. In one such site the decline in population of swiftlets has been arrested and in another site the decline is expected to stop in 2003. It is intended to extend the 'protect and harvest' systems at the different caves where the implementation of such a programme is feasible. Parallel to this, research and development is underway to establish populations of swiftlets within houses. While a population of Edible-nest Swiftlet has not yet been established within the experimental houses, it is expected that this will happen over the next year or two.

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6 CONSERVATION OF IMPORTANT SPECIES: IN COMMUNITY AND OTHER LANDS

6.1 THE IMPORTANCE OF NON-FOREST LANDS

It is becoming increasingly clear that land (including water bodies) outside of protected areas (defined in this context as land under the control of the forest departments) have an equally important conservation role. This is because;

- They contain the only populations of several animal species. For example, nearly 90% of nearly 110 new species of amphibians to be described in the coming months are known to occur only in private lands (Biju 2001, and *pers. comm.).* The Malabar civet, one of the two Critically Endangered species in the Western Ghats, is known to occur only in private lands (see Box 4.1).
- They contain significant resident populations of many endemics (*e.g.* nearly 30% of the endangered lion-tailed macaque), endangered species such as the Lesser florican, Great Indian bustard and several other species of water birds.
- Private lands close to protected areas are often used by several species as feeding and watering grounds, nesting sites *etc*.
- Since many protected areas (*e.g.* in the Western Ghats) surround private lands (and *vice versa*), the movement (seasonal or otherwise) of wide ranging animals (*e.g.* elephants and hornbills) are critically dependent on the private lands. Moreover, the seasonal migration and dispersal of many aquatic organisms are dependent on streams and rivers that flow through the privately owned landscape.
- Private lands are extensively used during the seasonal migration of several birds, especially waterfowls.
- Given the patchy distribution of several animal species in the tropics (a major reason for the high overall species richness), it is improbable that all the wild animal species in India would be represented in a protected area network even if it covers all the land presently under the Forest Department.

Despite the critical importance of private lands to the conservation of not only the wild animal species that they contain but also those in the protected areas, this is an area in conservation that has received very little attention, if at all. Private lands in this context

refer to land and inland wetlands owned by individuals, communities, corporate bodies (*e.g.* tea, coffee and cardamom estates), government departments other than forest department, *etc.* While the area that comes under different ownership is unknown, the conservation importance of these lands is disproportionately greater due to their geographic location and the nature of human activities that occur there. The private lands, which might be critical to conservation in this context, are undergoing rapid conversion. Among the most important habitats primarily outside the protected areas, and of considerable conservation importance, are the inland wetlands, corporate land in the Western Ghats, and the grasslands of the semi-arid regions of the Western India.

6.2 INLAND WETLANDS

Among all the habitats that are most critically important for the conservation of fauna, but fall by and large outside the protected area system, are the inland wetlands. This habitat covers nearly 4.1 million ha in India, of which nearly 2.6 million ha are man made showing their close association with man. Most wetlands are in a transition state between terrestrial and aquatic system, and thus have survived because of constant human management. They are driven by hydrological regimes at large scales whose disruption would change their transitional status. Nearly 85% of the important wetlands of the world are under some sort of threat, and 50% under serious threat, from settlement and agricultural encroachment, reclamation, domestic, industrial and pesticide pollution, over-fishing, siltation and erosion, harvesting of birds, introduced species *etc.* However, wetland conservation in India is far behind that of forest conservation, in the development of policies and programme as well as in the depth of coverage, knowledge base, eco-development initiatives and people's participation.

The conservation strategy for the inland wetlands should address landuse disturbances, altered hydrologies, and introduction of non-native species (Saunders *et al.* 2002), besides poaching.

Among the most important species in the wetlands are the waterbirds, of which many species and thousands of birds are winter visitors. The conservation of these water birds and their habitat, therefore, has international ramifications. Perhaps for this reason, the conservation of wetlands and water birds in India has been subject of international conventions, and bilateral or multilateral agreements. Surprisingly, domestic legislation and policies for the inland wetlands have not kept pace. As a result, the wetlands, several

hundred species (many of them nationally and globally threatened), and several thousands of birds occur primarily outside the mainstream conservation effort. The lack of understanding of the dynamic relationship between wetlands and people, and of the staging behaviour of the winter migrants has driven many species to endangerment.

A total of 420 species of waterbirds have been identified, of which 46% are fully dependent, 16% are less dependent and 14% are opportunists. Out of 78 globally threatened birds in India, 35 are wetland birds including 26 fully dependent and 9 partly dependent species (Lalitha Vijayan *pers.com*.).

6.2.1 Strategy and action plans

Strategy 1. Design and implement a protected or conservation area network for wetlands.

Action 1. *Design a protected area network for wetlands for conservation of wetland fauna, especially water birds, incorporating Asia-Pacific Waterbird Conservation Strategy 2001-05* (see Chapter 8).

Ongoing activities: Two important ongoing activities are addressing this issue to a considerable extent: the Inland Wetland Project being implemented by the Salim Ali Centre for Ornithology and Natural History (Box 6.1), and the Important Bird Area Programme being implemented by the Bombay Natural History Society (Box 6.2).

Action 2. *Make community conservation efforts an integral part of wetland conservation* (see Chapter 7).

Box 6.1. Inland Wetlands Project

This project, funded by UNDP and coordinated by the Salim Ali Centre for Ornithology and Natural History, aims at (a) Nation wide identification of candidate Ramsar Sites based on mapping micro and macro wetlands on an all India sample basis. This would use the results of the Wetland Project of the Space Application Centre. (b) Integrate field information with spatial data; and (c) Documenting the biodiversity rich wetlands of India and preparing a protected area network of wetlands covering the local wetland biodiversity of all the states. The project would also contribute and initiate a system of inland wetland inventory and monitoring.

The project includes mapping, and assessment of biodiversity (with special emphasis on waterbirds) contamination by pesticides and industrial effluents, and socio-economics. In the first phase, nearly 500 wetlands in different states would be covered during 2000-02.

The mapping is being carried at five centres of Regional Remote Sensing Service Centre and Maharashtra State Remote Sensing Application Centre. The selection of wetlands for sampling is based on size and satellite wetlands, thus addressing the network concept in the conservation of migratory waterbirds. Wide participation in the identification of wetlands, species documentation and sampling is a notable feature of this project.

A total of 420 species of waterbirds have been identified, of which 46% are fully dependent, 16% less dependant and 14% opportunists. Out of 78 globally threatened birds in India, 35 are wetland birds including 26 fully dependant and 9 partly dependant. The project also intends to produce maps of species assemblages (*e.g.* waders, herons, ducks), thus facilitating the implementation of another strategy of the Asia-Pacific Water Bird Conservation Strategy, that of generating actions plans for species groups.

The major outcomes would be:

- A user-friendly and cost effective process of wetland mapping from a biodiversity conservation perspective;
- An inland wetland information system encompassing *inter alia* socio-economic data on wetlands and ecological, ornithological and other biodiversity values; and
- Establishment of a framework for effective national, regional and sub-regional monitoring of wetlands using satellite data and other spatial information as well as ancillary data.

Sources:
Lalitha Vijayan
Salim Ali Centre for Ornithology and Natural History
Coimbatore 641 108

UNDP-India

Box 6.2 Important Bird Areas Programme (IBA)

Aim

The IBA Programme aims to identify, document and advocate the protection and management of a network of sites that are important for the long-term viability of naturally occurring bird populations across the geographic range of those bird species for which a site-based approach is appropriate.

Site based approach

The IBA Programme of BirdLife International is a worldwide initiative aimed at identifying and protecting a network of critical sites for the conservation of birds. The IBA Programme is being run by the Bombay Natural History Society (BNHS), the BirdLife Partner designate in India and is coordinated through the Indian Bird Conservation Network (IBCN). The IBA programme identifies sites of international importance for the conservation of birds and other biodiversity and collates and disseminates key information. Information availability on the importance and location of such sites is fundamental to the success of a site based conservation strategy. Given that birds are good indicators of overall biological diversity, most IBAs will also be important for other animals and plants. A significant proportion of bird (and other animal and plant species) can be effectively conserved by the protection of key sites, either as official protected areas (national parks and reserves) with necessary and appropriate management, and or through the promotion of sustainable land-use practices.

Coverage

The programme covers the 79 globally threatened birds in India, species that are endemic or have restricted ranges, congregatory birds, and assemblages of species that are typical to a habitat or biome. It also ranges across various habitats such as wetlands, islands, coastal areas, deserts, forests, grasslands and agricultural ecosystems. The BNHS have organised 9 regional workshops, and IBAs have been identified for all the states and union territories of India, except Daman and Diu, and Chandigarh.

However, species with highly dispersed or nomadic distributions may not be protected through this approach; *e.g.* large raptors, cranes and bustards, which are dispersed at low densities across wide areas and nomadic species. For some others, the IBAs might be appropriate only across some of their ranges or for parts of their life cycles *e.g.* colonial nesting species.

IBA Criteria

IBA sites are identified using four standard global criteria: (a) Sites that are internationally important for the 79 globally threatened species in India; (b) Sites for restricted range species or species unique to a small region; (c) Sites that support a species assemblage that are highly representative of a distinct biome; and (d) Sites for migratory and terrestrial species which congregate in high numbers Threat status, breeding/ non-breeding status, vulnerability through congregations and the proportion of the total population of each species that occurs at the site, are all important factors in determining a site's importance.

Source:
Report on IBA
Bombay Natural History Society
Mumbai 400 023

6.3 CORPORATE LANDS

Large extents of land are owned by corporate bodies and individuals and these have considerable biodiversity values. This is particularly true in the two biodiversity hot spots, the Western Ghats and Eastern Himalaya, including Sikkim and northeast India. The coffee plantations and cardamom estates, and forest fragments in tea estates in the Western Ghats are a typical example of how land outside protected areas have significant biodiversity values. These lands, covering nearly 3000 sq.km, occur within or adjoining protected areas. Most of the coffee and cardamom plantations in the Western Ghats still retain much of the original tree cover. Although the Western Ghats has the highest protected coverage in India (about 10%), the integrity of most protected areas depend critically on such estates, for several reasons:

- These estates are the stepping stones in the seasonal movements of large mammals and birds between and within many protected areas, providing the animals with daytime refuge as well as food. Often such seasonal movements are possible only through the estates.
- These fragments harbour substantial resident populations of some notable endemics such as the lion-tailed macaque, brown palm civet, Nilgiri langur, Malabar spiny dormouse, many birds, and reptiles such as *Salea anamallyana*.
- Studies in recent years have revealed that these fragments harbour many species of endemic amphibians and reptiles, and that some of these may not be found anywhere else due to the patchy distribution of many species. A recent survey has revealed the possible occurrence of nearly 110 new species of amphibians (Biju 2001), nearly 90% of them from private estates (Biju *pers.com*).
- Many estates have a high abundance of fruits in some seasons (*e.g Ficus*, *Cullenia* and *Artocarpus*) which are made use of by several species of birds and some mammals from adjoining protected areas.

Thus estates play a large role in the gene flow in large mammal and bird population in the area, besides having a high conservation value because of resident populations of many endemics. Most of the estates in the Western Ghats are under individual or corporate ownership, while some are under government ownership. The major threat to the biodiversity values in these estates is the fluctuating international prices of coffee and cardamom. The recent slump in coffee price is particularly disastrous, and many of the

estates are under pressure to convert their coffee estates into tea, or to replace natural tree cover with exotic trees such as silver oak. Such conversions would lead to the loss of all biodiversity values of these estates, and would also severely affect the integrity of adjoining protected areas. The crisis in tea estates also might have major impacts, as unemployed or underemployed estate workers are likely to supplement their income from adjoining protected areas through various means.

There is, however, some concern about conservation among the corporate bodies, although this is less so among the individual owners. This is evident from the formation of associations among the estate owners to promote biodiversity conservation, in several parts of the Western Ghats. Some of these have been formed several decades back (Nilgiri Wildlife Association), and some recently (*e.g.* Anamalai Biodiversity Conservation Association in the Anamalai Hills). There is considerable scope to promote conservation in corporate lands in the several parts of Western Ghats through such associations. The situation in northeast India, where also corporate lands have considerable conservation value, is not clearly known.

In other parts of India, water bodies in corporate land offer a good opportunity to promote conservation. For example, three water bodies the Panipat Refinery (Haryana) have more than 7000 ducks (Suresh C. Sharma, *pers. comm.*).

6.3.1 Strategy and action plans

Strategy 1: Provide economic or other incentives which would allow retention of natural tree cover in the coffee and cardamom estates, and prevent conversion of forest fragments into tea plantations in the Western Ghats.

The coffee that is grown in the Western Ghats has at least three major advantages that can be used to retain the natural tree cover. The Malabar coffee, due to its monsoon driven flavour, has been much sought after in the international market, nearly three decades ago. Unfortunately, the drastic decline in the quality due to the monopolistic procurement policies of the Coffee Board has led to the loss of international market on this count. Now the withdrawal of the Coffee Board from marketing provides an opportunity to improve quality and recapture the market. Second, coffee and cardamom are grown under natural shade in most parts of the Western Ghats. The use of fertilisers and pesticides is also low compared to many other coffee and cardamom growing regions of the world. These two together offers a unique opportunity to capture the growing market share in eco-friendly coffee and cardamom. Third, the coffee and cardamom estates retain fauna and flora which

can be of considerable value in eco-tourism. Lastly, the labour wages and other welfare in these estates are far better than that in many other countries, which can be made considerable use of in fair trade negotiations. Unfortunately, there has been no initiative to make use of these advantages so as to retain the natural tree cover, while also ensuring better financial return to the growers. One reason for this is that most of the growers affected have been small to medium owners who have retained coffee and cardamom estates.

Action 1. *The following actions need to be taken in order to address the above issues.*

- A professional assessment of the scope of marketing eco-friendly products such as coffee and cardamom under natural shade, and eco-tourism in the Western Ghats.
- An examination of other forms of incentives that would promote the retention of natural tree cover in these estates.

Strategy 2. Make a systematic assessment of the biodiversity values of corporate lands elsewhere in India.

While the importance of corporate lands in the Western Ghats has been well known, that in other parts of India is not, especially in northeast India. Of particular importance are the corporate estates in northeast India (including Sikkim) and waterbodies in corporate lands in other parts.

6.4 SEMI-ARID GRASSLANDS

The grasslands in the semi-arid zone of India have a unique fauna and conservation issues which highlight the fact that the conventional protected area approach may not be the ideal solution in a habitat which is mostly privately or community owned. Many of the species that occur in this area disperse over long distances during the dry period (*e.g.* lesser florican and Great Indian Bustard), have large home ranges (*e.g.* wolf), or are capable of surviving or even thriving in grasslands grazed moderately by domestic cattle (Jhala & Giles 1991; Rahmani 1996; Sankaran 1997). Some are, in fact, critically dependent on cattle grazing for their survival. Due to these reasons, as well as to the occurrence of large populations of domestic cattle, the scope for large protected areas is also limited. A combination of protected areas which are managed for designated species, and traditional grazing and agricultural lands might be best option for conservation of most fauna in the semi-arid grasslands. The issues in the conservation of wild animals in this habitat are

perhaps best exemplified by problems faced by the Great Indian bustard (Rahmani 1996; Box 6.3). The lesser florican is another example (Sankran 1997, 2000 a,b).

The situation in semi-arid grasslands is vastly different from that of the *terrai* grasslands in the Gangetic plains which receive a high rainfall. These grasslands support nearly 81 species of birds (Javed & Shafiq 2001), many endemic to the region and threatened; Bengal Florican, Swamp Francolin, Finn's Baya, Bristled-Grass Warbler and Large Grass Warbler. Many species here are threatened due to loss of habitat to agriculture, and have disappeared from outside the protected areas, at least as breeding birds (Javed & Shafiq 2001).

6.4.1 Strategy and action plan

Strategy 1. In order to conserve arid grassland fauna, it is necessary to manage the habitats, rather than merely protect them.

Action 1. *Establish with the co-operation of the state government and local people more conservation areas, which might include protected areas, community lands and private lands.*

Action 2. *Establish co-ordinated management of the conservation areas, so as to keep the grassland habitat ideal for the target fauna, while ensuring benefit sharing or other economic incentives.*

Action 3. *Co-ordinate long-term studies on bustards, associated fauna and their habitats in different states.*

Action 4. *Integrate habitat conservation with national grazing policy and over-all land use pattern.*

Action 5. *Produce educational material for publicity among decisions makers, stake holders, students, etc. specifically addressing the above issues.*

Box 6.3. The plight of the Great Indian Bustard and the semi-arid grasslands

Poaching of tigers and de-notification of protected areas have dominated the media so much that the slow disappearance of other endangered wildlife has been overlooked. Not many people know that the Great Indian Bustard is now on the brink of extinction. It is locally extinct from almost 90% of its former range and ironically it has disappeared from two sanctuaries made especially for its protection. In few other sanctuaries it is declining rapidly. Earlier it was mainly poaching and habitat destruction that resulted in such a pitiable situation, but now mismanagement of the habitat, sentimental protection of certain problem animals, and apathy would exterminate this species. Whenever we talk of wildlife protection, we think of some forested area that needs protection from cutting or encroachment or other human use. Grasslands, wetlands, coasts, rivers, and rural landscapes rarely find a place in conservation priority, although some of the most endangered Indian species are found in such habitats.

Four members of bustard family are found in India: the Great Indian bustard, Houbara Bustard, Lesser Florican, and the Bengal Florican. The Great Indian Bustard is a large handsome bird of the short grass plains of the Indian subcontinent. Formerly it was widely distributed from Punjab and West Bengal to Tamil Nadu, and Sind (in Pakistan) to Orissa. Now it is confined to a few pockets in Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Andhra Pradesh and Karnataka states of India. Fewer than hundred survive in Pakistan. It is always found in the grassy plains, some times highly overgrazed by livestock or wild herbivores, and strictly avoids hilly and forest regions. It shares its habitat with Blackbuck, Chinkara, Nilgai, Wolf, Fox, Jackal, and Jungle Cat. The majestic Great Indian Bustard is an indicator of the health of grassland ecosystems of the Indian plains.

Conservation measures

In the early 1980s, the five states where the Great Indian bustard is still found, took some conservation measures and eight protected areas were declared. Despite this, there has been an almost 50% decline in its population during the last 10-15 years. Now 400-500 bustards survive in India, making them one of the most endangered species of bustards in the world. This raises the question: Is the sanctuary approach appropriate for the protection of species that live in low density in scattered grasslands and marginal crop fields? The answer is yes and no. The sanctuary approach certainly helps in curtailing poaching but unless appropriate habitat management measures are taken, declaring a sanctuary for bustard does not help in the long run. Now the question comes: How do you take 'appropriate habitat conservation measures' in someone's private land? Or, what do you do if the conservation measures increase crop damage by wild ungulates? Should we kill the problem ungulates to get the support of rural communities for the rare bustards, or should we allow the problem to fester and see the disappearance of a highly endangered species? The major problems include (a) Habitat destruction and deterioration: Too many domestic animals, disturbance during breeding, conversion of grasslands and so-called wastelands into crop fields; (b) Poaching which is still widespread in parts of the Thar desert in.Rajasthan; (c) Increase in blackbuck and nilgai numbers resulting in crop damage and resentment by villagers against conservation in general, and bustard in particular; (d) Total mismanagement of bustard sanctuaries; and (e) Lack of clear cut land-use policy and livestock grazing policy in India.

The Need for Project Bustards

Project Tiger and Project Elephant have shown that by focusing on them a substantial part of our natural ecosystem that benefits an array of threatened species can be protected. Bustards and floricans are indicators of the grassland ecosystems and by conserving them and their habitats, a very large number of species of the grasslands will also be protected. Protection and proper management of these grasslands would also benefit the local communities. The grasslands are now under-represented in the protected area network. Some of the bustard sanctuaries have been destroyed by misguided management practices. There is no co-ordination among and within states. We do not know even the basic biology of these highly endangered and declining species. Taking in to consideration all these factors, the Government of India should start 'Project Bustards'' on the line of Project Tiger. Unless we take concerted measures such as Project Bustards, the future of the Great Indian Bustard is very bleak. The BNHS is starting a one-year intensive campaign to convince the government of India to take appropriate measures to reverse the decline of the Great Indian Bustard and to start Project Bustard.

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6.5 MARINE HABITAT

The marine habitat is unique in high faunal diversity (with many phyla not represented elsewhere), low endemism, high human use, a wealth of information on fisheries of human use, relatively low information about conservation status, and low protected area coverage (<0.3%). Very little information is available of several taxa, including marine mammals and invertebrates with low or no use value (see Menon & Pillai 1996). About 12,500 marine and estuarine species occur in India (Alfred & Nandi 2002). The conservation of the marine fisheries has a set of unique issues which have been dealt with elsewhere (see Box 6.4). An ecosystem based approach has been suggested by Vivekanandan (2001b). This requires a major shift in marine management paradigms, and demands an adaptive strategy that directs and derives from goal-driven monitoring and research efforts (Roberts 1999; Arthur 2000b).

What is important is that marine fisheries have had important consequences on the survival of several other species of high conservation value (5 species of marine turtles and 35 species of marine mammals such as dolphins, whales and dugong) through incidental catches and propeller hits. However, data on these species are very sparse. In fact, most of data on these come from incidental catches or mortality in marine fisheries (Lal Mohan 2001). This source has also dried up since it is now illegal to posses or sell any of the marine turtles or mammals.

The protection of marine turtles, marine mammals and other fauna is now primarily dependent on protected areas which cover <0.3% of the coastal and marine area. To protect the sea turtles, Bhitarkanika and Gahirmatha (65,000 ha) in Orissa were declared as wildlife sanctuaries in 1975. In addition, India has four coastal mainland national parks and 17 protected areas. There are 96 sanctuaries in the Andaman and Nicobar Islands (Rodgers *et al.* 2000). A `Recovery Program' for the Olive Ridley was started by the Central Marine Fisheries Research Institute along the Madras coast as a conservation measure due to the heavy predation on eggs by man as well as wild animals. Under the `Recovery program' nearly 60,000 Olive Ridley which hatched out at the CMFRI field Laboratory, Kovalam have been released from 1977 to 1987 (Rajagopalan 1997). Other initiatives for the conservation of marine turtles include Olive Ridley Sea Turtles Conservation Project (see Section 5.2.3.3), and the implementation of turtle exclusion devices in trawlers in some states (*e.g.* Andhra Pradesh).

While marine turtles have attracted considerable attention, many other marine or estuarine mammals, some of them high endangered, have received virtually no attention. Typical examples are the dugong (see Box 4.1) and the Irrawady dolphin. The former is the most endangered marine mammal in India with no sightings of a substantial population for the last several decades. It is thus obvious that marine conservation efforts have been highly skewed in favour of marine turtles.

The coral reef, as an ecosystem, has also been little studied, until recently. The effect of El Niño, for example, is relatively unstudied in the Indian waters, compared to many other parts of the world (Arthur 2000a, 2001).

6.5.1 Strategy and action plans

Strategy 1. An assessment of the conservation status and distribution of marine mammals and coral reefs along the Indian coast so as to integrate their conservation into the management of marine fisheries.

Action 1. *A survey using various methods (including aerial survey) to assess the occurrence, distribution, and abundance of marine mammals along the Indian coast.* Of particular importance is the dugong for which an aerial survey is the only way of making such an assessment.

Action 2. *Identify major gaps in the conservation of marine mammals, in terms of protected area coverage, integration with fisheries management and regulation.*

Action 3. *Initiate a research program on the reefs in the Indian waters so as to identify major threats including the effect of El Niño.*

Box 6.4. Marine fisheries conservation and sustainable use

Vivekanandan (2001a, b, c) has made a systematic evaluation of the conservation issues about marine fisheries. The value of the marine fish production of 2.7 million tonnes during the year 2000 was Rs 10,000 crores and the value of marine products export was Rs. 6,300 crores. The annual catchable potential of the Indian waters is 3.9 million tonnes; 2.2 m t from the inshore waters and 1.7 m t from the offshore waters (Ministry of Agriculture 1991). The fisheries exploit about 200 species belonging to about 50 groups every day – though a few may contribute 50% of the catch. The catch from the inshore waters is currently 2.2 m t and thus fully exploited. However, the decline in catch rate (the per capita production per active fishermen declined from 3250 kg in 1980 to 2240 kg in 2001 (source CMFRI homepage)) and several other biological parameters indicate that the status marine fisheries is not adequately reflected in potential and actual yields.

Conservation issues

The issues in the marine fisheries sector are unique. The fisheries resources are renewable but limited in nature. The fishes show diverse life histories which make some of them highly susceptible to harvest (*e.g.* sharks) and not others (*e.g.* clupeids). There are several uncertainties while setting management priorities for sustaining the biodiversity and the multispecies fisheries. The resources are common property with open access. The fishing operations will not stop until profitability reaches very low levels. For sustaining the inshore fisheries and biodiversity, there is need for an effective management system to intervene and regulate the activities of the fishers.

Several state governments have introduced marine fisheries regulation acts. These acts demarcate zones for fishing by non-mechanised and mechanised fishing vessels. There are regulations on the codend mesh size of trawls. There are also seasonal closure of fishing operations by the mechanised vessels. In general, such restrictions on fishing are difficult to implement.

Application of ecosystem approach

The main implication of the ecosystem-based fisheries management should be to cater to the well being of ecosystem as well as communities. While it is a major conceptual advancement, the practical problems raised by this recognition are immense. There is still uncertainty as to how to implement an effective ecosystem-based management system in practice. Amongst the immediate steps that should be taken up by India in moving towards ecosystem-based fisheries resource and biodiversity sustainability management are the following (Vivekanandan 2001b):

(i) Ecosystem classification and zonation

The ecosystems supporting fisheries along the Indian coast vary markedly, and the status of exploitation in each ecosystem and the way in which fisheries are managed within them will also vary according to their individual characteristics.

(ii) Setting objectives and options for each ecosystem

The objectives must be agreed upon for each ecosystem, in consultation with all legitimate stakeholders and interest groups. The objectives should include both long-term and short-term goals to increase the fish biodiversity as well as the biomass and should cover biological, socio-econimic and institutional issues.

No-fishing zones in the open waters can double the overall (multispecies) levels of biomass per unit area in two years. However, there is no direct experience of reserves along the Indian coast barring marine sanctuaries to protect coral reefs and mangroves. Fisheries managers in India may have to start working on how much of the fishing grounds should be placed in reserves, how many are needed, and where should they be. Resource enhancement programs such as sea ranching or installation of artificial reefs may be implemented in a few specific ecosystems.

The question is how India is prepared to adopt ecosystem-based fisheries management. The ecological considerations do not expect the halt of traditional, locally based management systems. However, the traditional community-based approach will have to be re-invented, within the specific cultural, social and economic constraints. Foremost among these is the requirement to involve all stakeholders.

Source
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Chennai

7 LOCAL COMMUNITIES AND CONSERVATION

7.1 STATUS OF COMMUNITY CONSERVATION

Traditional communities in India have a long and varied history of conservation practice which has profoundly influenced the survival of several hundred species of animals (see Kothari *et al.* 2000, for a review). Often this has been linked to the efforts of these communities to sustain their resource base, and has involved restrictions on removal of trees and other plant products, restrictions on hunting in terms of seasons, species, number of animals, life stages, methods *etc.* (Gadgil & Guha 1995). It has been estimated that nearly 10% of the geographical area of India had been so protected historically (Gokhale *et al.* 1997, cited in Kothari *et al.* 2000), an area twice the size of the protected area network at present. There are also several instance of communities actively protecting populations of several species, the well known examples being that of the Bishnoi community protecting black-buck, the villagers in Kokkare Bellur (Karnataka) protecting nesting colonies of spotbilled pelicans and painted storks, and villagers in Assam protecting nesting colonies of adjutant storks, one of the rarest storks in the world (see Kothari *et al.* 2000, for case studies). The protection afforded to monkeys in hundreds of villages and temples in India is another example.

However, recent decades have seen a drastic decline in such protection due to several reasons, which are as yet poorly understood (Kothari *et al.* 2000). Although the intervention by NGOs or provision of incentives by the Government (Forest Department) has been successful in some places in halting this decline to some extent, it is clear that without a drastic change in the framework within which the community led conservation operates, the decline would continue. This also became evident from a recent assessment of the folk ecological knowledge and wisdom in 52 village clusters in 8 states in India (Box 7.1). Although it is a matter of concern, the conservation of biodiversity is not in the immediate agenda of most communities (Gadgil *et al.* 2000).

7.2 COMMUNITY KNOWLEDGE OF WILD ANIMAL DIVERSITY

The nature and extent of knowledge that communities have on wild animal diversity has not been systematically assessed. We made a preliminary analysis with the data compiled during 1996-98 under BCPP (see Box 7.1) in order to examine the nature and extent of

folk or community knowledge about wild animal diversity *per se*. The People's Biodiversity Register (PBR) reports are very detailed and exhaustive. Details about the methodology, peoplescape, lifescape, ecological history, management options, development aspirations, conflicts and consensus, and strategy and action plan are clearly given. The important species of plants and animals that are found in the habitat surrounding the village are also given, mainly based on the interaction the people have with plants and animals – either directly or indirectly. The following questions were considered with regard to people's participation in the formulation of strategy and action plan for wild animal diversity:

- What is the nature and extent of the knowledge with the people about wild animal diversity (these were mostly rural or forest-dwelling communities)?
- Who or which section of the society really holds this knowledge?
- What factors govern the distribution of this knowledge and its continuation and sustainability?
- How can this knowledge be used in developing strategy and action plan in actual conservation?
- What needs to be done to nurture and use this knowledge?

Extent of knowledge

Local people's knowledge about animals is often associated with use (hunting and fishing), nuisance (crop raiding and cattle lifting) or some charismatic characteristics of the species. Of the total species about which they are aware, about 25% are the ones they are concerned about. Of these, 80% are due to commercial/use value and rest with nuisance value. The following table (Table 7.1) shows a preliminary assessment of the extent of the people's awareness about the occurrence of various species in their surrounding in 23 sites from 4 states.

Table 7.1. The extent of community knowledge about wild animals in 23 sites from 4 states. The data were collected during 1996-98, under the BCPP (Gadgil *et al.* 2000)

Taxa	No. of species known				Sites
	Mean	S.D.	Min.	Max.	
Mammals	14.65	7.36	5	29	20
Birds	34.25	22.8	9	100	20
Reptiles	8.5	5.47	2	18	6
Fishes	17.11	9.64	7	41	19

Box 7.1. People's Biodiversity Register (PBR): An attempt to promote folk ecological knowledge and wisdom.

The most extensive study of folk ecological knowledge in India was carried out during 1996-98 under the BCPP (Gadgil *et al.* 1996, 1998, 2000), covering 52 village clusters (in rural and forest setting) in 8 states (Andaman Nicobar Islands, Assam, Bihar, Himachal Pradesh, Karnataka, Maharashtra, Orissa, and Rajasthan), representing different ecological and social regimes. Besides documenting current folk knowledge and recent trends, the study also attempted to find new contexts and other ways and means by which such knowledge can be put to practice and thus maintained. The study was preceded by several training workshops and the preparation of a methodology manual (Chhatre *et al.* 1998), and the field study itself was carried out by local investigators that included lectures, school teachers, NGOs, and government officials. Others involved were nearly 350 researchers from the same sectors and 200 assistants from villages. Nearly 1000 villagers actively participated in the program as local knowledgeable individuals. Thus, in terms of its geographical coverage and involvement of personnel there are few parallels to this study. The findings of the study have major implications in the conservation of wild animals in lands other than that covered by the protected areas.

- There has been a widespread decline in folk ecological knowledge and traditions of conservation and sustainable use, which is amply evident among the youth. There are exceptions, however; in fishing communities (in Chilika) much of the knowledge still persist even among the youth who continue to put it to practice.
- Thus, greater knowledge of biological resources is associated with greater dependence on it. However, such segments of the society are also the poorest and politically the least powerful.
- There has been a steady decline in the biological resources (in diversity and productivity) in ecosystems managed under the folk knowledge, with rare exceptions. The reasons for this drastic decline are many.
- Although conservation and sustainable use are not among their major agenda, people are concerned about loss and erosion of biological resources.
- The suggestions put forth for maintaining folk knowledge and putting it into practice are locality specific. The suggestions show a deep understanding of the factors that has influenced the loss of biological resources, and the conflict of interest among different stakeholders that constrain conservation in the current scenario.
- Due to these conflicts, some form of co-operative management among villagers, local educational institutions, NGOs, and government agencies is required for effective conservation and sustainable use of biodiversity in community lands.
- Among the important issues to be addressed are definition of resource boundaries, benefit sharing, economic and other incentives to offset opportunity costs, enforcement machinery and process, and flexible management.

Who holds the knowledge?

Most of the PBRs identifies the peoples into three types of user groups; primary-for whom wild animal diversity is a major livelihood; secondary-the people who are into service sector as well as involved in some biodiversity related activities in their spare time; tertiary-the people who are in service sector but have some stake/influence in the biodiversity related matters indirectly. The primary user groups such as NTFP collectors, hunters, fishermen, and agriculturists are the major holders of information related wild animal diversity.

Type of Knowledge

In most of the sites more data have been reported on the tree species diversity and medicinal plants, compared to animals. Local people's (general public) knowledge about the wild animal diversity is restricted to the name and identity of the animals, their location and some qualitative information on their rarity/abundance. Some small groups whose livelihood related to wildlife through hunting or fishing have more specific knowledge on the behaviour, habitat preference and life history strategies of all the animals they regularly deal with. Additional knowledge about wild animal diversity is sometimes associated with livelihood other than hunting or fishing. For example, in areas like Bharatpur local people know more bird species due to tourism. However, wetland sites have given an exhaustive report on the species diversity of birds and fishes (*e.g.* Kanwar Lake and Hazaribag in Bihar, Bharatpur in Rajasthan and Chilka in Orissa), probably because (a) They are easier to spot in a wetland than in a forest canopy; (b) There are more birds, especially migratory birds in the wetland; or/and (c) Because the people use the water body more- fishing, water collection, bathing, *etc.* people are more aware of these birds.

However, as Gadgil *et al.* (2000) have concluded, biodiversity conservation does not seem to be on the immediate agenda of most communities. This is particularly true in the case of wild animal diversity, with very few strategies and action plans recommended by the surveyed village clusters addressing the conservation of wild animal diversity. The exceptions pertain to conservation of fish resources and birds in tourism areas. Other references to wildlife pertain to crop damage and other nuisances, and the need for adequate compensation.

7.3 CONSTRAINTS

It is clear that the knowledge, skills and attitudes of the local people who live in the immediate vicinity of biodiversity sites have to be integrated into any plan for conservation of wild animal diversity. Involvement of the people can be in prioritization of species and actions, development and implementation of management plan which might include protection and sustainable use of certain resources in areas. Even while this is being increasing recognised, unfortunately community knowledge base and the context in which it has functioned is rapidly declining due to several reasons (see Kothari *et al.* 2000, p 139 for a review, and Gadgil *et al.* 2000 for a case study). This is especially so in the case of wild animal diversity. Gadgil *et al.* (2000) have also identified several factors which should be considered while developing a new framework and context for promoting the

practice of community conservation. More over, these factors and their relative importance vary from place to place (and from time to time) so that generalisations are often simplifications of no value.

The declining community knowledge and commitment to biodiversity conservation, the lack of a model for devising new context and other means of promoting community conservation, and overriding influence of local factors are thus major constraints, especially in the conservation of wild animal diversity in areas outside protected areas. These constraints become important in the light of the proposed amendments to the Wildlife (Protection) Act (1998) so as to create new categories of conservation areas like 'community reserves' and 'conservation reserves' (NWAP 2002).

7.4 STRATEGY AND ACTION PLANS

Strategy 1. Ensure that the new conservation area categories would not break down or accelerate the already declining community conservation efforts in different parts of the country.

Despite the declining community knowledge and conservation efforts, an amazing array of wild animal diversity still survive in the landscape outside of the protected areas. Much of this animal diversity is of considerable conservation significance, especially in wetlands, semi-arid grasslands, alpine grasslands, corporate lands, and marine areas. One of the major reasons for the loss of biodiversity in community lands has been legislation alienating the land and other resources (see Kothari *et al.* 2000; Gadgil & Guha 1995). Studies have shown that half hearted governmental intervention has often accelerated the already declining community efforts at conservation *e.g.* the case of spotbilled pelicans and painted storks in Kokkare Bellur (Karnataka) (Kothari *et al.* 2000). Mediation of conflicts of various kinds and intensities, and substantial economic benefits to counter the costs are among the important considerations.

Action 1. *Develop framework within which the new categories of conservation areas would operate, in terms of common objectives, conflict resolution, benefit sharing etc. based on case studies in representative areas.*

Action 2. *Ensure that legislation is flexible enough to accommodate the variety of management systems that might be required.*

Strategy 2. Due to the above constraints, community conservation reserves should not be considered as an alternative to protected areas.

Strategy 3. Prioritisation of community and other lands for inclusion in the new conservation areas.

The new conservation areas are expected to supplement the protected area network by enclosing significant populations of threatened species and also complement it by enclosing the only populations of some species. The candidates for inclusion in the new conservation areas would number in hundreds while resources would be limited. Therefore, their selection should be based on a set of criteria that should include gaps in the protected area network in terms of species representation, threat status of species, population size *etc*. in addition to other considerations such social acceptability and feasibility.

Although community conservation has attracted much attention, conservation by corporate bodies and individuals are also very important in some areas *e.g.* Western Ghats.

Action 1. *Prioritisation of community lands and other lands for inclusion in the new conservation areas, based on the occurrence and abundance of threatened species, gaps in the present protected areas network, values as corridors etc.*

Some information for this might already be available in the case of wetlands (see Box 6.1 & 6.2), especially with reference to birds. Birds in other habitats have also been covered by IBA. Information on species occurrence (vertebrates) in corporate lands might also be available in the Western Ghats.

8 CROSS BORDER ISSUES

8.1 INTRODUCTION

The main cross border issues in the context of wild animal diversity include migration, non-migratory animal movement across boundaries, and poaching and trade in wild animals. The last of these have been addressed elsewhere (Chapter 5). India has been a prompt signatory to almost all international conventions that address cross border issues in the conservation of wild animals, the major ones being CITES, Ramsar Convention (on wetlands), Bonn Convention (on migratory species), and CBD. However, these have been rarely followed with domestic legislation, policies or action (NWAP 2002). Bilateral agreements or understanding with neighbouring countries, often a mandatory follow up from international conventions, have also been few.

8.2 MIGRATION ACROSS INTERNATIONAL BORDERS

Several animal species belonging to different taxonomic groups move periodically and predictably over long distances, often across the borders of several countries, *e.g.* terrestrial and marine mammals, birds, and marine turtles. These migratory species are prone to several varieties of threats in different countries that they move through. Due to this reason, co-operative effort among several countries is needed in order to ensure the conservation of migrant species. The need for cooperative action among countries for the conservation of migratory species was recognised by the Stockholm Declaration on the Human Environment in 1972 (Recommendation 32). India is a signatory to the Bonn Convention on the Conservation of Migratory Species or CMS (1979, which came into effect in 1983) which resulted from the Stockholm Declaration (see Box 8.1). CMS calls upon Parties to implement several measures for the conservation of endangered species listed in Appendix I, and also to develop bilateral agreements or MoUs for the conservation of species or groups of species listed in Appendix II.

Five species of marine mammals, 15 birds, 4 marine turtles and the gharial which occur in India are listed in Appendix I, and another 5 species of mammals, 15 birds and saltwater crocodile are listed in Appendix II of the CMS (see Appendix 8.1 for a species list). The CMS, therefore, places considerable responsibility on India for the protection of these species as well as their habitats (see Box 8.1 on duties and responsibilities on Range

countries). Apart from measures to conserve the species and their habitats within the country, the CMS provides for bilateral or mulilateral agreements/MoUs to develop co-ordinated species management plans for (a) conservation and restoration of habitats; (b) control of factors impeding migration; (c) co-operative research and monitoring; and (d) exchange of information and public education.

India is also member of the Asia-Pacific Migratory Waterbird Conservation Committee (MWCC) which has recently released the Asia-Pacific Migratory Waterbird Conservation Strategy for 2001-2005 (see Box 8.2). The key elements of the strategy include (a) action plans for species-groups and globally threatened species; (b) effectively managed networks of sites that are internationally important for migratory waterbirds; (c) capacity building; and (d) harmonised national and state policies and legislation.

Despite being a signatory to the above conventions and agreements for many years, India has not followed up these with domestic legislation, policies and action plans, and bilateral or multi-lateral agreements for the protection of migratory species. The need for this has been highlighted in the NWAP (2002). An exception to this is the Indo-Russian agreement signed in 2000, which would facilitate collaborative research on several species of migratory birds using satellite telemetry agency.

Box 8.1. Aims and instruments of the Convention on Migratory Species

CMS aims to conserve migratory (avian, marine and terrestrial) species over the whole of their range. The Convention provides a framework within which Parties may act to conserve migratory species and their habitats by:

- adopting strict protection measures for migratory species that have been categorised as being in danger of extinction throughout all or a significant proportion of their range (listed in Appendix 1 of the Convention);
- concluding Agreements for the conservation and management of migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation (listed in Appendix II of the Convention); and
- undertaking joint research and monitoring activities.

Appendix I. Endangered migratory species

Appendix I lists migratory species which, according to the best scientific evidence available, are endangered. This Appendix currently includes more than 85 species

Range States are obliged to:

- prohibit the taking (*i.e.* hunting, fishing, capturing, harassing and deliberate killing) of animals of Appendix I species, with few exceptions
- endeavour to conserve and restore important habitats of Appendix I species, to counteract factors impeding their migration and to control other factors that might endanger them.

Appendix II. Migratory species conserved through agreements

CMS provides for the development of specialized regional Agreements for individual species, or more often, for a group of species listed in Appendix II. In addition, State Parties to CBD should consider that CMS is one of those "*international organisations*" through which CBD Parties are invited to cooperate "*in respect of areas beyond national jurisdiction and on other matters of mutual interest, for the conservation and sustainable use of biological diversity".*

Appendix II lists migratory species that (1) have an unfavourable conservation status which requires international Agreements for their conservation and management, and (2) would significantly benefit from the international co-operation deriving from an international Agreement. Parties within whose territory such migratory species occur shall endeavor to conclude Agreements which can range from legally binding multilateral treaties to less formal MoUs. The object of such Agreements is to restore the migratory species to a favourable conservation status or to maintain it at that status. More specifically the Agreements should provide for (a) co-ordinated species conservation and management plans; (b) conservation and restoration of habitats; (c) control of factors impeding migration; (d) co-operative research and monitoring; and (e) exchange of information and public education.

The Convention also provides for Agreements for the conservation of any population or geographically separate part of the population of any species of wild animals which periodically cross jurisdictional boundaries (Article IV, para 4). This flexibility provides for the development and conclusion of targeted treaties which can be the most effective instrument for the conservation and management of certain species or groups of species. Under this category of "agreement", the geographic coverage does not have to extend to the whole of the migration range of the species concerned, nor does the species have to be listed in Appendix II of the Convention; the species does not even have to fall within the narrow definition of "migratory" .

CMS requires (a) that the Parties have national legislation for strict protection of endangered species (Appendix I) to which the country is a Range State, as well as to the conservation and restoration of their habitat; and (b) implementation at national and international levels through programmes and/or direct action. National activities such as research, monitoring, removal of obstacles which impede the migration of species may benefit from having a legislative basis.

Box 8.2 Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005
Prepared by Asia-Pacific Migratory Waterbird Conservation Committee

Summary
Complementary actions in all range states are essential for the conservation of migratory species. The Asia-Pacific Migratory Waterbird Conservation Strategy: 1996-2000 was developed, in recognition of the threats to migratory waterbirds. The Strategy has been actively supported by the governments of Australia and Japan and coordinated by Wetlands International. An international committee, the Asia-Pacific Migratory Waterbird Conservation Committee (MWCC) was established to monitor the implementation of the Strategy. The MWCC comprises seven government representatives including India, Ramsar Convention, Bonn Convention, BirdLife International and WWF, a representative of the UNDP/GEF, chairs of technical Working Groups for Anatidae, cranes and shorebirds, and a Wetlands International Specialist Group Coordinator. The Strategy has been very successful in promoting international cooperation and an awareness of the need to work together to promote conservation. A number of international and national activities have been undertaken, primarily through the implementation of three regional migratory waterbird conservation action plans (shorebirds, cranes and Anatidae) including the establishment of three networks of sites of international importance for these groups of waterbirds. The networks (as at December 2000) comprised 67 sites in 11 countries with new sites being added each year. Based on the successes of the Strategy over the past five years, the MWCC recommended the development and implementation of this second Strategy for the period 2001-2005. The Strategy outlines eight key elements to promote the conservation of migratory waterbirds and their habitats:

1. Action plans for species-groups and globally threatened species.
2. Effectively managed networks of sites that are internationally important for migratory waterbirds.
3. Raised awareness of waterbirds and their link to wetland values and functions throughout the region and at all levels.
4. Increased capacity of government agencies and non-government organisations to implement conservation actions for migratory waterbirds.
5. An enhanced knowledge base and increased information exchange for the sound management of migratory waterbirds and their habitats.
6. Harmonised national and state policies and legislation as a foundation for the conservation of migratory waterbirds and their habitats.
7. Enhanced organisational relationships at all levels to increase cooperation and deliver greater conservation benefits.
8. Adequate planning and resources to implement the Strategy.

Implementation of the Strategy will require cooperation between governments, conventions, international and national corporations, bilateral and multilateral donor agencies, international and national non-governmental organisations and local communities.

8.3 NON-MIGRATORY MOVEMENT ACROSS INTERNATIONAL BORDERS

Non-migratory movement of animals occurs across borders of neighbouring countries. In the case of India such movement occurs across borders with Pakistan, Nepal, Butan, China, Bangladesh, and Myanmar. Animals that move across national borders are prone to several threats in the countries that they move into, as in the case of migratory species. Habitat loss and degradation and poaching are among the most important. Cooperative action among neighbouring countries is necessary in order ensure that cross-border

movement of animals are not hindered and does not pose a threat to conservation. A provision for multilateral agreements for the conservation of such species is provided in the CMS (Article IV, para 4). Unlike migratory species, however, cross-border movement of animals has not received much attention in India till recent years. The following are among the major initiatives.

Sundarban Biodiversity Management Project: Bangladesh and India will work together under a United Nations plan to protect the eco-system and bio-diversity of Sundarban, the world's biggest mangrove forest shared by the two countries. Bangladesh and India currently use different approaches to protect the same eco-system. Nearly two-thirds of the 9,630 square km Sundarban lies in Bangladesh and the rest in India, stretching along the Bay of Bengal. Sundarban is home to the endangered Royal Bengal Tigers and a number of other unique species such as Batagur turtle. But it is facing a number of threats including poaching, the felling of trees and dwindling freshwater flow.

Terai Conservation Area Project: This project proposes to address conservation issues at a landscape level, including trans-border issues between Indian and Nepal.

Trans-border consultation meeting between India and Nepal: This meeting for biodiversity was organised in 1999, under the Tiger Conservation Project of WWF-India (WWF 1999). It approved a declaration and action plan, which included:

- Acceptance of the fact that trans-border fauna is a shared source and that adjacent trans-border protected areas should complement each other;
- Measures to ensure easy movement of animals across the borders and to check smuggling of wildlife products;
- The need for harmonising Indo-Nepal Trade Treaty (1996) with CITES;
- The need for allowing tran-border migration of aquatic fauna;
- The need for simultaneous wildlife census, periodic meeting of forest managers from bordering protected areas, and periodic exchange of information.

8.4 STRATEGIES AND ACTION PLANS

Strategy 1: Harmonize legislation, policies and management measures for the conservation of migratory species at the regional level, using the flyway approach in the case of birds.

The conservation of Indian wetlands and waterbirds has been influenced more by international conventions than domestic policies. Apart from CBD, two other conventions

(the Ramsar Convention, and the Convention on Migratory Species, CMS) deal specifically with wetlands, especially in the context of migratory water birds. While six wetlands have been notified as wetlands of international importance under the Ramsar Convention, multilateral (on conservation of the Siberian crane) and bilateral agreements (with Russia) or MoUs have been signed under the CMS. A conservation strategy and action plan (2001-05) for Asia-Pacific migratory waterbirds has been prepared by the Asia-Pacific Migratory Waterbird Conservation Committee (AMWCC 2001) in which India was also represented. (see Box 8.2). There is thus an urgent need to have bilateral and multilateral agreements so as to harmonise legislation, policies and management measures for the conservation of migratory species at the regional level, using the flyway approach in the case of birds.

Strategy 2. Develop action plans for the conservation of migratory bird species or species groups, as called for by the Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005.

Action 1. *Identify bird species and species groups that are in immediate need of action plans for conservation.*

Action 2. *Identify a network of sites which need to be managed for the conservation of migratory birds, and action plans for their conservation.*

Ongoing efforts: Two major ongoing projects, the Inland Wetland Project and the Important Bird Area Project (see Boxes 6.1 and 6.2, respectively) are expected to provide much of the information needed for developing the above action plans, in the case of birds.

Strategy 3. Develop action plans, including bilateral agreements, for the conservation of migratory mammals and reptiles.

Besides birds, CMS has also included several species of mammals, marine turtles, and gharial in the two Appendices. These species have, however, received no attention, except in the case of marine turtles in recent years. Important species in this regard are the blue whale, humpback whale, bowhead whale, snow leopard, wild yak, green turtle, loggerhead turtle, hawksbill turtle, olive Ridley turtle, and gharial in Appendix I, and Gangetic river dolphin, finless porpoise, Indo-Pacific hump-backed dolphin, Irrawaddy dolphin, dugong and saltwater crocodile in Appendix II. It is noteworthy that all these species are highly endangered in within India.

9 IDENTIFYING LOCATIONS OF WILD TAXA DIVERSITY

9.1 THE USE OF INDICATORS

An intimate knowledge of the spatial and temporal distribution and abundance of species is essential for conservation actions such as the design of protected area networks. This is, however, a luxury afforded only to very few species, especially in tropical countries; typically some large mammals and a few birds. A large majority of invertebrate species still remains to be discovered. Several recent descriptions of lower vertebrates show that even in these taxa species are far from being completely documented, at least in the tropics. Furthermore, several described species are known only from very few localities, often only from the type locality, an indication of the severe lack of information on species distribution. Given that vast areas in the tropics remain to be systematically surveyed and several thousand species remain to be discovered, methods to identify areas of high biodiversity in unsurveyed regions become critical to conservation. In this scenario, the identification of indicators has been of considerable research interest, but a critical review of this is beyond the scope of this report. Indicators in this context refer to one or more relatively well known taxa, or other features of the habitat, with which relatively unknown taxa covary spatially or temporally. The idea of such simple indicators came from the relatively high correlation among different taxa that has observed at regional scales, and with landscape level variables such as altitude, latitude, vegetation types *etc.* (see Gaston 2000, for a recent review). The use of indicators for assessing faunal diversity as well as for monitoring structure and function of marine ecosystem also has received considerable attention.

However, at less than regional scales at which conservation priorities are often set, such correlations among different taxa are often weak, absent, inconsistent or artifacts (see Gaston 2000, for a review). This lack of strong covariance among different taxa at local scales is a major constraint in the identification of indicators of biodiversity, and using them in identification of areas of conservation importance in ecologically unknown areas.

9.2 USE OF INDICATORS IN INDIA

The protected area network in India is based on the principle of indicators, although this is not explicitly stated. For example, the conservation of tigers and elephants, which have

had a profound influence on the designation of protected areas, is assumed to also conserve a vast majority of other species. A test of this assumption has never been done, however. Similarly, the use of biogeographic classification in the design of the protected area network (Rodgers *et al*. 2000) is based on the assumption that climatic and vegetation characteristics are good indicators of biodiversity. Preliminary analysis shows that both these assumptions might be far from true for some taxa (see Box 5.1).

Although the application of GIS in the identification of wildlife habitats in India has been attempted as early as (Worah *et al.* 1986), there has been little progress in this field since then. There have been only few studies using indicators to identify potential areas of conservation importance. Chundawat *et al* (*pers. comm*.) based on a field study identified topographical and other habitat features with which the occurrence of the mountain ungulates were associated. These topographical features were then used to identify other habitat areas in the Himalaya, and field surveys were then done to validate the prediction. Prasad *et al.* (1996) identified several vegetation and topographical features with which bird diversity was associated in one area in Mehao Wildlife Sanctuary in Arunachal Pradesh. These features were then used to predict other potential areas with high bird diversity. However, no validation of the predictions could be carried out. Other such studies include an assessment of the habitat of the Western Tragopan in Uttar Pradesh (Prasad 1993) crane habitats also in Uttar Pradesh (Prasad *et al.* 1994), and wetlands (Prasad *et al*. 2001).

That there are no simple indicators of overall biodiversity is becoming clear from recent studies in the Western Ghats. While woody plants show highest species richness and endemism in the southern most parts (Pascal 1988), the diversity of other forms of plant life is highest in the high altitudes. Amphibians show a high turn over of species with drainage, while maintaining a relatively low local diversity (Vasudevan *et al.* 1998). In contrast, reptiles show a turn over with vegetation types and with altitude (Ishwar *et al.* 1998). Fishes show major differences between drainage, especially east and west flowing rivers. Bird diversity is negatively correlated with angiosperm diversity (Daniels 1989) while insect diversity is not related to either of these (Gadagkar *et al.* 1989). Insect communities apparently show a faster spatial turnover even within the same vegetation type (P.T.Cherian, *pers. comm.*). It is thus apparent that there are no simple indicators or other tools to help us to assess the biodiversity of relatively unsurveyed areas or taxa, at a

spatial scale in which conservation priorities are set in India. This is a rapidly emerging area of ecological research and needs to be supported in India.

9.3 STRATEGY AND ACTION PLANS

Strategy 1. Promote scientific studies in order to identify biotic and abiotic indicators that can be used in biodiversity assessment, including habitats that are relatively unsurveyed.

Action 1. *Hold a national level workshop on the use of indicators in order to identify potential research areas in different ecosystems.*

Action 2. *Provide funding for identified project.*

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ANNEXURE

Indian species covered by the Convention on the Conservation of Migratory Species of wild animals (CMS) in Appendix I and II (Effective:14 February 2000).

APPENDIX I

Mammals

Balaenoptera musculus Blue whale (EN)
Megaptera novaeangliae Humpback whale (VU)
Balaena mysticetus Bowhead whale (CD)
Uncia uncia Snow leopard (EN)
Bos grunniens Wild Yak (VU)

Birds

*Pelecanus crispus** Dalmatian pelican (VU)
Ciconia boyciana Oriental stork (EN)
*Anser erythropus** Lesser white-fronted goose (VU)
*Branta ruficollis** Red-breasted goose (VU)
*Marmaronetta angustirostris** Blue duck (VU)
*Aythya nyroca** Ferruginous duck (VU)
*Oxyura leucocephala** White-headed duck (VU)
*Haliaeetus albicilla** White-tailed eagle (NT)
*Aquila clanga** Greater Spotted eagle (VU)
*Aquila heliaca** Imperial eagle (VU)
*Falco naumanni** Lesser kestrel (VU)
*Grus leucogeranus** Siberian crane (EN)
*Grus nigricollis** Black-necked crane (VU)
Vanellus gregarius * Sociable lapwing (VU)
*Tryngites subruficollis**

Reptiles

*Chelonia mydas** Green turtle (EN)
*Caretta caretta** Loggerhead turtle (EN)
*Eretmochelys imbricata** Hawksbill turtle (CR)
*Lepidochelys olivacea** Olive Ridley turtle (EN)
Gavialis gangeticus Gharial (EN)

APPENDIX II

Mammals

Platanista gangetica gangetica Ganges River dolphin (EN)
Neophocaena phocaenoides Finless porpoise (DD)
Sousa chinensis Indo-Pacific Hump-backed dolphin (DD)
Orcaella brevirostris Irrawaddy dolphin (DD)
Dugong dugon Dugong (VU)

Birds

Gavia arctica Artic loon
*Pelecanus crispus** Dalmatian pelican (VU)
Ciconia nigra Black stork
Ciconia episcopus microscelis White-necked stork
Ciconia ciconia White stork
Plegadis falcinellus Glossy ibis
Platalea leucorodia White spoonbill
Pandion haliaetus Osprey
Coturnix coturnix coturnix Common quail
Porzana parva parva
Porzana pusilla intermedia
Crex crex Corncrake (VU)
*Chlamydotis undulata** Houbara bustard (LR:lc) (only Asian populations)
Dromas ardeola Crab plover
Burhinus oedicnemus Stone curlew
Glareola pratincola Collared pratincole
Larus hemprichii Sooty gull
Larus genei Slender-billed gull
Sterna sandvicensis sandvicensi Sandwich tern
Sterna albifrons Little or Least tern
Sterna saundersi
Sterna repressa
Chlidonias niger niger Black tern
Merops apiaster European bee-eater
Coracias garrulous European roller

Reptiles

Crocodylus porosus Saltwater Crocodile