Biodiversity Conservation in India

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Description of photographs on the cover

	Dry grasslands of Ranthambore National Park, Rajasthan
The Trans-Himalayas, Eastern Himalayas, Sikkim	Tropical evergreen forests, mangroves, corals, and beaches of the Wandoor National Park, Andaman & Nicobar Islands
Tropical semi evergreen and deciduous forests of Periyar National Park, Kerala	Cold deserts of the Trans-Himalayas, Northern Himalayas
Deodar forests of Shimla Catchment Area Sanctuary, Himachal Pradesh	Moist grasslands of Kaziranga National Park, Assam

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TABLE OF CONTENTS

Introduction

INTRODUCTION

This section seeks to describe the status of biodiversity conservation in India and to make recommendations regarding measures to be taken for conserving domesticated biodiversity, genetic material and mirco-organisms, and wild biodiversity outside protected areas.

The conservation of biodiversity within protected areas (national parks and sanctuaries), and the management of wildlife in these areas is dealt with in another section.

'Biodiversity', as used in this section, refers to "the variety and variability of all animals, plants and micro-organisms on earth" (Flint, 1991). There are three levels at which biodiversity needs to be conserved : at the level of genetic variation (and number of individuals) within a species; the variety of species; and the variety of habitats (Bennett, 1991). In this section, the second and third levels are looked at, both for wild and domesticated (or cultivated) species and natural or human modified habitats. Consertvation strategies looked at include both in situ and ex situ efforts.

BIOGEOGRAPHIC REGIONS OF INDIA

There is a wide range of natural ecosystems in India, stretching from the snowbound peaks of the Himalayas to the Indian Ocean, and including the deserts of Rajasthan and Kutch, river systems like the Ganga and Brahmaputra, forests and grasslands of Central India, and the wet evergreen forests of the Andaman & Nicobar Islands, and Arunachal Pradesh. Climate soil types, hydrological systems, and other conditions vary greatly, in turn influencing vegetation types, and consequently the flora-fauna composition.

Several attempts have been made to classify natural ecosystems in India. Early attempts were to present zoogeographies, e.g. classification of regions according to bird distribution by T.C. Jerdon, and according to reptile distribution by A.C.L. Gunther, both in the 19th century. Subsequent attempts were made by W.T. Blanford, based on vertebrate fauna distribution in general. These and more recent zoogeographical classifications have been presented by Mani (1974) and by Puri et. al. (1983).

However, more fundamental ecosystemic classifications are phytogeographic (based on vegetation types), or, of late, biogeographic (combining various biological and physical phenomena). Of the former, the most popular over the last two decades has been the forest type classification of H.G. Champion and S.K. Seth (1968). This system recognises 16 major types of forests. The advent of more sophisticated classifications has not yet displaced Champion and Seth's system, which is still widely used by official forest and wildlife management agencies.

More recently, V.M. Meher-Homji (1983, 1984) and others have developed a more detailed phytogeographic classification for the country. However this is more elaborate for south India, since detailed work has been done there, and is undergoing elaboration for other parts

of the country.

The most comprehensive ecosystemic classification has come from the Wildlife Institute of India (WII), W.A. Rodgers and H.S. Panwar (1988) have grouped India's natural habitats into 10 major biogeographic zones based on their species composition and geographic distribution. These zones are divided into biotic provinces, differentiated by their distinctive species compositions. Some of the larger provinces are further divided into biogeographic regions, or sub-divisions, which are geographically distinct in some way, but may not be different in species composition. Finally, a set of biomes is recognized within each region - these correspond to the ecological units we are most familiar with, and are based on similarity in appearance and structure and climatic conditions. The same biome may be present in two or more biogeographic zones, e.g. evergreen rainforest in Western Ghats, North-east India, and the Andaman and Nicobar Islands. However, while similar in structure, this biome will have greatly different species compositions in the different biogeographic zones. Detailed descriptions of the zones, provinces, and biomes are given in Rodgers and Panwar (1988), presenting a picture of the array of diverse ecosystems in India.

RANGE, DISTRIBUTION AND OCCURRENCE OF BIODIVERSITY IN INDIA

India harbours about 6.5% of the species worldwide. Records have so far been made of a total of over 45,000 species of plants, and over 77,000 species of animals. The list is being constantly added to, especially in the case of lower plants and invertebrate animals and it is estimated that the flora and fauna species already identified are only part of what must actually occur in India.

2.1 Wild Flora

The 45,000 species of flowering and non-flowering plants so far recorded in India (Appendix 1) [BSI undated] are about 7% of the world total.

In phytogeographic terms, Indian flora is closely related to the Indo-Chinese region's flora, and about 35% of it has affinity to South-East Asia and Malaya [WCMC 1988].

Endemism is high: about 33% of the flowering species, and 18% of the total, are considered endemic [BSI undated]. These are concentrated in the floristically rich areas of north-east India, the Western Ghats, north-west Himalayas, and the Andaman & Nicobar Islands [WCMC, 1988]. The Western Ghats alone are reported to have 1,500 endemic species, while the eastern Himalayas about 2000 [WCMC 1988].

Exceptional diversity has been recorded in taxa like the Pteridophytes (ferns, etc.), with 1022 species, and Orchidaceae (orchids), with 1082 species [BSI undated].

2.2 Wild Fauna

A total of over 77,000 faunal species has been recorded in India, some 6.4% of the world total [ZSI 1991]. Of these, the vast majority are insects, with over 50,000 species. The vertebrate fauna, though less than invertebrates, is nevertheless diverse, with groups like aves (birds) being amongst the largest in the world. Appendix 2 displays the full list of faunal diversity in India.

Perhaps even more so than in the case of plants, the recorded animal diversity in India is only a part of what must actually exist. This is particularly true of invertebrates, new species of which are being constantly discovered. As an example, the group Hymenoptera (bees, wasps) today numbers 9,000 species in India, while in United Kingdom it is estimated to contain about 6,000 species. Considering the fact that tropical biodiversity is far greater than temperate, it would be safe to assume that Hymenoptera alone may number over 60,000 species in India [WCMC 1988].

Exceptional diversity has already been recorded in animal groups which have been well-studied. Amongst insects, for instance, Lepidoptera (butterflies and moths) are relatively well-known, except perhaps from some remote parts of India. Already about 13,000 species of butterflies and moths have been identified [ZSI 1991]. India is believed to have the third largest group of swallowtail butterflies in the world, some 77 species. Similarly, birds number over 1200 species, about 14% of the worldwide estimate. For both these groups, India is likely to be amongst the five nations with greatest diversity.

Though most parts of India support a diversity of fauna, some regions have especially high concentrations. For instance, in the case of mammals, Assam in the north-east contains 85 (63%) of the 135 genera of land mammals recorded in India [WCMC 1988]. High reptilian (especially snake) and amphibian concentrations occur in the Western Ghats [WCMC 1988].

Endemism amongst Indian vertebrate fauna varies from very low in mammals to very high in amphibia. For the latter, it is estimated that 62% of the known species are endemic, of which a majority occur in the Western Ghats [Inger and Dutta, 1987]. Amongst reptiles, nearly 50% of the 153 species of lizards found in India are endemic, with a large number being found, once again, in the Western Ghats.

Endemism amongst invertebrates is still little known. Among those

4

few groups which are known to have high endemism are Kinoryncha (marine sediment worms) with about 70% endemicity, Chilopoda (related to centipedes) with about 59%, Ephemeroptera (mayflies) with about 77%, and Spongellidae (freshwater sponges) with about 39% [ZSI 1991; Thomas undated].

3. Artificial (human-dominated) ecosystems

As is to be expected in a densely populated country like India, natural ecosystems almost everywhere have been modified to varying degrees by human intervention. While generally such intervention has caused an erosion in biodiversity, many ecosystems heavily influenced by humans retain or develop their own complement of species. This is especially true of habitats like periodically-burnt pastures, and multi-cropped agricultural fields. For example, studies have shown that the Cheer pheasant *Catreus wallichii* may well benefit from the regular burning of vegetation in parts of Himachal Pradesh. Similarly, traditional rice fields and their surrounds are known to harbour an abundance of "algae, azolla, insects, fish, frogs, crabs, birds and other creatures.... all living in webs of interdependence" [Pereira 1991].

Two interesting characteristics of such artificial ecosystems are significant from the point of view of biodiversity. First, certain wild species of plants and animals adapt to and often benefit from human intervention. Secondly, the existing wild species are supplemented by a new set of biological forms, viz. domesticated animals and cultivated plants. It is the diversity within this new set which is significant, especially for its value to humanity.

4. Domesticated Flora and Fauna

Over the last three thousand years or more, Indian farmers and pastoralists have been discovering, synthesizing, and modifying life forms for a variety of purposes: food, clothing, housing, medicine, rituals, household goods, draught power, and others. In the process, a wealth of domesticated biological diversity has evolved. Unfortunately,

the extent and significance of this diversity is even less understood
than that of wild flora and fauna, while its erosion is just as rapid.

4.1 Domesticated animals

Recent research and documentation by the National Bureau of Animal
Genetic Resources and other agencies, though incomplete, has indicated
the impressive diversity of livestock, poultry, and other domesticated
fauna' in India. Appendix 3 presents an overview of this diversity.

Diversity amongst certain livestock forms is exceptional: 27 desi
(indigenous) breeds of cattle, 40 of sheep, and 22 of goats [Balain
undated; Singh 1988]. Cattle breeds, like the Red Sindhi, Rathi,
Tharparkar, Sahiwal, Hariana, Ongole, Kakreji, and Cyir are now
recognised to be much better adapted to their home ranges than the
exotic crossbreeds that have been replacing them [Shiva 1991]. The eight
breeds of buffalo comprise nearly all the recognised buffalo breeds of
the world, while the goat variety is one-third of the world's [Balain
undated]. There is also a significant diversity of poultry and other
domesticated birds, like ducks, pigeons, and doves.

4.2 Cultivated Flora

As one of the world's oldest and largest agricultural societies,
India has a vast diversity of crop species and varieties. Unfortunately
research on, and documentation of this aspect of India's biodiversity is
poor and of recent origin. Therefore, there is little indication today
of the full extent of this diversity, as it existed before the advent of
modern agriculture seriously depleted the range of traditional
varieties.

The Hindustan Centre of Origin of Crops and Plant Diversity, as
termed by the Russian Scientist N.I. Vavilov (1951), consisting of parts
the Indian subcontinent and neighbouring countries, is considered to be
the origin of at least 166 species of crops and 320 species of wild
relatives of cultivated crops [Rana undated].

But it is the diversity of varieties within these species which is

6

great. Rice is a good example. Estimates of the varieties of rice grown in India, within the recent past, range from 30,000 [Shiva 1991] to 50,000 [CSE 1985]. The Central Rice Research Institute at Cuttack alone houses over 15,200 varieties, while another 40 stations under the Indian Agricultural Research Institute have a collection of over 35,000 varieties [CSE 1985]. But more impressive than these numbers is the diversity of characteristics these varieties displayed, and the myriad uses that are or were made of them by traditional communities. In a single village in Bastar or in Nagaland, for instance, there would be a rice variety grown for its yield, another for its sweet taste, another for its colour (red or black being special), yet another for its glutinous content, another for its smell, and so on. With the advent of new hybrid varieties and the narrowing of focus purely to yields, the displacement of traditional varieties has been drastic, so it is unclear how many of the tens of thousands of varieties are still cultivated in India.

Apart from rice, India is known to have exceptional diversity of several other foodgrains, vegetables, and fruits. Records available at the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, list probably just a fraction of the total genetic stock available in the country, but are nevertheless indicative (Appendix 4). The Indian subcontinent is considered to be the centre of origin of rice, pigeonpea, turmeric, ginger, pepper, banana, bitter gourd, brinjal, okra, coconut, cardamom, jack fruit, sugarcane, bamboo, taros, indigo, sunhemp, amaranthus, gooseberries [BSI undated].

Crops with rich diversity in India include:

Wheat (Triticum aestivum, T. durum, T. diococcum)
Sugarcane (Saccharum species and allied genera),
Legumes (Vigna radiata, V. mungo, V. aconitifolia, V. umbellata, V.
    unguiculata, Cicer arietinum, Cajanus cajan, Lablab purpureus),
Sesame (Sesamum indicum),
Okra (Abelmoschus esculentus and other allied species),
Eggplant (Solanum melongena and related types),
Citrus species
Banana and plantains (Musa species belonging to different genomic groups),
Jack fruit (Artocarpus heterophylla, A. integrifolia),

7

Mango (Mangifera indica),
Jamun (Syzygium species,
Jute (Chorchorus capsularis),
Tree cotton (Gossypium arboreum),
Ginger (Zingiber officinale),
Turmeric (Curcuma species),
Pepper (Piper species),
Cinnamon (Cinnamomum zeylanicum)
Cardamom (Elettaria cardamomum)

Among tuberous crops, rich variability exists in:

Sweet potato (Ipomea batata),
Taros (Colocasia and Allocacia),
Yams (Dioscorea esculenta, D. alata, D. deltoides etc.)
Wordbean (Canavalia)
Velvetbean (Muccuna species)
Elephant yams
Coconut (Cocos nucifera)

Diversity also occurs in several minor fruits such as: Zizyphus jujuba and Z. nummularia, Capparis decidua, Syzygium cummuni, Myristica fragrans, Aegle marmelos and several Rubus, Juglans, Pyrus and Prunus species [Rana undated].

By December 1990, the NBPGR gene bank had a collection of nearly 1.44 lakh (0.144 million) varieties (Appendix 5) [NBPGR 1991]. These included over 34 thousand varieties of cereals and nearly 22 thousand varieties of pulses. This collection includes indigenous, exotic and hybrid varieties, and overlaps with the collection listed in Appendix 4.

Cultivated flora is the component of biodiversity which has seen maximum invasion of exotics. A large number of the food and non-food crops grown in India today are exotic, most notable being some varieties of wheat, cashewnut, pumpkin, barley, linseed, grapes, coffee, and tea. In many cases, exotics have augmented indigenous diversity, but in many other cases, they have displaced traditional varieties and led to a decline in the total available range.

Concentration of diversity amongst cultivated species/varieties and their wild relatives is in the areas of humidity: the Western Ghats, parts of the Eastern Ghats, central India and the Deccan Plateau, North-west Himalayas, and the north-eastern hills [Rana undated]. This concentration appears to be a combination of at least two factors: natural plant diversity in a humid tropical system, and a multitude of

8

tribal and other local cultures, resource use patterns, and rituals which have discovered, cultivated, conserved, and modified species from the wild.

THREATS TO BIODIVERSITY IN INDIA

1. Threats to Natural Ecosystems

The major threat to biological diversity in India is the threat to the different ecosystems which support this biodiversity. One way of broadly classifying these ecosystems is:

- Forests
- Grasslands
- Wetlands (including riverine systems)
- Coastal regions and islands (including mangroves and coral reefs)
- Mountains
- Deserts

In general, all these ecosystems face, to various degrees, threats from development projects (dams, roads, industries, human settlements, mining and quarrying, power stations, etc.). They also face threats from other human and biotic pressures (grazing of domestic livestock, fuelwood and fodder collection, extraction of timber, extraction of non-timber forest produce, clearing for agriculture, hunting, burning, introduction of exotics, etc.)

Certain species are also threatened by hunting, over-exploitation, and the introduction of exotics.

1.1 Forests

Of the 75 million hectares (23% of the total land area) of forest land in India, about half, 37.8 million hectares (11.5%) has closed forest cover with crown density of over 40% [FSI 1989]. According to one source [Mackinnon and Mackinnon, 1986], India has lost 80% of its original habitat. It is difficult to imagine what this means in terms of loss of biodiversity.

Even the figure of 37.8 million hectares of closed forests is misleading for at least two reasons. First, this only indicates density of crown cover and not of the naturalness of the forest. It, therefore, includes certain plantations, including mono-culture and exotic species plantations, which do not contain much biological diversity. Secondly, it does not indicate the health of the total forest system, especially

10

the ground vegetation and forest creepers, which in many parts of the country have disappeared even from those forests where crown cover remains above 40%. Therefore, the forest area with significant remnants of biological diversity would most likely be much less.

The major threats being faced by India's forests can be listed as follows:

Commercial felling: Huge areas of natural forest systems have been destroyed, and continue to be destroyed, due to commercial felling. Estimates suggest that while the industrial requirement of wood in India is 27.58 million cu.m., silviculturally permissible production is only 12 million cu.m. [Steering Group Report, 1989].

Even where these forests are "rotationally" or "selectively" felled, and replanted often by predominantly commercial species, the trees come up but much of the rest of the forest system is either destroyed or modified.

One example of the toll commercial felling has taken, and continues to take, of biodiversity can be seen in the Andaman and Nicobar Islands. These islands are perhaps among the richest areas, in terms of biodiversity, in India. Despite the fact that biological investigations are still incomplete and a large proportion of the islands have not yet been studied for the fauna and flora they have, so far 2200 flowering plants and 120 ferns (besides other plants), 58 mammals, 242 birds, 83 reptiles, 10 amphibians, 750 fishes, 326 coelentrates (corals, sponges, sea anemones, jellyfish, etc.) 407 crustaceans, 941 molluscs, 1500 insects, 62 spiders and scorpions, etc. have been reported from these islands. There is also a high level of endemism. For instance, around 200 flowering plants, 95 birds, 33 mammals, and 23 reptiles have so far been identified as endemic to these islands [Pande et. al 1991].

Despite this richness in biodiversity, commercial felling, to feed various wood based industries, has been going on since 1883 and, by the middle of the nineteen-eighties, 1,43,000 cu.m. of wood was being

extracted annually. Though a part of this extraction was done using the "Andaman Canopy Lifting Shelterwood System", even this system changed the biological profile of the forests, while allowing certain commercially valuable species of trees to grow back quickly [Pande et.al, 1991]. Deforestation has also resulted in soil erosion which has negatively affected the coral reefs.

The destruction of biological diversity, in the last 140 years or so, through commercial felling in Andamans, especially given their unique biological richness, is unmeasured.

In other parts of the country, especially the Himalayan range, vast tracts of forested land have become bare because of commercial exploitation and the resultant soil erosion, which prevents regeneration and plantation.

Unfortunately, such destruction continues even today all over India, most regrettably in the evergreen forests of the north-east, in the Western Ghats, and in the Andaman and Nicobar Islands.

Development Projects and Activities: Another major pressure on our forests comes from development projects and activities. It is estimated that the area of forest diverted for non-forest use between 1951 and 1980 was 4.238 million ha [FSI, 1987]. The rate of diversion has gone down since 1980 (and the enactment of the Forest (Conservation) Act), but is still alarming. Several large projects like dams (Narmada Sagar, Tehri, etc.) road construction, expansion of human settlements, establishment of industries and power stations, mining activities, and defence establishments continue to take a heavy toll of forests and biological resources.

A case in point is the proposed Narmada Sagar dam which is going to submerge 40,000 hectares of forests in Madhya Pradesh [Kalpavriksh 1988], some of which are among the best sal forests of central India. The project was approved without an idea of the fauna and flora that would be lost, and whether there are endemic, rare and threatened

12

species among these.

Mining activities have also contributed significantly to the destruction of biological resources. One such example is the impact of dolomite and marble mines in and around Sariska Tiger Reserve in Rajasthan. Despite the fact that Sariska is a valuable wilderness area in a region almost devoid of forests, mining has been going on for years in a most destructive manner, degrading the Reserve and the fauna and flora in it [Singh 1992].

Biotic and Other Human Pressures: Another threat to our forests comes from the demands of the primarily rural population living in and around these forests. These demands are of two types. First, there is a demand for bio-mass in terms of fodder, fuelwood, timber, and non-timber forest produce, and for fruits, tubers and animals, for food. There is also the demand for land, especially for cultivation and for human settlements..

Currently, India is estimated to support a population of 500 million livestock [MoEF 1990], a very large proportion of which feed off the forests. The actual availability of green fodder from grasslands, agricultural wastes, and sustainable extraction from the forests, is only 434 million tonnes. This is far below the estimated actual demand of 882 million tonnes [FSI 1987]. The balance is, consequently, unsustainably extracted from the forests.

Fuelwood demand in India, in 1987, has been estimated to be 235 million cu.m. Of this, only 40 m cu.m. can be sustainably extracted, the remaining 195 cu.m. coming at the cost of the forests [FSI 1987].

Even the figures of sustainable extraction are misleading for they refer to the forest's ability to regenerate. However, what is sustainable from the point of view of regeneration might still result in severe loss of biological diversity.

Over the years, the increase in population and the inequitable distribution of land has resulted in a great demand for forest land.

Large tracts of forest lands have been encroached upon by settlers who have cleared the forests to establish their settlements and cultivation. Between 1951 and 1980, 2.623 million hectares of forest land were diverted for agricultural purposes [FSI 1987]. Considering regularised and illegal encroachments have been going on for years, the actual area affected would be much larger. In many of the tribal areas, shifting cultivation is also eroding the biodiversity of forests.

Environmental Disasters: The forests are also vulnerable to human caused fires, droughts and floods. The impact on forest ecosystems of frequent and intensive human disturbance is manifested in the extreme form by forest fires set off carelessly, or on purpose. These fires destroy huge areas of forests and drastically change the mix of species. It has been estimated that half a million ha. of forests were affected by fires between 1980-85 [FSI 1987].

Deforestation and degradation of river catchments have resulted in there being unnaturally severe and frequent droughts and floods. These have not only destroyed forest ecosystems but also changed their biological profile.

Pollution: Forests are also vulnerable to pollution, especially air pollution. The spraying of pesticides, especially aerial spraying, has also affected forest ecosystems. Pollutants and pesticides affect elements of the forest ecosystem, especially the insects and micro-organisms, which are crucial for the maintenance of the ecosystem. The killing of these insects and micro-organisms seriously affects the process of plant fertilisation and of biodegradation, and disrupts the food chain.

Many species of trees and other plants are also affected by pollutants.

Exotics and Weeds: The introduction of exotics, especially weeds, has also affected the forest ecosytems in many parts of the country.

14

1.2 Grasslands

Only 3.7% of the country is under permanent pastures and other grazing lands [Steering Committee Report 1989]. These are perhaps one of the most threatened ecosystems in India, especially because their protection has not been taken up by any specialised agency. Apart from commercial pressures (for grass, as raw material for paper mills, etc.) they come under pressure from grazing, fires, pollution, development projects, floods, droughts, encroachments and conversion to both agricultural lands and tree plantations. The spread of weeds, like Eupatorium sp., is also threatening the Shola grasslands of the Western Ghats, among others. Some grasses are also used by artisans for making rope and other daily use items, however the impact of such use on the biodiversity has not been studied.

1.3 Wetlands

The lakes, marshes, and river systems of India are threatened by domestic pollution from untreated sewage from towns and cities. They are also threatened by pollutants and toxic effluents from industry. Agricultural runoffs, containing residues of pesticides and chemical fertilisers, also contribute to the pollution and eutrophication of water bodies. Silt brought down from degraded catchments affects the water quality and silt-up water bodies and river beds.

Excessive withdrawal of water from lakes, marshes, and rivers, for industry, irrigation or domestic use, added to the other pressures, has irretrievably altered or destroyed the ecosystems of many water bodies and river systems in India. Dredging and "reclamation" of water bodies, excessive fishing and netting, and the building of dams, jetties, canals and other encumberances to the drainage of water bodies and the free flow of rivers has exacerbated the damage.

Many of the major rivers are, at least in parts, critically polluted. For many kilometers downstream of metropolitan centres, the water in major rivers like the Yamuna and Ganga is not even fit for

bathing, leave alone for drinking. Obviously such polluted water cannot support the full complement of aquatic fauna and flora.

The backwaters of Kerala, locally known as kayals, are an example of threatened water bodies. Though these water bodies are among the richest ecosystems in India, providing a breeding ground for a large number of species of fish, prawns, shrimps, zooplanktons and other aquatic and marine fauna and flora, they are seriously threatened because of industrial, agricultural and domestic pollution, because of disturbance by navigation, dredging, excessive withdrawal of water for industry and power stations, and because of siltation due to degraded catchments.

1.4 Coastal Regions and Islands

Mainland India has a coastline of 9000 kms [Steering Committee 1989]. India also has two groups of islands, the Andaman and Nicobar group comprising of 306 islands with a coastline of 1962 kms [Pande 1991], and the much smaller Lakshadweep group. Surrounded by tropical seas, the coastal waters spreading across the continental shelf are immensely rich in fish and other marine flora and fauna. Much of the coasts must at one time have been covered with mangrove forests. Today only 60% of these remain, mainly on the eastern coast of West Bengal, and in the Andaman and Nicobar Islands [MoEF 1989]. Much of these coastal waters also support rich coral reefs.

The coastal waters and the continental shelf are under threat primarily from effluents from industry and towns, and pollution and oil spills caused by ships and offshore drilling platforms. Trawling and mechanised fishing has also seriously affected the breeding grounds of marine life and depleted fish stock and diversity.

The coral reefs are also threatened by pollution, trawling, and silt from deforested inland areas. In addition, corals are being ruthlessly extracted to be sold as souvenirs, and for use as

16

construction material and decoration pieces.

The mangrove forests have also been affected by pollution, and been mercilessly cut for firewood. With the destruction of coral reefs and mangrove forests, the coastal regions have become subject to erosion by the sea. Also, the beaches have been encroached upon by hotels, houses, harbours, and hordes of tourists. The resultant disturbance, along with the litter and extensive collection of shells, and the extraction of sand, has seriously affected the coastal ecosystem.

1.5 Mountains

Among the most valuable mountain ranges in India, in terms of biological diversity, are the Eastern and Western Himalayas, and the Western Ghats. Of these three, the Western Himalayas and the Western Ghats are facing very high levels of pressure.

Commercial felling, extracton of fuel and fodder, rapid growth in population, conversion of hill slopes into agricultural fields, building of inappropriate roads in an environmentally destructive manner, and the spread of human habitation have all contributed to the degradation of these mountain ecosystems.

The construction of dams, like the proposed Tehri dam, and the resultant increase in economic activities will also contribute to their degradation.

The Himalayas, particularly, are a relatively new mountain range in a highly seismic zone. Much of the area is unstable and frequent earth tremors cause the progressively degrading hill sides to slide down, destroying the vegetation and the habitat of wild animals.

These mountain ranges have also seen extensive "shikar" in the last hundred years and many species of animals have disappeared from these ranges.

The Eastern Himalayas face similar threats, though to a somewhat lesser degree, due to geographical isolation from the rest of the country and a lower density of human population. However, an additional

17

threat in the Eastern Himalayas is the practice of shifting cultivation, or jhuming, which, given the increasing pressures on forests, has become ecologically unviable. Insurgency and the consequent military action in some of the north-eastern states, especially Nagaland, Mizoram, Manipur and, recently, Assam have also resulted in extensive damage to the forest systems.

1.6 Deserts

India has two types of deserts. There is the hot desert of Rajasthan and Gujarat. There is also the high - altitude cold desert in Ladakh (Jammu & Kashmir), and in Lahaul & Spiti, and Kinnaur (Himachal Pradesh).

The Thar desert has come under pressure due to growing human and livestock pressure, and the waterlogging and ecological modifications due to the introduction of irrigation water. An example is the Indira Gandhi Canal which has waterlogged large tracts of land and threatens to waterlog more. Considering the Thar desert, the Salt Desert and the cold deserts of Jammu and Kashmir, and Himachal Pradesh, are adjacent to international borders, there has been increasing disturbance due to the location and movement of military and para-military forces.

Deserts, given the ecosystem, usually have sparse populations of animals. Unfortunately, both the hot and cold deserts of India have seen extensive hunting and poaching. As a result, many of the desert animals have become threatened. The Great Indian Bustard and the Wild Ass are two examples.

2. Threats to Specific Species

Apart from threats to ecosytems, certain specific species which have either economic or cultural significance, often get threatened. Some of the common reasons for these threats is hunting, overexploitation, and introduction of exotics.

2.1 Hunting

Though greatly reduced in the last twenty years, in the last century hunting and poaching has taken a serious toll of "game". Apart from depleting animal populations all over, the Cheetah and the Pink headed duck are two of the many species that have become extinct. Various species continue to be poached, especially the Rhino, the Tiger and the Elephant. Other species have totally disappeared from certain parts of the country where they occurred for hundreds of years.

2.2 Overexploitation

Populations of many species of commercially utilised plants and animals, especially fish, have been seriously depleted because of overexploitation. Rauvolfia serpentina, Strychnos nuxvomica, Carum copticum and Datura spp. are some of the important medicinal plants which are threatened. A more complete list is at Appendix 6.

Marine biota like the Sacred chank (Xancus pyyrum) is over exploited in the Gulf of Mannar, Palk Bay and to an extent in the Gulf of Kutch by trawlnets. Tritons trumpet (Charoia tritonis) is very rare, Collectors pay heavy sums for it. The genus Nautilus is considered a 'living fossil' and prized for its colourful shell. Echniroderms are rare but commercially exploited.

Similarly, crocodiles, species of pheasants, species of deer, especially musk deer, are examples of terrestrial animal species which are threatened. A more complete list is at Appendix 7.

2.3 Introduction of Exotics

The introduction of exotics into the ecosystem, especially if they are agressive species, often results in the displacement of some of the natural species whose ecological niche the exotics take over, or whose food and breeding viability is destroyed by such exotics. In India, exotics which could have caused such disruption include Chromolaena odorata (Eupatorium), which has colonised large areas of shola grasslands in the Western Ghats, and Lantana camara, which has infested many forest areas in north India.

3. Threats to Domesticated Fauna and Flora

3.1 Livestock

India has an estimated 500 million livestock [MoEF 1990]. These include cows, buffaloes, goats, sheep, and camels. These animals are still the mainstay of much of the agricultural operations in India, providing draught power and manure for fertilizer. They also give milk, provide wool, leather, meat and a host of other commodities and functions.

The major threat to the diversity of indigenous livestock breeds has been the introduction of hybrid and exotic species. In many parts of the country, local breeds are being replaced by these new breeds without any ability to preserve the local breeds for posterity. Changes in the habitat (described in the earlier section) have also affected the survival of various local breeds, which have been unable to adapt to these changes.

The disruption of traditional lifestyles, through urban migration and through displacement by development projects, has also resulted in the loss of local breeds, especially when these breeds were endemic to the areas so affected.

3.2 Crops and Other Cultivated Plants

Similarly, introduction of hybrid and exotic species of crops, replacement of food-crops by cash-crops, substitution of multiple cropping by monocultures, destruction of habitat and dislocation or change in lifestyles (especially eating habits) have resulted in the disappearance of indigenous crop species.

Genetic diversity of cultivated species of plants, especially cereal crops, pulses, vegetables, and the plants used for religious and social purposes, have been threatened by changing social and religious norms, and cultivation methods. Intense grazing activity by cattle has depleted wild cereal grasses, which are vital sources of genes for the improvement of existing crops. The clearing, in modern agricultural

practice, of bunds and hedgegrows, which once served as respositories of genetic diversity of crop and animal species, has also taken its toll.

CONSERVING INDIA'S BIODIVERSITY: LEGAL AND INSTITUTIONAL MECHANISMS

1.   LEGAL PROVISIONS RELATING TO BIODIVERSITY IN INDIA [adapted from Kothari and Singh 1992]

1.1 Biodiversity Components [*] : A Conceptual Approach

For the purposes of this chapter, biodiversity components have been categorised into three heads:

1. Wild fauna and flora
2. Domesticated fauna (livestock) and flora (crops and other cultivated plants)
3. Genetic materials (seeds, eggs, germplasm, semen, etc.)

The legal framework relating to each of these categories of biodiversity components has been assessed in terms of 11 aspects of biodiversity :

- Identification

- Protection in-situ

- Protection ex-situ

- Access/extraction

- Use

- Breeding/Cultivation/Multiplication

- Trade

- Introduction/Augmentation/Re-introduction

- Release

- Movement

- Intellectual property rights

1.2 Central Laws Relevant to Biodiversity: A General Overview

Appendix 8 provides a checklist of the legal status of different categories of biodiversity components in India, pertaining to the various aspects mentioned above. In this section, the main findings are summarised.

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[*] Unless otherwise specified, 'biodiversity components' refer to both living species as also genetic material like seeds and germplasm.

Wild fauna and flora

By far the largest number of the laws reviewed were relevant to wildlife and wild biodiversity habitat. These are discussed below, as relevant to each of the 11 aspects of biodiversity.

Identification: There appears to be no legal provision stipulating the identification of wild species of fauna and flora. Nevertheless, agencies like the Zoological Survey of India, the Botanical Survey of India, State Forest Departments, and many independent organisations and individuals are involved in identifying species of wild fauna and flora.

Protection in-situ: Several acts are relevant to the protection of species in-situ, either through stipulating restrictions or prohibitions on hunting, cutting, etc. of notified species, or through providing protection to their habitats. The former (species protection) is provided for in the Wild Life (Protection) Act of 1972 and its 1991 amendments (with legal protection being given to all species listed in Schedules I to IV). The latter (habitat protection) is directly stipulated in the:

Indian Forest Act of 1927,
Wild Life (Protection) Act of 1972,
Forest (Conservation) Act of 1980,
Territorial Waters, Continental Shelf, Exclusive Economic Zone, and
     Other Maritime Zones Act of 1976,
Environment (Protection) Act of 1986.

It is also indirectly provided for in the following acts, in so far as these regulate damage to or destruction of natural habitats, though not explicitly with the purpose of protecting biodiversity:

Fisheries Act of 1894
Water (Prevention and Control of Pollution) Act of 1974
Air (Prevention and Control of Pollution) Act of 1981
Prevention of Damage to Public Property Act of 1984.

Protection ex-situ: Very few acts relate to ex-situ protection of wild species. The Wild Life (Protection) Act of 1972 provides some controls over keeping of animals in captivity, while its 1991

23

amendments contain provisions regarding the management of zoos, and relating to the possession and cultivation of notified plant species. Agencies like the Botanical Survey of India, and wildlife wings of state Forest Departments are making attempts at giving ex-situ protection to wild fauna and flora, though without any legal mandate. Botanical gardens seem to have no national legal status.

Access/Extraction: With the exception of the legal rights vested in individuals, communities, and governments, by virtue of their ownership of private, community, or government property, respectively, there seem to be no central acts governing property rights to wild fauna and flora. The few acts which regulate extraction, and methods of extraction, of wild flora and fauna include the Indian Forest Act of 1927 and the Wild Life (Protection) Act of 1972, for terrestrial biodiversity, and the Fisheries Act of 1894 and the Territorial Waters, Continental Shelf, Exclusive Economic Zone, and Other Maritime Zones Act of 1976, for aquatic biodiversity.

Use: There are not many acts which regulate the way in which biodiversity components are to be used, though there may be several on the use of the products or extracts of these components (e.g. medicines). The Wild Life (Protection) Act of 1972 specifies restrictions on the use of wild animals, and its 1991 amendments have extended this to notified plants and to wild animals in captivity (specifically, in zoos). The Prevention of Cruelty to Animals Act of 1960 extends protection, against misuse, to animals in captivity or under human use, including to those being used for performances or for experimentation.

Trade: Within India, barter, sale, and other forms of exchange of notified wild animals and plants, and their parts or derivatives, are regulated by the Wild Life (Protection) Act of 1972.

Import and export of specified biodiversity components are

controlled by:

the Destructive Insects and Pests Act of 1914,
the Import and Exports (Control) Act of 1947,
the Customs Act of 1962, and
the Marine Products Export Development Authority Act of 1972.

In addition, the new Import and Export Policy announced by the Government of India in 1990-has banned the export of all birds for a period of three years.

- Breeding/Cultivation/Multiplication: Control mechanisms for captive breeding of wild animals and cultivation of specified wild flora are provided for in the 1991 amendments to the Wild Life (Protection) Act of 1972. As pointed out above, there seems to be no central law which governs botanical gardens in the manner in which the Wild Life (Protection) Act of 1972 governs zoological parks.

Introduction/Augmentation/Re-introduction: There appears to be no central act governing the introduction, augmentation, or re-introduction of wild animals and plants. The only one which may be relevant, to some extent, is the Destructive Insects and Pests Act of 1914, which regulates or prohibits activities that could lead to an introduction or spread of pests from one area to another, or from another country into India.

- Release: There appears to be no central act covering this.
- Movement: Control over the mode and means of transportation of specified biodiversity components is provided for in all the acts relevant to trade (mentioned above). In addition, the Prevention of Cruelty to Animals Act of 1960 and its subsequent rules regulate conditions of transportation of animals.

- Intellectual property rights: Knowledge of biodiversity components and their characteristics is not covered under any central law. The Patents Act of 1970 does not include within its purview biodiversity components, since it is restricted to inventions relating specifically to products and processes of manufacture.

25

Domesticated fauna and flora

Compared to wild fauna and flora, there are relatively few laws concerning livestock, crops, and other domesticated biodiversity. These are discussed below, as relevant to each of the 11 aspects of biodiversity.

- Identification: There appears to be no central law stipulating the identification (and associated activities) of domesticated fauna and flora. Agencies like the National Bureau of Plant Genetic Resources, the National Bureau of Fish Genetic Resources, and the National Bureau of Animal Genetic Resources, are conducting identification exercises, but these do not seem to have any legal mandate.

- Protection in-situ: Conservation of crops and livestock at the sites of their use, or conversely, sanctions against their destruction at these sites or elsewhere, is not covered by any central law.

- Protection ex-situ: There seems to be no act governing the protection of domesticated biodiversity in ex-situ conditions, though agencies like the National Bureau of Plant Genetic Resources (NBPGR) are maintaining such stocks, and the 1988 New Policy on Seed Development provides for the supply of imported plant cuttings and saplings by the importers to the gene bank of the NBPGR.

- Access/Extraction: With the exception of the legal rights vested in individuals, communities, and governments, by virtue of their ownership of private, community, or government property, respectively, there seem to be no central acts governing property rights to domesticated fauna and flora.

- Use: As in the case of wild biodiversity, the use of domesticated flora and fauna is governed by very few acts, though there may be several on the use of the products or extracts of these components. The Prevention of Cruelty to Animals Act of 1960 extends

protection, against misuse, to domesticated animals.

− Trade: The largest number of laws relevant to domesticated biodiversity relate to its barter, sale, import, export, or other form of exchange. Provisions for controlling trade within India are contained in the Agricultural Produce (Grading and Marking) Act of 1937, and in several laws relating to individual species or classes of crops, such as the:

Rubber (Production and Marketing) Act of 1947,
Tea Act of 1953,
Cardamom Act of 1965,
Tobacco Board Act of 1975,
Coconut Development Board Act of 1979,
National Oilseeds and Vegetable Oils Development Board Act of 1983,
Spices Board Act of 1986.

These acts also govern the import and export of these crops; in addition, import-export of domesticated plants is regulated by the Destructive Insects and Pests Act of 1914 (especially under the Plants, Fruits, and Seeds (Regulation of Import into India) Order of 1984) and the Agricultural and Processed Food Products Export Development Authority Act of 1985-86; the latter includes within its purview medicinal plants. In addition, the Special Licensing Procedures and the Import Policy for Registered Exporters of the Export and Import Policy govern the import of living plants. International trade in some kinds of livestock is covered by the National Dairy Development Board Act of 1987. In addition, import-export of specified kinds of both plants and animals can potentially be controlled by the Import and Exports (Control) Act of 1947 and the Customs Act of 1962.

Breeding/Cultivation/Multiplication: There appears to be no central act covering the breeding of domesticated animals, except to some extent the National Dairy Development Board Act of 1987, which has general clauses on promoting animal husbandry and facilitating the "enhancement of cattle wealth". Cultivation of domesticated plants in general is not covered by any central act, but growing of tea, cardamom and other spices, coconut, tobacco, oil-yielding plants,

and certain other crops is encouraged or regulated by the specific acts mentioned above in the section on trade in wild fauna and flora.

- Introduction/Augmentation/Re-introduction: More or less the same acts as govern breeding and cultivation also deal with the introduction, augmentation, and re-introduction of domesticated animals and plants.

- Release: There appears to be no central law relating to this aspect.

- Movement: Transportation of specified plants within India, specifically those which might carry pests with them, is regulated by the Destructive Insects and Pests Act of 1914. There appears to be no act regulating other domesticated plants. The Prevention of Cruelty to Animals Act of 1960 and its subsequent rules specify conditions of transportation of animals. The international movement of domesticated species is regulated by the various acts related to import and export, mentioned above.

- Intellectual property rights: Knowledge of agricultural and animal husbandry, variously known as intellectual property, farmers' rights, or breeders' rights, is not covered by any central law. The Patents Act of 1970 does not include within its purview such components, since it is restricted to inventions relating specifically to products and processes of manufacture.

Genetic materials

With the exception of seeds, genetic materials seem to be least covered by laws in India. The acts relevant to various aspects of such materials are discussed below.

- Identification: This does not appear to be stipulated in any central act. Agencies like the National Bureau of Plant Genetic Resources, the National Bureau of Fish Genetic Resources, and the National Bureau of Animal Genetic Resources, are conducting

28

identification exercises, but these do not seem to have any legal mandate.

- Protection in-situ: In-situ protection seems relevant mainly to seeds, since other genetic materials are best preserved in the living organisms which are their source. However, there appears to be no act providing protection to even this restricted class of materials; neither the Seeds Act of 1966, nor the 1988 New Policy on Seed Development deal with this aspect.

- Protection ex-situ: Supply of a portion of imported seeds and other plant material, by the importer to the NBPGR for accession to its gene bank, has been made obligatory under the 1988 New Policy on Seed Development. There appear, however, to be no laws relevant to ex-situ protection of genetic materials. The agencies named above are conducting ex-situ operations without any legal mandate.

- Access/Extraction: There seems to be no law governing this aspect, except of course those relating to property, in so far as genetic materials may be under private, corporate, or government ownership, and therefore given the status of property.

- Use: It may be possible to use the Environment (Protection) Act of 1986 to control the use of those genetic materials which can be classified as hazardous. Otherwise, there appears to be no law governing this aspect.

- Trade: Sale and other exchange of seeds of notified crops, as also their export and import, is governed by the Seeds Act of 1966, while all imports of seeds and plant materials are regulated by the Plants, Fruits and Seeds (Regulation of Import into India) Order of 1984 made under the Destructive Insects and Pests Act of 1914. The 1988 New Policy on Seed Development also stipulates restrictions on the import of plant materials. The Agricultural Produce (Grading and Marking) Act of 1937 can be used to regulate internal trade of seeds (and possibly other genetic material under a general clause of extension) considered below standard. Import-export of seeds of

29

certain specified crops, like tea and cardamom, are governed by the specific laws mentioned above in the section on trade of wild fauna and flora. The National Dairy Development Board Act of 1987 provides for the import of livestock semen, but there is no other act regulating the trade in animal genetic materials. It may be possible to extend the scope of both the Import and Export (Control) Act of 1947 and the Customs Act of 1962 to include such materials. However, there is no evidence to believe that they have ever been so extended.

- Breeding/Cultivation/Multiplication: The National Oilseeds and Vegetable Oils Development Board Act of 1983 has provisions for assisting in the production and development of oilseeds. Such a provision is also made in the acts regulating the cultivation of, and trade in, tea, rubber, and cardamom, named above in the section on trade of wild flora and fauna. Apart from these, there seems to be no other act encouraging or regulating the multiplication of genetic materials. The agencies mentioned above in the section on identification of genetic materials, are engaged in this task, but not under any legal mandate.

- Introduction/Augmentation/Re-introduction: Introduction of genetic materials of exotic varieties of plants into India is partially covered by the Seeds Act of 1966, and the Plants, Fruits, and Seeds (Regulation of Import into India) Order of 1984 made under the Destructive Insects and Pests Act of 1914. The National Dairy Development Board Act of 1987 provides for the introduction of semen of exotic livestock species into India. There seems to be no other act governing the introduction of genetic materials, even the hazardous act of introducing genetically altered materials.

- Release: Recently (1991) rules have been framed under the Environment (Protection) Act of 1986, to regulate the release of genetically altered materials into the environment. Other genetic

30.

materials are however not covered by this, or other laws.

- Movement: The various laws regulating internal and external trade in genetic materials, particularly seeds, also have general stipulation concerning the transportation of any goods under their purview. Otherwise, there is no act concerning this aspect.

- Intellectual property rights: There is no act relevant to knowledge regarding genetic material.

2. **INSTITUTIONAL MECHANISMS** (adapted from Singh, Shekhar, 1993)

This section attempts to outline some of the actions required nationally to develop institutions for conserving biological diversity. The tasks and strategies for which appropriate institutional structures are required, are listed below.

THE TASKS

1 To <u>develop</u> <u>our</u> <u>understanding</u> of biological resources, especially in terms of

- their genetic characteristics
- their taxa
- their populations
- their distribution
- their ecology
- their biological value
- their socio-economic uses and value
- their status
- threats they face
- methods of conservation and regeneration

2 To <u>protect</u>

- wild fauna
- wild flora
- natural ecosystems
- domesticated (or modified) fauna
- cultivated (or modified) flora
- modified ecosystems
- micro-organisms

3 To use biological resources <u>sustainably</u>

4 To use biological resources <u>equitably</u> <u>and</u> <u>justly</u>

THE STRATEGIES

1 To Understand, especially through

      -    biological research
      -    biogeographic research
      -    agroclimatic research
      -    socioeconomic research
      -    surveys and inventories
      -    census
      -    satellite mapping
      -    traditional practices and knowledge

2 To Protect, especially by

      -    integration of concerns into all sectors of activity
      -    formulation of plans and policies for protecting biodiversity
      -    enactment and application of laws
      -    setting up and managing a network of protected areas
      -    ex situ conservation
      -    captive breeding
      -    environmental impact assessment
      -    formulation and enforcement of standards
      -    fiscal and economic measures
      -    ecodevelopment
      -    people's participation and joint forest management
      -    research and development
      -    monitoring
      -    education and awareness
      -    international cooperation

3 Sustainably Use, especially by

      -    formulation of plans and policies for sustainable development
      -    enactment and application of laws forbidding unsustainable use
      -    environmental impact assessment
      -    formulation and enforcement of standards
      -    fiscal and economic measures
      -    efficient use of resources
      -    enhanced productivity of biomass
      -    recycling of resources
      -    use of alternatives
      -    research and development
      -    people's participation
      -    education and awareness

4 Equitably and Justly Use, especially by

      -    formulation of appropriate, integrated, plans and policies
      -    enactment and application of laws ensuring equity and justice
      -    socioeconomic impact assessment
      -    fiscal and economic measures
      -    ecodevelopment
      -    people's participation
      -    education and awareness
      -    international cooperation

INSTITUTIONAL STRUCTURES

Institutional structures are understood to include agencies, both within and outside the government, policies, laws, and programmes and schemes.

Given below is a description of some of the institutional structures in position for biodiversity conservation.

2.4.1 Wild Fauna and Flora, and Natural Habitats

Forests

The forests in India are managed by State forest departments, except in some of the tribal States in North-east India, where much of the forests are under the control of tribal District Councils. Under the Indian Forest Act of 1927, forests have been demarcated into Reserved and Protected forests. The State forest departments draw up working plans for each forest division, and these working plans are supposed to regulate the use and management of these forests and ensure that they are sustainably managed. Unfortunately, the thrust of these working plans and, infact, the orientation of the forest department, has been largely towards commercial forestry. Therefore, by and large forests are supposedly managed with the objective of sustainable extraction of timber, and not with the object of protecting biodiversity.

For protection of wildlife and biodiversity the state governments have constituted to date 75 national parks and 419 sanctuaries [MoEF 1992]. There is also an effort to set up 13 biosphere reserves (MoEF 1989). However, only a part of the area under these is forest area.

National parks are supposed to be without any disturbance and are supposed to be maintained as gene pools. Sanctuaries are also aimed at protecting wild fauna and flora, but not to the level expected of national parks. Biosphere reserves are designed to promote the interaction between different components of the ecosystem and human beings, and have the objective of maintaining the diversity of both wild and domesticated species of fauna and flora.

34

There are various laws (described in the section on laws) which regulate the use of forests, the transfer of forest land for non-forestry purposes, and the killing or disturbing of wildlife.

The protection of forests is primarily the responsibility of the state forest departments, except in the north-east. The Ministry of Environment and Forests, Government of India, in regulating the diversion of forest lands for non-forestry purposes and in assessing the impact of development activities and projects before according environmental clearance, contributes to the the effort of forest and wildlife protection.

The wildlife protected areas (national parks and sanctuaries), are protected by the wildlife wing of the state forest departments.

Grasslands

At present, no designated government agency, at the state or Centre, has the responsibility of specifically protecting grasslands. In so far as some of these grasslands are within forest areas, the forest department has control over them but there appears to be little attention paid to them and little experience and expertise available for their management. Of the grasslands outside forest areas or wildlife protected areas, the State and Central Departments of Environment can offer protection under general Acts like the Environmental (Protection) Act. Species of plants and animals found in these grasslands, insofar as they are scheduled under the Wildlife (Protection) Act, can be protected.

There also does not appear to be any specific Central or Centrally sponsored scheme, at present, like there is for wetlands and mangroves, to protect and manage grasslands.

Wetlands

Apart from the wetlands and portions of rivers that are within national parks and sanctuaries, there is no specific governmental institution that is responsible for their protection and management,

especially from the environmental aspect. The Central and State Pollution Control Boards have the responsibility of preventing and regulating water pollution, especially from industry and municipalities. The Central Water Commission monitors the water flow and, at a few points in some rivers, the water quality. There are also various state and local organisations which are responsible for regulating the agricultural, industrial and municipal use of water from some of these water bodies.

The Ministry of Environment and Forests (MOEF), Government of India started, in the VII Plan, a Ganga Action Plan which seeks to clean stretches of the River Ganga with the help of State Governments and municipalities. It is now proposed to start a River Action Plan, along similar lines, for cleaning up some of the other critically polluted rivers in India.

The MOEF also has a central scheme for the protection of wetlands in India. Under this scheme, funds are available to institutions, NGOs and State Governments for research and action aimed at protection or regeneration of wetlands. There is also a Central Committee, with corresponding State Committees, to advise on the protection and management of wetlands.

Apart from these, the general environmental laws and the procedure for assessing the environmental impact of projects before according them environmental clearance, offers some level of protection to wetlands and riverine systems.

Coastal Regions and Islands

Those of the coastal regions, mangroves, islands and coral reefs that are either within national parks or sanctuaries, or a part of designated forest areas, have the protection of the relevant Acts and are managed by State Forest Departments. For the two groups of Islands (Andaman & Nicobar, and Lakshadweep), the Government of India has set up an Island Development Authority which has the responsibility of ensuring that activities and projects in these islands do not destroy the

36

environment.

The Government of India has also issued a notification, under the Environment (Protection) Act, prohibiting the building of hotels, houses and certain other types of structures within 500 metres of the high tide line. There is also a Central Committee, with corresponding State Committees, to advise on the protection and management of mangroves and coral reefs.

Mountains

There is no government institution specifically to safeguard the environment of our mountain ranges. In fact, the few institutions, like the North Eastern Council, have the objective of promoting the economic development of the hill regions. Consequently, only those parts of the mountain ranges which are either forests or national parks and sanctuaries actually get managed to protect their environment. Ofcourse, other general laws and procedures are also applicable to them.

Recently (January, 1992), the MOEF has issued a notification, under the Environment (Protection) Act, specifying that the construction of hotels and other tourist facilities above 1000 metres altitude would require the clearance of the MOEF, if it is above a certain investment level. If this is finally gazetted, then it would provide some measure of protection to the mountain ecosystems.

The MOEF has also gazetted a notification for the protection of the Aravalli range of mountains in Gurgaon District of Haryana and Alwar District of Rajasthan, and for the hills around the Doon valley. Both these areas are ecologically fragile and under severe threat. The notifications prohibit, without the specific clearance of the MOEF, various types of projects in these regions.

Deserts

Unfortunately, apart from general laws and laws protecting wildlife and wilderness areas, there is no specific legal or institutional protection for our desert ecosytems.

Specific Species

A network of 33 well known Botanical Gardens and 107 Zoological Parks attempt to conserve, ex situ, threatened species of plants and animals. For plants, as far as the climatic and soil conditions are not too different, it is relatively easy to reintroduce or supplement populations of threatened species, provided that the host environment is conducive for their establishment.

The value of zoological gardens as a method of preserving threatened animal species is less certain. Zoos in India still have no proper method of ensuring scientific breeding, though with the recent setting up of the Zoo Authority of India, this problem might be tackled. At present, there is acute inbreeding among zoo animals and many of them also suffer from diseases, especially tuberculosis.

Most of these animals have spent their lives in small and dirty cages, far removed from their natural habitats. Apart from the human imprinting this has caused, these animals would be unable to adapt to the wild. Therefore, though zoo specimens can, at present, have the limited value of providing basic biological data about their species, only under extreme circumstances can they be considered for reintroduction to the wild.

There are also certain institutions which preserve germplasm of wild relatives of domesticated plants, in vitro. A list of some of these institutions is at Appendix 9.

The MOEF, along with State Governments, has started various projects to protect specific species of animals by protecting their habitat and ecosystems. Some of the projects are:

- Project Tiger, started in 1973, are aimed at protecting the tiger and its habitat. At present there are 18 Tiger Reserves across the country.

- Project Elephant has been launched in 1991, and similarly seeks to protect the elephant and its habitat.

- Project Hangul was launched in 1970.

38

- Crocodile breeding project was launched in 1975.

- Manipur Brow-antlered Deer Conservation Project was started in 1973.

Efforts have been made to reintroduce and supplement populations of threatened species through captive breeding. Most notably, for wild species, the successful crocodile and gharial breeding programmes are examples.

The reintroduction of species has also been attempted by translocating species from elsewhere. The reintroduction of the Indian Rhino into Dhudwa National Park in U.P., which was a part of its original range, is an example.

2 Domesticated Fauna and Flora

The main governmental responsibility for conserving domesticated species of plants and animals is with the Indian Council of Agricultural Research (ICAR), and its subsidiary institutions. Among the most important of these institutions are the National Bureaus for Plant, Animal, and Fish Genetic Resources. Details of these and other institutions are given in Appendix 12.

Alarmingly, there appears to be no institutional mechanism for in situ conservation, i.e. at the site of cultivation or breeding, for domesticated species.

ABSTRACT

A status of the administrative structures pertaining to the different tasks and strategies is summarised in table I. Table II contains the action points relevant for India and emanating from the Convention on Biological Diversity. It also indicates the agencies responsible for each of the actions required and the current status of laws in India in relation to the action points.

Table 1

INSTITUTIONAL STRUCTURES

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1 To Understand, especially through								
1.1 biological reserach								
1.2 biogeographic research								
1.3 agroclimatic research								
1.4 socioeconomic research								
1. A network of research institutions, both within and outside the government, with strong links to individual experts within and outside the country, and ability to collaborate internationally.	P	P	Y	Y	-	-	P	P
2. A network of voluntary organisations and community groups willing and able to support research activities in the relevant areas, especially socioeconomic research.	-	Y	-	Y	-	-	-	Y
3. An institutional ability to set up and maintain interdisciplinary research.	P	P	-	-	-	-	P	P
4. A coordinating institutional structure with the ability to review research activities and to encourage and support research in priority areas.	N	N	-	-	-	-	N	N
5. Institutional mechanisms for the dissemination of research findings.	P	P	P	P	N	N	P	P
1.5 survey and inventories								
1. A statutory authority to systematically survey and make inventories of the biological resources of a country.	Y	P	Y	P	N	N	Y	P
2. A network of scientific institutions and voluntary organisations for detailed surveys and inventories, and for the verification of data, especially in ecologically rich areas.	P	P	Y	Y	-	-	P	P

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1.6 census								
1. Local level governmental and voluntary organisations with the mandate and ability to conduct regular census, especially of threatened and endangered species of fauna and flora.	P	N	Y	N	Y	N	P	N
2. Central level institution which coordinates the national census activities and compiles and analyses data.	P	-	P	-	Y	-	P	-
3. Institutional mechanisms for the dissemination of census information.	P	P	P	P	N	N	N	N
1.7 satellite mapping								
1. Remote sensing and GIS institutional capabilities.	Y	P	-	-	-	-	Y	P
2. Field level institutions, both within and outside the government, to assist in the ground proofing.	P	P	-	-	-	-	P	P
3. Institutional mechanisms for the dissemination of this information.	P	P	P	P	N	N	P	P
1.8 traditional practices and knowledge								
1. Local level institutions, preferably independent of the government, to record and support traditional knowledge, and appropriate traditional practices.	P	P	P	P	N	N	P	P
2. Scientific institutions with the ability to objectively assess and investigate traditional knowledge and practice.	P	P	P	P	N	N	P	P
3. Institutional mechanisms to collate and appropriately disseminate this information.	P	P	P	P	-	-	P	P

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
2 To Protect, especially by								
2.1 integration of concerns into all sectors of activities								
1. A statutory institutional ability, at all levels, to integrate concerns about biodiversity conservation into the planning (pre activity) stages of all government, corporate, or community activities.	P	–	Y	N	N	–	N	–
2. A statutory institutional ability to scrutinise all plans, laws, policies or programmes (governmental and others) and to ensure that they are not destructive of biological resources.	P	N	P	N	N	N	N	N
3. Institutional ability, especially through research institutions independent of the government and the corporate sector, to scientifically assess the impact on biological resources of various plans, policies, laws or programmes; to recommend remedial measures; and to advise the statutory bodies especially through the formulation and upgradation of guidelines.	P	P	P	N	N	N	P	P̃
2.2 setting up and managing a network of protected areas								
1.An institutional structure to identify areas of representative or unique ecological value, for protection, and to periodically review the protected area network.	P	P	P	N	N	N	P	P
2. Statutory institutional ability to create the required protected areas.	Y	N	Y	N	Y	N	Y	N

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
3. Local level institutional structures, both within and outside the government, to manage individual protected areas and to interact with the communities living in and around such protected areas, or having an impact on them.	Y	N	Y	N	Y	N	Y	N
4. Local and national level institutions, independent of park-management, to periodcally monitor the management and state of individual protected areas and the protected areas network.	P	P	Y	P	Y	N	N	N

2.3 ex situ conservation

2.4 captive breeding

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. Local, regional and national level botanical gardens, managed by government and non-government institutions.	Y	P	Y	P	Y	P	Y	P
2. Local and regional level zoological parks.	Y	P	Y	Y	Y	Y	Y	N
3. Local and regional level captive breeding facilities, preferably independant of zoos.	P	P	Y	P	Y	P	Y	P
4. National and regional zoo authorities and breeding co-ordinators.	P	N	Y	N	Y	N	Y	N
5. Gene banks for fauna, flora and micro-organisms.	Y	P	Y	P	Y	P	Y	P

2.5 environmental impact assessment

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. Statutory institutional ability to insist on an environmental impact assessments prior to the initiation of projects and activities potentially damaging to biological resources.	P	N	Y	N	N	N	P	N

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
2. A statutory institutional ability to block projects and activities which, based on a EIA, have not been found viable from the considerations of biodiversity conservation.	P	N	Y	N	N	N	P	N
3. A network of scientific institutions and local level voluntary groups, independent of assessing authorities and project proponents, to prepare environmental impact statements.	N	P	P	P	N	N	P	P
4. A network of institutions, independent of project proponents, for regular collection and compilation of biogeographic, agroclimatic and socioeconomic and other relevant baseline data for the whole country.	Y	P	Y	Y	-	-	Y	P
5. An institutional ability to have public hearings and community participation in the process of assessing projects and activities.	N	N	P	N	N	N	N	N
6. An institutional ability to monitor compliance of prescribed environmental safeguards.	P	N	Y	N	Y	N	Y	N
7. An institutional ability to restrospectively assess completed projects and activities for reviewing the EIA process and methodology.	P	P	P	P·	-	-	Y	P
2.6 formulation and enforcement of standards								
1. A statutory institutional ability for developing, setting and reviewing standards, in terms of impact on biological resources, of, among others. - air pollution - water pollution - thermal pollution - noise pollution	P	P·	Y	N	Y	N	Y	P

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
- chemical contamination								
- nuclear contamination								
- biotic pressures								
- genetic modification								
2. An institutional ability, both within and outside the government, to enforce standards.	Y	N	Y	P	Y	P	Y	P

2.7 fiscal and economic measures

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. An institutional ability to ensure that market prices of biological resources and their derivatives reflect correctly their ecological and socioeconomic value.	P	N	P	N	N	N	P	N
2. An institutional ability to determine ecological and socioeconomic value, in fiscal or some other appropriate terms, of biological resources.	P	P	Y	P	N	N	Y	P
3. An institutional ability to use taxation as a method for conserving biological diversity, both by the government and by local communities.	P	P	Y	P	Y	P	-	-
4. An institutional ability to use fiscal and economic incentives (like rebates, ecomarks, soft credit, etc.) for the conservation of biological resources.	Y	N	Y	N	Y	N	Y	N

2.8 ecodevelopment

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. An institutional ability to ensure that the local communities dependent on biological resources which need to be protected, are provided adequate, appropriate and sustainable alternatives.	P	N	Y	N	Y	N	Y	P
2. Local level voluntary and community institutions which can plan for the most appropriate form of ecodevelopment, and help implement and monitor the activities involved.	-	P	-	P	-	N	-	P

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
3. Regional and national level institutional ability to help plan, implement, and monitor ecodevelopment, in partnership with the people.	P	P	Y	Y	P	N	Y	P

2.9 people's participation and joint forest management

1. An institutional ability within the government, to allow the citizens and communities to plan for, make decisions about, and control, their own natural resources.	P	-	P	-	N	-	P	-
2. Local, community, institutions with the ability to manage their own resources democratically, and in partnership with the government.	-	P	-	P	-	P	-	P
3. An institutional ability to support community management by the required, appropriate, scientific and managerial inputs.	P	P	Y	Y	-	-	P	P
4. An institutional ability to make available, to the people, information and data relevant to their efforts at conserving and managing their own biological resources.	P	Y	P	-	N	N	P	P

2.10 research and development

As in 1.1 to 1.6 above.

2.11 monitoring

1. Local and regional level institutional ability to monitor, over time, the status of biological resources.	P	P	P	P	Y	P	Y	P
2. Regional and national level institutions to compile and analyse the monitoring data, and to send out alarm calls.	P	P	P	P	P	N	P	P

	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
2. Special scientific institutions for the monitoring of selected ecosystems (like mangroves, coral reefs, etc.) and species.	P	P	P	P	Y	P	Y	P

2.12 education and awareness

	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. An institutional ability to introduce messages concerning biodiversity conservation in formal education curricula, at all levels.	Y	N	P	N	Y	N	Y	P
2. An institutional ability to promote appropriate conservation messages through the printed and electronic mass media.	Y	P	Y	Y	Y	Y	Y	f
3. Local level institutions, governmental and community, for dissemination of information relevant to the specific region.	P	P	P	P	-	-	P	P
4. An institutional ability to educate and raise awareness through specialised institutions like museums, zoos, visitor's centres and wilderness parks.	Y	Y	Y	Y	Y	P	Y	P

2.13 international cooperation

	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. The institutional ability to interact and cooperate with other governments, and with institutions in other countries.	Y	Y.	Y	N	Y	N	Y	P
2. The institutional ability to be a party to international agreements and conventions.	Y	N	Y	N	Y	N	Y	N
3. The institutional ability to take-up multi-national conservation efforts.	Y	P	Y	N	Y	N	Y	P

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for	for
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others

3 Sustainable Use, especially by

3.1 environmental impact
     assessment

     Same as 2.5

3.2 formulation and enforcement
     of standards

     Same as 2.6

3.3 fiscal and economic measures

     Same as 2.7

3.4 efficient use of resources

3.5 recycling of resources

	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
1. The institutional ability to develop technological methods for recycling and/or using biological resources more efficiently.	P	P	P	P	-	-	P	P
2. The institutional ability to develop managerial methods for recycling and/or using biological resources more efficiently.	P	P	P	P	-	-	P	P
3. The institutional ability to make the recycling and/or efficient use of biological resources, through fiscal and economic incentives and disincentives, socially preferred.	P	N	P	P	Y	P	P	N
4. The institutional ability to penalise and prevent uses of biological resources which are inefficient and in excess of stipulated standards.	N	N	P	N	N	N	N	N

3.6 use of alternatives

| 1. An institutional ability to identify or develop alternatives for biological resources threatened by human use. | P | P | Y | Y | - | - | P | P |

2. An institutional ability to propogate and ensure the use of these alternatives through fiscal and economic incentives and disincentives. — P N P P Y N P P

3. An institutional ability to ensure, by law, that alternatives, threatened biological resources where available, are used. — N N P N N N N N

3.7 research and development

Same as 1.1 to 1.6

3.8 people's participation

Same as 2.9

3.9 education and awareness

Same as 2.12

4 Equitable and Just Use, especially by

4.1 socioeconomic impact assessment

1. Statutory institutional ability to insist on an socioeconomic impact assessments prior to the initiation of projects and activities using biological resources. — Y N Y N N N P N

2. A statutory institutional ability to block projects and activities which, based on such an assessment, are found to be promoting inequity. — P N Y N P N P N

3. A network of institutions and local level voluntary groups, independent of assessing authorities and project proponents, to prepare socioeconomic impact statements. — Y Y Y Y P N P P

4. A network of institutions, independent of project proponents, for regular collection and compilation of socioeconomic data for the whole country. — Y Y Y Y - - Y Y

	Agencies		Policies empowering		Laws empowering		Programmes & Schemes for for	
	Govt.	Others	Govt.	Others	Govt.	Others	Govt.	Others
5. An institutional ability to have public hearings and community participation in the process of assessing projects and activities.	N	N	P	P	N	N	N	N
6. An institutional ability to monitor compliance of prescribed socioeconomic safeguards.	P	N	P	N	P	N	P	N
7. An institutional ability to restrospectively assess completed projects and activities for reviewing the process and methodology of assessing the socioeconomic impact.	P	P	P	N	-	-	P	P

4.2   fiscal and economic measures

Same as 2.7

4.3   ecodevelopment

Same as 2.8

4.4   people's participation

Same as 2.9

4.5   education and awareness

Same as 2.12

4.6   international cooperation

Same as 2.13

Key: Y = Yes, P = Partial, N = None

Table II:

Analysis of Action Points Emanating from the
Biodiversity Convention: The Indian Situation

ACTION REQUIRED	AGENCY RESPONSIBLE	LEGAL INSTRUMENTS
To conserve biological diversity (1)	MOEF, MOAGRI	Some
To ensure sustainable use of components of biological diversity (1)	MOEF, MOAGRI	Some
To ensure fair and equitable sharing of the benefits of genetic resources (1)	MOEF, MOAGRI, DOBIO	None
Ensuring appropriate access to genetic resources (1)	MOEF, MOAGRI	None
Ensuring appropriate transfer of relevant technologies (1)	MOEF, MOAGRI, MOS&T	None
Ensuring appropriate funding (1)	MOEF, MOAGRI, MOFIN	NA
To exploit one's own resources according to environmental policies without damage to other States or international commons. (3)	MOEF	None
To cooperate with other Parties for conservation and sustainable use of biological diversity in international commons, and in other matters of mutual interest (5)	MOEF, MOEA	NA
To develop national strategies for conservation and sustainable use of biodiversity or adapt already existing strategies, plans and programmes reflecting the relevant measures of the convention (6a)	MOEF	NA
To integrate the conservation and sustainable use of biodiversity into sectoral/cross sectoral plans, programmes and policies (6b)	MOEF, PC, MOAGRI, OTHR	None
To identify components of biodiversity important for their conservation and sustainable use with reference to annexure I (7a)	MOEF, DOBIO, MOAGRI	None
To monitor identified biodiversity components, especially those requiring urgent conservation measures and with potential for sustainable use (7b)	MOEF, DOBIO, MOAGRI	None
To identify activities that have adverse impacts on conservation and sustainable use of biodiversity and to monitor their effects (7c)	MOEF, MOAGRI	Some

ACTION REQUIRED	AGENCY RESPONSIBLE	LEGAL INSTRUMENTS
To maintain and organize information derived from the above listed monitoring activities (7d)	MOEF, MOAGRI, DOBIO	NA
To establish a system of protected areas or special areas to conserve biological diversity (8a)	MOEF, MOAGRI	Some
To develop guidelines for selection, establishment and management of protected areas/special areas (8b)	MOEF, MOAGRI	NA
To regulate or manage biological resources important for conservation of biological diversity, within or outside protected areas (8c)	MOEF, MOAGRI	Some
To promote protection of ecosystems and natural habitats and the maintenance of viable populations of species in natural surroundings (8d)	MOEF	Some
To promote sustainable development in areas surrounding protected areas (8e)	MOEF, MORD	None
To promote rehabilitation of degraded ecosystems and recovery of threatened species (8f)	MOEF, MORD	Some
To regulate risks associated with use and release of living modified organisms that may have adverse environmental or human impacts (8g)	MOEF, DOBIO, MOAGRI	None
To prevent introduction of (and control or eradicate) alien species threatening ecosystems (8h)	MOEF, DOBIO, MOAGRI	Some
To strike a balance between present uses of biological diversity and sustainable use and conservation of its components (8i)	MOEF	Some
To respect and preserve knowledge, innovation and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity (8j)	MOEF, MOHRD	None
To promote their wider application (8j)	MOEF, MOHRD	NA
To encourage the equitable sharing of benefits arising from this (8j)	MOEF, MOHRD	NA
To develop and maintain legislations/regulations for protection of threatened species and populations (8k)	MOEF	NA
To regulate activities and processes having significant adverse effects on biodiversity (as identified in article7) (8l)	MOEF, DOBIO, MOAGRI	None
To get (from the Global Community) financial and other support for in-situ conservation (8m)	MOEF, MOFIN, MOEA	NA

ACTION REQUIRED	AGENCY RESPONSIBLE	LEGAL INSTRUMENTS
To adopt measures for ex-situ conservation of components of diversity, particularly in country of origin (9a)	MOEF, MOAGRI, DOBIO	Some
To establish and maintain facilities for ex-situ conservation of and research on plants, animals and micro-organisms (9b)	MOEF, DOBIO, MOAGRI	NA
To adopt measures for recovery and rehabilitation of threatened species and for reintroduction into natural habitats (9c)	MOEF	Some
To regulate and manage collection of biological resources from natural habitats for ex-situ conservation without damage to in situ populations and ecosystems (9d)	MOEF, MOAGRI, DOBIO	Some
To get (from the Global Community) financial and other support for ex-situ conservation (9e)	MOEF, MOFIN, MOEA	NA
To integrate conservation and sustainable use of biological resources in national decision making (10a) (See 6b)	MOEF, PC	None
To use biological resources so as to avoid impacts on diversity (10b)	MOEF, MOAGRI, OTHR	Some
To protect and encourage traditional and customary uses of biological resources which are sustainable (10c) (See 8j)	MOEF, MORD, MOAGRI	None
To support local populations in taking remedial action in degraded areas with reduced biodiversity (10d)	MOEF, MORD	None
To encourage cooperation between government and private sector for developing methods for sustainable use of biological resources (10e)	MOEF, MOIND, MOAGRI, DOBIO	NA
To adopt socio-economic incentives for conservation and sustainable use of the components of biodiversity (11)	MOEF, MOAGRI, MORD	NA
To establish and maintain programmes for scientific and technical education and training in identification, conservation and sustainable use of biodiversity and its components (12a)	MOEF, MOHRD, MOS&T, MOAGRI	NA
To get funds (from the Global Community) for such education and training (12a)	MOEF, MOHRD, MOEA, MOS&T, MOAGRI	NA
To encourage research into conservation and sustainable use of biodiversity (12b)	MOEF, MOS&T, MOAGRI	NA

Action Required	Agency Responsible	Legal Instruments
To promote, and cooperate in the use of, scientific advances for conservation and sustainable use of biological resources (12c)	MOEF, MOS&T	NA
To promote an understanding of the importance of, and conservation measures for, biodiversity conservation through media and educational programmes. (13a)	MOEF, MOI&B, MOHRD	NA
To develop educational and awareness programmes in biodiversity conservation, along with other States and international organisations (13b)	MOEF, MOHRD, MOEA	NA
To introduce procedures for environmental impact assessments of proposed projects that have an impact on biological diversity, and to allow public participation (14,1a)	MOEF	None
To ensure that impact on biodiversity of programmes and policies are taken into account (14,1b) (See 6b)	MOEF	None
To promote exchange of information and consultation on activities likely to affect biodiversity of international commons or of other states, through international arrangements (14,1c)	MOEF, MOEA	None
To notify concerned States in the event of imminent danger/damage to their biological diversity or to the diversity of international commons (14,1d)	MOEF, MOEA	None
To initiate action to minimise such damage (14,1d)	MOEF, MOEA	NA
To promote national arrangements for emergency/disaster management (14,1e)	MOEF, MOS&T, MOAGRI	Some
To encourage international cooperation in disaster management (14,1e)	MOEF, MOEA	NA
To set up joint contingency plans with other states for disaster management (14,1e)	MOEF, MOEA	NA
To retain sovereign rights over, and access to, genetic resources (15,1)	MOEF, MOEA, MOFIN	Some
To facilitate access to genetic resources for environmentally sound uses by other Parties, as per the convention (15,2)	MOEF, MOEA	None
Regulate access to genetic resources (15,5)	MOEF	Some
To ensure that research, on genetic resources provided by other Parties, is with their participation (15,6)	MOEA, MOS&T, MOAGRI	None

ACTION REQUIRED	AGENCY RESPONSIBLE	LEGAL INSTRUMENTS
To ensure the fair and equitable sharing of the results of such research (15,7)	MOEF, MOS&T, MOAGRI	None
To facilitate access to and transfer of biotechnologies relevant to conservation and sustainable use of biodiversity and the environment (16,1)	MOEF, MOEA, MOS&T, MOAGRI	None
To get (access to) technology on fair and most favourable terms (16,2)	MOEF, MOS&T, MOIND, MOEA, MOCOM	NA
Safeguarding of intellectual property rights (16,2)	MOEF, MOEA, MOCOM	None
To ensure access to technology to suppliers of biological resources (16,3)	MOEF, MOS&T, MOEA, MOAGRI	None
To see that the private sector facilitates access to, joint development and transfer of technology, especially to governmental institutions (16,4)	MOIND, MOS&T, MOCOM	None
To ensure that intellectual property rights are supportive of and do not run counter to objectives of Convention (16,5)	MOEA, MOCOM	NA
To facilitate exchange of information, from public sources, relevant to conservation and sustainable use of biodiversity (17,1)	MOEF, MOEA, MOHRD	NA
To facilitate exchange especially of results of technical, scientific and socio-economic research, indigenous and traditional knowledge, and repatriation of information (17,2)	MOEF, MOS&T	None
To promote international technical and scientific cooperation in conservation and sustainable use of biodiversity (18,1)	MOEF, MOS&T, MOAGRI	NA
To promote technical and scientific cooperation through the development and implementation of national policies (18,2)	MOEF, MOHRD, MOS&T, MOAGRI	NA
To develop and strengthen national capabilities by means of human resource development and institution building. (18,2)	MOEF, MOHRD, MOAGRI, MOS&T	NA
To cooperate in the development and use of technologies including indigenous and traditional technologies, especially through training and exchange of experts (18,4)	MOEF, MOS&T, MOAGRI, MOHRD	NA

To establish joint research programmes and   MOEF,   NA
ventures for technology development (18,5) [Rep]   MOS&T,
                                                     MOAGRI

To take legislative and administrative measures to MOEF,   NA
ensure participation in biotechnological research   DOBIO,
of suppliers of biological resources (19,1) (See   MOAGRI
16,3)

To provide priority access, to the concerned   MOEF,   None
parties, to results and benefits arising from   DOBIO,
biotechnologies based on genetic resources   MOAGRI
provided by those Parties (19,2)

To ensure safe transfer, handling and use of any   MOEF,   Some
living modified organism resulting from   DOBIO,
biotechnology that may have adverse effects on   MOAGRI
diversity (19,3)

To provide information on use and safety   MOEF,   None
regulations in handling modified organisms, and on DOBIO,
potential adverse impacts of organisms, to   MOAGRI
countries where they will be introduced (19,4)

To provide, according to capability, financial   MOEF, PC,   NA
support and incentives to achieve objectives of   MOFIN,
the convention. (20,1)   MOAGRI

To get funds (from the Global community) for   MOEF,   NA
implementing measures (20,2)   MOFIN,
                                                     MOAGRI,
                                                     MOEA

To avail of financial resources through bilateral, MOEF,   NA
regional and multilateral channels (20,3)   MOFIN,
                                                     MOAGRI,
                                                     MOEA, MOS&T

Report on implementation of convention (26)   MOEF, MOEA, NA
                                                     MOAGRI,
                                                     DOBIO

Key : NA = Not Applicable
List of Abbreviations

DOBIO	DEPARTMENT OF BIOTECHNOLOGY
EPA	ENVIRONMENTAL (PROTECTION) ACT, 1986
MOAGRI	MINISTRY OF AGRICULTURE
MOCOM	MINISTRY OF COMMERCE
MOEA	MINISTRY OF EXTERNAL AFFAIRS
MOEF	MINISTRY OF ENVIRONMENT AND FORESTS
MOFIN	MINISTRY OF FINANCE
MOHRD	MINISTRY OF HUMAN RESOURCES DEVELOPMENT
MOI&B	MINISTRY OF INFORMATION AND BROADCASTING
MOIND	MINISTRY OF INDUSTRIES
MORD	MINISTRY OF RURAL DEVELOPMENT
MOS&T	MINISTRY OF SCIENCE AND TECHNOLOGY
OTHR	OTHER MINISTRIES
PC	PLANNING COMMISSION

RECOMMENDATIONS

Recommendations for biodiversity conservation are given separately for the seven broad heads, namely wild fauna, wild flora, cultivated flora, domesticated fauna, natural habitats, modified habitats, and micro-organisms. These seven broad heads are further looked at in terms of both research and conservation.

1. Wild fauna

1.1 Whereas the Zoological Survey of India (ZSI) is involved in the taxonomic listing of faunal species in the country, much greater stress needs to be given to this work, especially for Insecta and marine fauna. The identification and description of fauna species is essential if commitments under the Convention on Biological Diversity are to be met, and if we have to conserve and sustainably use our biological resources.

The ZSI, as a national institute, needs to coordinate research in this area but needs to network other agencies, especially universities and non-governmental organisations. The current listings are mainly geographical. What is required as a priority is to:

-Develop a comprehensive national listing of all phyla, genus, species and sub-species with their location, distribution, description and status. Some of the phyla especially in need of attention are :

Ctenophora, Nemertina, marine Nematoda, Gnathostomulida, Pongonophora, Priapulida, Pentastomida and Targigrada (most of these are marine planktonic forms). Protozoa, Gastrotricha, Kinorhyncha, Acanthocephala, Entoprocta, Sipuncula, Echiura, Brachiopoda, Hemichordata , Protochordata, freeliving (non parasitic) nematodes and platyhelninthes.

Also, very little work is being done on minor phyla.

-Develop a detailed listing of fauna of ecologically important locations including protected areas.

-Analyse the taxonomic data, including the trends over time, the ecology of selected species, the causes behind depletion or extinction of populations, and interrelationships between taxa.

-Identify 'keystone' and 'umbrella' species for conservation.

-Identify endemic species and their conservation needs.

-Study the ecological niches of important species and their role in the ecosystem.

-Update and verify old listings.

The levels of funding for the ZSI and for networking institutions (including universities and NGOs) will have to be significantly enhanced over current availability.

Budget

Funding for the co-ordination activities through the ZSI for five years	Rs. 1 crore
Support to institutions, NGOs and the ZSI itself for carrying out surveys, analysis and research over five years	Rs. 100 crores
Total	Rs. 101 crores

Agencies: MoEF (Ministry of Environment & Forests), MOHRD (Ministry of Human Resources Development), MOS&T (Ministry of Science and Technology)

1.2 A significant amount of research needs to be undertaken in assessing the socio-economic value of various animal species, especially with the objective of, on the one hand, controlling poaching and illegal trade and, on the other hand, setting up programmes of artificial breeding in order to meet legitimate socio-economic demands. Such research should also record traditional uses and attitudes towards animal species. The research needs to be multi-disciplinary and, therefore, needs the involvement of various types of institutions and organisations within and outside the Government.

Budget

Support of socio-economic and cultural   Rs. 20 crores
(ethnozoological) research
through   governmental   and   non-
governmental institutions over 5 years.

1.3 The _in situ_ protection of wild animals, within protected areas, is

being looked at separately in the section on wild life management.

However, much of the wild animal population is outside designated

protected areas.   Unfortunately, though laws exist for protecting

various species of animals, there is very little infrastructure outside

protected areas for the purpose. Some of the main actions required are:

-Sensitising the public towards wild animals through awareness

campaigns.

-ensuring protection of habitats of such animals and their sources

of food and water.

-making provision to compensate for the damage that such animals

might inflict on the crops or livestock of village communities.

-establishing alternative sources of income for those artisans and

villagers who traditionally earned their living off wild animals

(like ivory carvers)

Much of the wild animal population outside protected areas is   in

forests, grasslands, deserts, wetlands, and ;in aquatic and marine

ecosystems.   Though there are separate sections dealing with some of

these   ecosystems, the recommendations here are specific to   the

protection of wild animals rather than the ecosystem itself.

Budget

Awareness campaigns aimed at raising   Rs. 10 crores
the sensitivity levels of .communities
living in areas rich in wild animals,
to   be   run   primarily by   non-
governmental   organisations   and
educational institutions for   five
years.

Provision of funds for compensating damage by wild animals or for rehabilitating wild-animal dependent workers and artisans, over five years, to be carried out through the State Wildlife Department	Rs. 200 crores

	Total	Rs. 210 crores

1.4 The _ex situ_ conservation of wild animals takes place primarily through a network of zoological parks and captive breeding centres. _In vitro_ conservation is achieved in gene banks. The Government of india has recently set up a National Zoo Authority which hopes to coordinate the various zoological parks in the country and to supervise captive breeding both for zoos and for possible reintroduction into the wild.

The Indian Council of Agricultural Research has set up various bureaus for animal and fish genetic resources in an effort to conserve genetic strains of certain important species. Both these initiatives need significant additional support.

Budget

Support for setting up/improving zoological parks and captive breeding centres, over five years, to be implemented through the National Zoo Authority	Rs. 200 crores
Support for strengthening of the bureaus for animal and fish genetic resources, so as to give a higher priority to wild species, for five years, to be implemented through the Indian Council of Agricultural Research.	Rs. 50 crores

	Total =	Rs. 250 crores

2. Wild Flora

2.1 The Botanical Survey of India (BSI) has the responsibility of listing the flora of the country. Though the BSI has been studying the flora for many years, a significant amount of work still needs to be done.

60

The identification and description of flora species is essential if commitments under the Convention on Biological Diversity are to be met, and if we have to conserve and sustainably use our biological resources.

The BSI also needs to coordinate research in this area and to network other agencies, especially universities and non-governmental organisations. What is urgently needed is to:

-Develop a comprehensive national listing of all phyla, genus, species and sub-species with their location, distribution, description and status. Those needing special attention are : non-flowering plants, fresh-water and terrestrial algae, fungi, ferns, and lichens. Also, much more work is required in India on gymnosperms.

-Develop a detailed listing of the flora of ecologically important locations including protected areas.

-Analyse the taxonomic data, including the trends over time, the ecology of selected species, the causes behind depletion or extinction of populations, and interrelationships between taxa.

-Identify 'keystone' and 'umbrella' species for conservation.

-Identify endemic species and their conservation needs.

-Study the ecological niches of important species and their role in the ecosystem.

-Update and verify old listings.

Budget

Funding for the co-ordination activities through the BSI for five years	Rs. 1 crore
Support to institutions, NGOs and the BSI itself for carrying out surveys, analysis and research over five years	Rs. 100 crores
Total	Rs. 101 crores

Agencies: MoEF (Ministry of Environment & Forests) MOHRD, (Ministry of Human Resources Development), MOS&T (Ministry of Science and Technology)

2.2 There are a large number of traditional uses of various plants, especially as medicine. Both the knowledge and the required plants are rapidly becoming extinct. Though the Government of India had, earlier, initiated a national project on ethnobiology, much more work still remains to be done. Efforts also have to be made to develop the ability to cultivate those plants and herbs that are commercially in demand, so that they do not become extinct in the wild.

Budget

Ethnobotanical surveys, especially of traditional uses and practices.	Rs. 25 crores
Research into methods of cultivating commercially valuable wild plants.	Rs. 25 crores
Establishment of farms for medicinal herbs and other commercially valuable plants, all through the Ministry of Environment and Forests, in collaboration with the Anthropological Survey of India, Ministries of Health, of Agrilculture, and of Science and Technology.	Rs. 100 crores
Total =	Rs. 150 crores

2.3 In situ conservation of wild flora is being dealt with separately in the sections dealing with forests and wild life management. Ex situ conservation is primarily carried out through the setting up of botanic gardens, and banks for plant genetic resources. Though India has a network of botanic gardens, there is a need to make the coverage more comprehensive in terms of biogeographic regions. There is also a need to upgrade the management of many of these botanic gardens. Gene banks for plant genetic resources are currently managed by the ICAR. There is a need to strenghten the collection of genetic resources of non-cultivated, non-commercial species of plants.

Budget

Setting up/upgradation of botanic gardens, to be jointly handled by the Ministry of Environment and Forests and the State Governments, over a five year period.	Rs. 200 crores
Strengthening of the Bureau for Plant Gentic Resources, to cover wild plants	Rs. 25 crores
Total =	Rs. 225 crores

3. Cultivated flora

The Indian Council of Agricultural Research (ICAR) is charged with the responsibility of cataloguing, surveying and analysing cultivated species of plants, many of which are cultivated for food. Unfortunately, much of the conservation of cultivated flora is being carried out ex situ through the bureau of plant genetic resources. There is relatively little effort towards in situ conservation of cultivated varieties of plants, especially traditionally cultivated plants. The social and technological practices associated with the cultivation of many of these traditional varieties are also, therefore, getting lost. The need is to urgently catalogue and study these traditional plant varieties and the socio-cultural ethos within which they evolved. It is also important to continue the cultivation of many of these varieties by compensating farmers who would otherwise find it more profitable to replace these species with modern, high yielding, varieties. This would ensure that these varieties are conserved in situ with all the consequent advantages.

Budget

For identification, research, and in situ conservation of traditionally cultivated varieties of plants, to be carried out through the Ministry of Environment and Forests and the Ministry of Agriculture, over a five year period.	Rs. 200 crores

4. Domesticated fauna

Though there is a fair amount of research in various species of domesticated animals, much of this research is aimed at producing

"improved" breeds. Unfortunately, much less attention is being paid to the conservation of traditional domesticated species, many of which are being replaced by hybrid, modern, breeds. If this very valuable pool of genetic resources is not to be lost for ever, it is important that especially identified groups of people, with a history of skills related to the production and handling of traditional species of domesticated animals, be compensated to continue to conserve these species in situ.

Budget

For identification, research and in situ conservation of traditional varieties of domesticated fauna, to be implemented jointly by the Ministry of Environment and Forests and the Ministry of Agriculture, over five years.	Rs. 100 crores

5. Natural Habitats

There are separate sections on most of the natural habitat types including forests and wetlands. However, some of the other important natural habitats like grasslands, mangroves and coral reefs need special focus. These ecosystems need to be understood much better and protected from pollution and over exploitation. Given the pressures on these ecosystems, the optimum strategy for protecting them from over exploitation, especially for grasslands and mangroves, is ecodevelopment.

There is also a need to better understand the edge effect and the effect of fragmentation of natural ecosystems on biodiversity.

Budget

Research into natural habitats like grasslands, coral reefs and mangroves, to understand their ecology better and to raise the awareness of the general public about their functions and vulnerabilities, to be implemented through the Ministry of Environment and Forests, the Ministry of Science and Technology and the Ministry of Human Resources Development, over five years.	Rs. 50 crores

Research into the impact on biodiversity   Rs. 10 crores
of the edge effect and fragmentation

Financing ecodevelopment   Rs. 500 crores.
initiatives based on micro level,
participatory, planning, around a
hundred natural habitats at
Rs. 5 crores per habitat for a five
years period. This would be
implemented through the Ministry of
Environment and Forests.

                              Total :   Rs. 560 crores

6.   **Modified Habitats**

Agro-ecosystems, especially traditional ones, and forest plantations

need to be studied from the viewpoint of biological diversity. Also,

there needs to be a significantly enhanced level of research on bio-

fertilizers and bio-pesticides as a part of the efforts to promote

integrated pest management, and organic farming, in agricultural crop-

lands and forest plantations

Budget

        Research into biodiversity of agro-   Rs. 50 crores
        ecosystems and forest plantations, to be
        done through the Ministry of Environment
        and Forests, in collaboration with the
        Ministry of Agriculture, over five years.

        Research into integrated pest management   Rs. 50 crores
        and organic farming methods,
        using bio-pesticides and bio-fertilizers,
        done through the Ministry of Environment
        and Forest in collaboration with the
        Ministry of Agriculture and the Ministry
        of Health, over five years.

        Promotion of integrated pest management   Rs. 500 crores
        programmes, both for agricultural pest
        control and vector control, and organic
        farming initiatives. done through
        the Ministry of Environment and Forests
        in collaboration with the Ministries of
        Agrilculture and of Health, over five years

7.   **Micro-organisms**

Very little work has been done in India on micro-organisms.

Research needs to be urgently undertaken on:

      - The role of micro-organisms in ecosystems.

- Their relationship with other species.

- Their role in nutritional recycling for all living organisms.

Budget

Integrated study into different aspects of   Rs. 50 crores
micro-organisms, through the Ministry of
Environment and Forests and in collaboration
with the Ministries of Sciences and Technology
and of Agriculture, over five years.

INDIA'S FLORAL BIODIVERSITY IN A GLOBAL CONTEXT
[BSI undated; Sharma undated]

(Note: A blank entry denotes absence or non-availability of information).

1 KINGDOM	2 DIVISION/ORDER	3 COMMON NAME	4 NO. OF SPECIES IN INDIA	5 NO. OF SPECIES IN WORLD	6 4 AS A PERCENTAGE OF 5	7 ENDEMIC TO INDIA
Non-flowering plants	‡		30000	406500	7.00	3000
Monera	Bacteria	Bacteria	850	2700	31.48	
Mycota		Fungi	12500	150000	8.00	
Protista	Algae		23000	100000	23.00	
Plantae	Bryophyta	Liverworts, Mosses & Hornworts	2564	160000	1.60	
	Psilopsida	Psilopsids	12			
	Lycophyta	Club-mosses	103	1000	10.00	
	Sphenophyta	Horsetails	7	30	23.00	
	Pteridophyta ‡	Ferns	900	12000	8.00	200
Flowering Plants			15000	250000	6.00	4950
	Coniferophyta	Conifers	55	550	10.00	
	Cycadophyta	Cycads	5	100	5.00	
	Gnetophyta	Gnetum	4	70	6.00	
Total			45000	656500	7.00	

‡
  Statistics for different divisions/orders within non-flowering and flowering plants, as given in the available sources, do not add up to the total number of species recorded withing these two categories of plants. This discrepancy could not be resolved within the time available.

Appendix 2

INDIA'S FAUNAL BIODIVERSITY IN A GLOBAL CONTEXT

.(Note: A blank entry denotes the absence or non-availability of information).

1 PHYLUM	2 CLASS/GROUP	3 NO. OF SPECIES IN WORLD	4 NO. OF SPECIES IN INDIA	5 4 AS A PERCENTAGE OF 3	6 ENDEMIC
Protozoa		31250	2577	8.24	
Porifera (Sponges)		5100	519	10.18	
	Marine	5000	486		2 spp.
	Freshwater	100	33	33.00	13 spp.
Coelenterata (Jelly fishes, Anemones, Corals)	Siphonophora (Jelly fishes)	180	118	65.56	
	Gorgonaceae (Sea fans)	400	app. 80	0.00	
	Sclerectinia (Stony corals)	7000	119	1.70	
Ctenophora (Sea gooseberries, Comb jellies)		100	10	10.00	
Platyhelminthes (Flat worms)		17500	1622	9.27	
Trematoda (Flukes)					
Cestoda (Tapeworms)					
Nematoda (Round worms)		25000	2350	9.40	
Mollusca (Shells)		8000	5042	6.30	Endemism more in land and freshwater snails than in marine.
Annelida (Segmented worms)		12620	1093	8.66	Atleast 60 spp.
Rotifera (Wheel animalcules)		2500	310	12.40	26 spp.
Phoronida		11	3	27.27	
Bryozoa		20000	170	0.85	
Entoprocta		60	10	16.67	
Brachiopoda		300	3	1.00	

1 PHYLUM	2 CLASS/GROUP	3 NO. OF SPECIES IN WORLD	4 NO. OF SPECIES IN INDIA	5 4 AS A PERCENTAGE OF 3	6 ENDEMIC
Chaetognatha (Arrow worms or Glass worms)		100	30	30.00	
Gastrotricha		2500	88	3.52	60 spp.
Kinorhyncha		100	10	10.00	7 spp. endemic, 2 spp. uncertain
Acanthocephala (Thorn-head worms)		800	110	13.75	
Sipuncula (Peanut worms)		202	38	18.81	
Echiura (Spoon worms)		127	33	25.98	
Onychophora		100	1	1.00	
Arthropoda		952116	57525	6.04	
	Crustacea	24375	2970	12.88	
	Anostraca	175	72	41.14	
	Notostraca	15	11	73.33	
	Conchostraca (Clam shrimp)	180	27	15.00	
	Cladocera (Water fleas)	400	90	22.50	2 spp.
	Ostracoda	2000	120	6.00	
	Copepoda	4500	540	12.00	
	Branchiura	75	4	5.33	
	Cirripedia	750	104	13.87	
	Isopoda	4000	200	5.00	
	Amphipoda	3600	143	3.97	
	Stomatopoda (Shrimp, Crabs)	180	124	68.69	
	Decapoda (Crabs, Prawns, Lobsters)	8500	1535	18.06	

1 PHYLUM	2 CLASS/GROUP	3 NO. OF SPECIES IN WORLD	4 NO. OF SPECIES IN INDIA	5 4 AS A PERCENTAGE OF 3	6 ENDEMIC
	Insecta				
	Thysanura (Silver fish, Bristle-tails)	1250	23	1.84	
	Diplura	355	16	4.50	
	Protura	260	20	7.69	
	Collembola (Spring tails)	5000	200	4.00	
	Ephemeroptera (One-day flies, May flies)	2146	94	4.38	72 spp.
	Coleoptera (Beetles)	350000	15000	4.28	
	Strepsiptera (Stylops)	300	8	2.66	
	Mecoptera (Scorpion flies)	350	15	4.28	
	Siphonaptera (Fleas)	2000	52	2.60	
	Diptera (Mosquitoes, Midgets, Flies)	96600	6093	6.31	175 spp.
	Lepidoptera (Butterflies and moths)	142500	13000	9.12	
	Trichoptera	7000	812	11.60	
	Hymenoptera (Bees, wasps)	100000	5000	5.00	
	Diplopoda (Millipedes, centipedes)	7500	162	2.16	
	Chilopoda (Scolopend-rids)	3000	100	3.30	59 spp.

1 PHYLUM	2 CLASS/GROUP	3 NO. OF SPECIES IN WORLD	4 NO. OF SPECIES IN INDIA	5 4 AS A PERCENTAGE OF 3	6 ENDEMIC
	Xiphosura (Horse-shoe or king crabs)	4	2	50.00	
	Arachnida:	6385	409	6.40	
	Scorpionidae (Scorpions)	1500	102	6.80	
	Pedipalpida (Whip-scor-pions)	85	25	29.41	
	Solpugida (Wind scorpions)	900	15	1.67	
	Opiliones (Harvestmen)	1600	167	10.43	
	Pseudoscor-pionida (False scorpions)	2300	100	4.35	
	Acari (Mites)	36800	1915	5.20	approx. 600 spp.
	Araneae (Spiders)	35000	1250	3.57	
Echinodermata (Starfish, Brittle star, Sea urchins)		6226	765	12.28	
Hemichordata		118	12	10.16	
Chordata		47674	4894	10.27	
	Protochordata (Sea squirts etc.)	2173	116	5.34	
	Pisces	21723	2546	11.72	6 spp.
	Amphibia	5145	204	3.96	53 spp.
	Reptilia	5375	428	7.96	44 spp.
	Aves	9026	1228	13.61	42 spp.
	Mammalia	4232	372	8.79	
GRAND TOTAL		1211584	77452	6.40	

71

Appendix 3

BIODIVERSITY IN DOMESTIC ANIMALS AND POULTRY IN INDIA
[Singh 1988; Balain undated]

ANIMAL	POPULATION IN THOUSANDS (1982)	INDIGENOUS BREEDS	EXOTIC BREEDS
Cattle	192453	27	6
Buffalo	69783	8	
Sheep	48765	40	3
Goat	95255	22	5
Poultry	900	17	9
Horse	419588	6	2
Camel	1078	9	
Pig	10071	0	10
Ducks	9010000 (1972)	3	
Geese		1	8
Donkey	1010000 (1977)	2	5

[Note: Blank entries denote absence or non-availability of information]

**CROP VARIETY RECORDS AT THE NATIONAL BUREAU OF PLANT
GENETIC RESOURCES, NEW DELHI [Singh and Chandel 1987]**

Crop Group	Traditional varieties
Wheat	1400
Rice	6200
Barley	700
Maize	500
Oats	1000
Sorghum	915
Pearl millet	2690
Prosomillet	270
Sugarcane	800
Fodder (Barsem)	40
Amaranthus	1195
Chickpea	816
Urad bean	1414
Moth bean	1100
Mung bean	1367
Rice bean	400
Lentil	325
Peas	1825
Cowpea	2523
Sword bean	93
Guar	3580
Kulthi	600
Toria Brassica	98
Jute and Cotton	200
Pigeon pea	1772

Vegetables

Okra	1045
Tomato	1750
Onion	1094
Garlic	680
Chillies	195
Brinjal	821
Cucurbits.	92
Sem	1361
Roselle	112
Chakwat	32
Jute mellow	15

Fruits

Apple	12
Peach	15
Plum	5
Pear	8
Pomegranate	49
Grape	9
Ber	16
Gooseberry	7
Bael	2

BASE COLLECTIONS IN NATIONAL GENEBANK AT NBPGR [NBPGR 1991]

(As on 30 September, 1991)

Crop Groups	No. of Accessions*
Cereals	37,536
Pulses	21,745
Millets & Minor Millets	13,410
Oil Seeds	13,063
Vegetables	3,839
Fibre	2,609
Narcotics	665
Medicinal & Aromatic Plants	138
Pseudocereals & Misc.	635
Improved (Named) varieties	19,786
Voucher Specimens of Exotics	19,786
Ref. samples of indigenous collection	30,075
	1,43,897

*   It is not clear whether each of these accessions is a different variety.

THREATENED, ENDANGERED, VULNERABLE, AND RARE MEDICINAL PLANTS OF INDIA [Thakur undated]

A. Some Threatened/Endangered Medicinal Plants

1.	Aconitum deinorrhizum	Himalayan region
2.	A. heterophyllum	"
3.	Andrographis paniculata	Plains of India
4.	Aqualaria agallocha	N.E. India
5.	Arnebia benthamii	Western Himalaya
6.	Atropa acuminata	"
7.	Bacopa monnierii	Throughout plains of India along with water courses.
8.	Boerhaavia diffusa	Plains of India
9.	Colchicum luteum	Western Himalaya
10.	Coptis teeta	Arunachal Pradesh
11.	Dioscorea deltoides	Western Himalaya
12.	D. prazeri	Eastern Himalaya
13.	Gentiana kurroo	Himalayan region
14.	Gloriosa superba	Tropical India
15.	Inula racemosa	Kashmir
16.	Nardostachys jatamansi	Himalayan region
17.	Picorhiza kurooa	"
18.	Podophyllum hexandrum	"
19.	Pterocarpus santalinus	Cuddapah, Andhra Pradesh
20.	Rauvolfia serpentina	Plains of India
21.	Rheum emodi	Himalayan region
22.	R. nobile	"
23.	Santalum album	Karnataka
24.	Saussurea costus	Himalayan region
25.	S. lappa	Western Himalaya
26.	Swertia chirayita	Western and Eastern Himalaya
27.	Valeriana wallichii	Himalayan region

B. Vulnerable species

1.	Corydalis govaniana	Himalayan region
2.	Dactylorhiza hatagirea (Syn. Orchus latifolia)	"
3.	Ferula jaeschkeana	"
4.	Hedychium spicatum	"
5.	Jurinea dolomiaea	"

C. Rare species

1.	Angelica glauca	Himalayan region
2.	Artemisia brevifolia	"
3.	Berberis aristata	"
4.	Hyoscyamus niger	"
5.	Peganum harmala	Plains of India
6.	Valeriana jatamansi	Himalayan region

SOME ENDANGERED/THREATENED FAUNA OF INDIA (ZSI 1991)

NOMENCLATURE	AREA OF DISTRIBUTION	EXPLOITATION

Phylum: Coelenterata

NOMENCLATURE	AREA OF DISTRIBUTION	EXPLOITATION
Order: Goronacea (sea fans)	Of the 408 spp. worldwide 80 spp. have been recorded in India. Areas with extensive beds in the Gulf of Mannar, (especially the Krusadei islands), Andaman & Nicobar, Lakshadweep. Maximum exploitation in Gulf of Mannar.	Heavily pressurised due to over-fishing of the larger colonies. 'Wonder drug' prostaglandin is extracted from seafan. Discovered in 1975, since then West has been importing raw material for a pittance. 1975-80, 25 tonnes exported at Rs.16/- kg. 1980-85, 11 tonnes exported at Rs. 103 /- kg. Fall in quantity is a direct consequence of the depletion of the larger and older colonies. 22 spp. support gorgonid fishery in India. Red & black types most depleted (10 spp.) 1987 - ban on gorgonids suggested. Still fishing continues unabated with no regard to size or type.
Order : Scleractinia (Stony corals)	Of 7000 spp. worldwide 119 spp. are found in India. Family Fungiidae found rarely on the main coast.	11 genera are under pressure due to exploitation & pollution. These corals are responsible for reef building. Depletion due to a) oil pollution: Minicoy Island, Gulf of Kutch b) siltation:(due to dredging included) Gulf of Kutch genus Acropor totally absent. Minicoy Island, Middle Andamans, Palk Bay, Gulf of Mannar. c) Crown-of-stars (Acanthaster planci): Andamans d) coral diseases: Coliform bacterial infection - Manauli Island. White band disease-Andamans e) quarrying: Widespread. Gulf of Kutch (Pirotan Island), Palk Bay, Gulf of Mannar (Krusadei Islands, Tuticorin, Mandapam in Rameshwaram), Lakshadweep, Andamans.

Phylum: Mollusca

NOMENCLATURE	AREA OF DISTRIBUTION	EXPLOITATION
Genus. Crassostrea (Rock oysters)	Occurs singly in estuaries of Maharashtra & Gujarat	Exists in small numbers yet commercially exploited
C. cristagalli	Pishotra Point, Gujarat	Exists in small numbers yet commercially exploited
Katelysia opima	Both coasts	Heavy fishing pressure in Kerala & Karnataka. Demand outstripping supply.
Villorita cyprionoides	Both coasts	Kerala coast - Demand outstripping supply.
Anadara granosa (Blood clams)		Kakinada Bay, A.P. Demand outstripping supply.
Genus: Tridacna(Giant clams)	Lakshadweep, Andaman & Nicobar	Andaman & Nicobar - indiscriminate fishing for shells. (Nicobar especially)

Xancus pyrum (Sacred chank)	Both east and west coast	Over exploitation in Gulf of Mannar, Palk Bay and to an extent in Gulf of Kutch Depletion of juvenile and undersized chanks by trawlnets.
Trochus niloticus (Top shell)	Andaman & Nicobar	Drastic depletion due to over exploitation. Licenses given periodically to authorise collection. Limits imposed on catches.
Turbo marmoratus (Green turban)	Andaman & Nicobar	Drastic depletion due to over exploitation. Licenses given periodically to authorise collection. Limits imposed on catches.
Charonia tritonis (Tritons trumpet)	Andaman & Nicobar	Very rare. Collectors pay heavy sums for it. Not protected.
Genus: Cyprae (Cowries)	Wide distribution	Over-exploited
Genus: Cassia (Helmet shells)	Wide distribution	Becoming rare due to over-exploitation
Genus: Nautilus	Both coasts	Considered a 'living fossil'. Rare. Prized for its colourful shell.

Phylum: Arthropoda

Class: Onycophora	Considered a living fossil or missing link between Phyla Arthropoda and Annelida.	Very rare, endangered. In fact no recent records available.
Class: Xiphosura (Horse-shoe or King crab)	Living fossil. Salt water swamps, especially Sunderbans.	2 spp. found in India. Both over-exploited as these are said to have medicinal properties.
Family: Lepidoptera	Mostly confined to NE hills, Himalayan foothills or the Western Ghats.	144 spp. of very rare butterflies in India. Their endemicity not confirmed due to lack of studies.

Phylum: Echinodermata

Class: Holothuria (Sea cucumbers)

Actinopyga lacanora (Stony Sea cucumber)	Andamans	Rare but commercially exploited.
Thelenota ananas (Spiny red sea cucumber)	Lakshadweep	Very rare, endangered but exploited commercially along with other species.
Holothuria scabra, H. spinifera	A&N, Lakshdweep, SW&SE coastal regions	Endangered but commercially exploited. Ban on fishing all the above species suggested.

Phylum: Chordata

Super Class: Amphibia

Tylotoriton verrucosus (Himalayan newt)	Darjeeling, Sikkim and Manipur	Endangered. No study has been done to pinpoint cause but is believed to be due to loss of habitat.

Super Class: Reptilia

Gavialis gangeticus (Gangetic gharial)	Ganga & tributaries as far as Mahanadi, Orissa.	One of the most endangered reptiles of the world.
5 species of marine turtle (Olive Ridley, Green, Loggerhead, Hawksbill, Leather back)		Endangered. Over exploited - fished commercially, eggs collected from resting sites.
10 species of fresh water turtles	Wide distribution	Over exploited
Uromastix harwickii (Spiny-tailed lizard)	Arid tracts of N W India	Endangered. Hunted down since oil from its fat is considered medicinal.
Family Varanidae: 4 species of Monitor lizards	Wide distribution	All four endangered. Hunted for skin. Protected.
Pythons (2 spp)	Wide distribution	Endangered. Hunted for skin. Protected.
Family : Uropeltidae (Rough-tailed snakes)	Restricted to mountains & foothills of Southern India	4 out of 7 genera endemic. Under heavy pressure due to loss of habitat.

Super class: Pisces

7 species of carps and 5 species of masheers		Commercial fishes - depletion heavy due to 2 factors 1) loss of breeding grounds due to the building of the Farakka Dam. 2) Overfishing of juveniles and brood fish.
Schizothoracine fishes	Restricted to mountains streams of Himalayas, Periyar river and lake. - (endemic subfamily)	Threatened due to introduction of carps.
Monocentris japonicus (Bercyform fish)	Indian waters	Endemic, endangered species. Caught along with commercial fishes.
Notopterus chitala	SW coast	Very rare. Depleted due to overfishing.
Marine mammals : 20 spp. Cetaceans (Whales, porpoises and dolphins) 1 sp. Sirenia (Sea cow)	Arabian Sea, Bay of Bengal, Indian Ocean	Endangered. Protected. Snared in gill nets, trawl nets etc. 2 spp. endemic - Gangetic and Irrawady dolphins. The Sperm Whale of which about 50000 may be present in the Indian Ocean (including those migrating through Arabian Sea and Bay of Bengal) over exploited.
Terrestrial mammals: 55 spp.	Throughout India	25 species highly endangered. Cheetah (Acinonyx jubatus) extinct in India.

LEGAL COVERAGE OF VARIOUS ASPECTS OF BIODIVERSITY IN INDIA

		Wild		Domestic		Genetic
		Fauna	Flora	Fauna	Flora	Materials
1.	Identification	N	N	N	N	N
2.	Protection in-situ	W	W	N	N	N
3.	Protection ex-situ	W	P	N	N	N
4.	Access/Extraction	P	P	N	N	N
5.	Use	W	P	W	N	N
6.	Trade	W	W	P	W	P
7.	Breeding/Cultivation/ Multiplication	W	P	P	P	P
8.	Introduction/Augmentation/ Re-introduction	P	P	P	P	P
9.	Release	N	N	N	N	P
10.	Movement	W	P	P	P	P
11.	Intellectual property rights	N	N	N	N	N

N = Not covered   P = Partially covered   W = Well covered

SOME GOVERNMENT INSTITUTES INVOLVED WITH BIODIVERSITY IN INDIA

INSTITUTE	SCOPE
Indian Society for Plantation Crops	Work done mainly on new coconut varieties, maintain germplasm of local variety.
Central Tuber Crop Research Institute	Germplasm maintained of Cassava, Yam, Sweet Potato and Cc'ccasia
The Indian Mycological Society	Identification and classification of Fungi in India; maintains local strains and conducts research.
Central Inland Capture Fisheries Research Institute	Advancement in knowledge in fisheries and its allied fields. Research; maintain germplasm of local varieties.
National Dairy Research Institute	Research in cattle breeding, nutrition management, dairy technology; maintain germplasm of local varieties.
Central Institute for the Research on Buffaloes	Breeding genetics, nutrition, milk and meat technology resources for superior germplasm & local varieties.
Central Institute of Horticulture for Northern Plains	Maintain germplasm for superior varieties & local varieties of mango, guava, papaya, melons. Propagation of sub tropical/temperate fruits.
Directorate of Pulses Research Institute	Refining technology of pulses production. Maintaining germplasm of local and introduced varieties.
Indian Institute of Horticulture Research	Coordinated projects and germplasm collection of vegetables, fruits medicinal and aromatic plants, honey bee, mushroom, betelvine. Pesticide residue tests, post harvest technology and propagation.
Indian Society for the Advancement of Insect Science	Research, identification, classification, control of pests, studies on behaviour and population dynamics.
Indian Society of Oilseeds Research	Seed certification, improvement, genetic stocks maintained.
The Indian Society of Tree Scientists	Development of tree sciences, maintaining genetic stocks for improved agroforestry resources.
Jute Agricultural Research Institute	Selection, development, and improving Jute cropping; Maintain germplasm of wild stock of jute.
Central Tobacco Research Institute	Research, development, maintaining local and exotic genetic stocks.
Society of Fisheries Technology	Research and development of fisheries technology with exchange programmes.
Central Rice Research Institute	Research, development of breeding technology. Maintaining local and exotic germplasm.
Central Research Institute for Dryland Agriculture	Research and development in introducing crops and tree species in dryland areas. Maintain wild genetic stock.

Central Marine Fisheries Research Institute	Research and development in marine and allied sciences. Seaweed culture.
Indian Institute of Sugarcane Research	Breeding and research. Lab to land programmes, maintain genetic stocks.
Indian Veterinary Research Institute	Livestock health, production, technology, development of vaccines and rural economy management. Maintain local and introduced genetic stocks.
Central Institute of Fisheries Education	Aquaculture, extension training, ocean management.
All India Co-ordinated Project on Pigs (Indigenous)	Research on nutrition, pureline breeding, cross breeding and breeding for slaughter.
National Centre for Mushroom Research & Training	Survey, collection and identification of mushroom flora, regional adaptibility trials on promising strains. Standardizing cultivation techniques for higher yeilds.
All India Co-ordinated Floriculture Improvement Project	Collection and improvement of flowers of various regions. Maintaining local germplasm especially of orchids.
Central Institute for Research on Goats	Conducting courses, maintaining pure lines. Large base for evolving Indian Angora.
Centre for Mohair	Centre for pashmina is located at the Indian Veterinary Research Institute Mukteshwar - Kumaon.
Central Sheep and Wool Research Institute	Wool for carpet, garments, fine wool. Extensive research and maintaining germplasm. Interbreeding with Merino, Dorset, Russian Merino. Pureline breeding.
Central Institute of Medicinal and Aromatic Plants	Research and development for medicinal plants.
Naional Institute of Oceanography	Research, development exploration and co-ordinated programmes on marine biota
National Botanic Research Insitute	Research and development; maintain large number of rare and exotic plants.
Regional Research Lab, Jorhat	Special centre for research on medicinal plants and orchids.
Regional Research Lab, Jammu	Pioneering research on medicinal plants.
Botanical Survey of India, Calcutta	Maintain all national botanical gardens. Research.
Zoological Survey of India, Calcutta	Research.
Salim Ali Institute of Ornithology & Natural History, Bombay	Exploration and research on birds and nature.
National Zoological Park, New Delhi	Captive breeding of wild animals.

81

Wildlife Institute of India, Dehra Dun	Research programmes for Indian wildlife. Forest Management.
Padmaja Naidu Himalayan Zoological Park, Darjeeling	Maintain Himalayan wildlife.
G.B. Pant Insitute of Himalayan Environment & Development, Almora	Research, training courses, field experiments.
Forest Survey of India, Dehra Dun	Forest management training. Research.
Forest Research Institute, Dehradun	Research and training programmes.
Indian Council of Forestry Research & Education, Dehra Dun	Research and training programmes.
Indian Institute of Forest Management, Bhopal	Forest management training. Research.
Institute of Forest Genetic & Tree Breeding, Coimbatore	Research.
Institute of Wood Science & Technology, Bangalore	Research and development.
Institute of Arid Zone Forestry Research, Jodhpur	Research and development.
Institute of Deciduous Forests, Jabalpur	Research and development for deciduous forests.
Institute of Rain and Moist Deciduous Forests, Jorhat	Research and development for moist deciduous forests.

INTERNATIONAL TREATIES RELEVANT TO BIODIVERSITY

1. Convention Relative to the Preservation of Fauna and Flora in their Natural State. Date of adoption 8.11.1933, London. India ratified 9.8.1939.

2. International Convention for the Regulation of Whaling. Date of adoption 2.12.1946, Washington. India ratified 2.12.1981.

3. International Plant Protection Convention. Date of adoption 6.12.1951, Rome. India ratified 9.6.1952.

4. International Convention for the Prevention of Pollution of the Sea by Oil. Date 12.5.1954, London. India ratified 23.5.1962.

5. Plant Protection Agreement for the South East Asia and Pacific Region. Date of adoption 27.2.1956, Rome. India ratified 2.7.1956.

6. The Antarctic Treaty. Date of adoption 1.12.1959, Washington. India ratified 19.8.1983.

7. Treaty Banning Nuclear Weapon Tests in the Atmosphere in Outer Space and Under Water. Date of adoption 5.8.1963, Moscow. India ratified 10.10.1963.

8. Convention on Wetlands of International Importance Especially as Waterfowl Habitat. Date of adoption 2.2.1971, Ramsar. India ratified 1.2.1982.

9. Protocol to Amend the Convention on Wetlands of International Importance Especially as Waterfowl Habitat. Date of adoption 3.12.1982, Paris. India ratified 9.3.1984.

10. Convention Concerning the Protection of the World Cultural and Natural Heritage. Date of adoption 23.11.1972, Paris. India ratified 14.2.1978.

11. Convention on International Trade in Endangered species of Wild Fauna and Flora. Date of adoption 3.3.1973, Washington. India ratified 18.10.1976.

12. Convention on the Conservation of Migratory Species of Wild Animals. Date of adoption 23.6.1979, Bonn. India ratified 1.11.1983.

13. Convention on the Conservation of Antarctic Marine Living Resources. Date of adoption 20.5.1980, Canberra. India ratified 17.7.1985.

14. United Nations Convention on the Law of the Sea. Date of adoption 10.12.1982, Montego Bay. India ratified 10.12.1982.

15. International Tropical Timber Agreement. Date of adoption 18.11.1983, Geneva. India ratified 1.4.1985.

16. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Date of adoption 22.3.1989, Basel. India signed 15.3.1989.

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