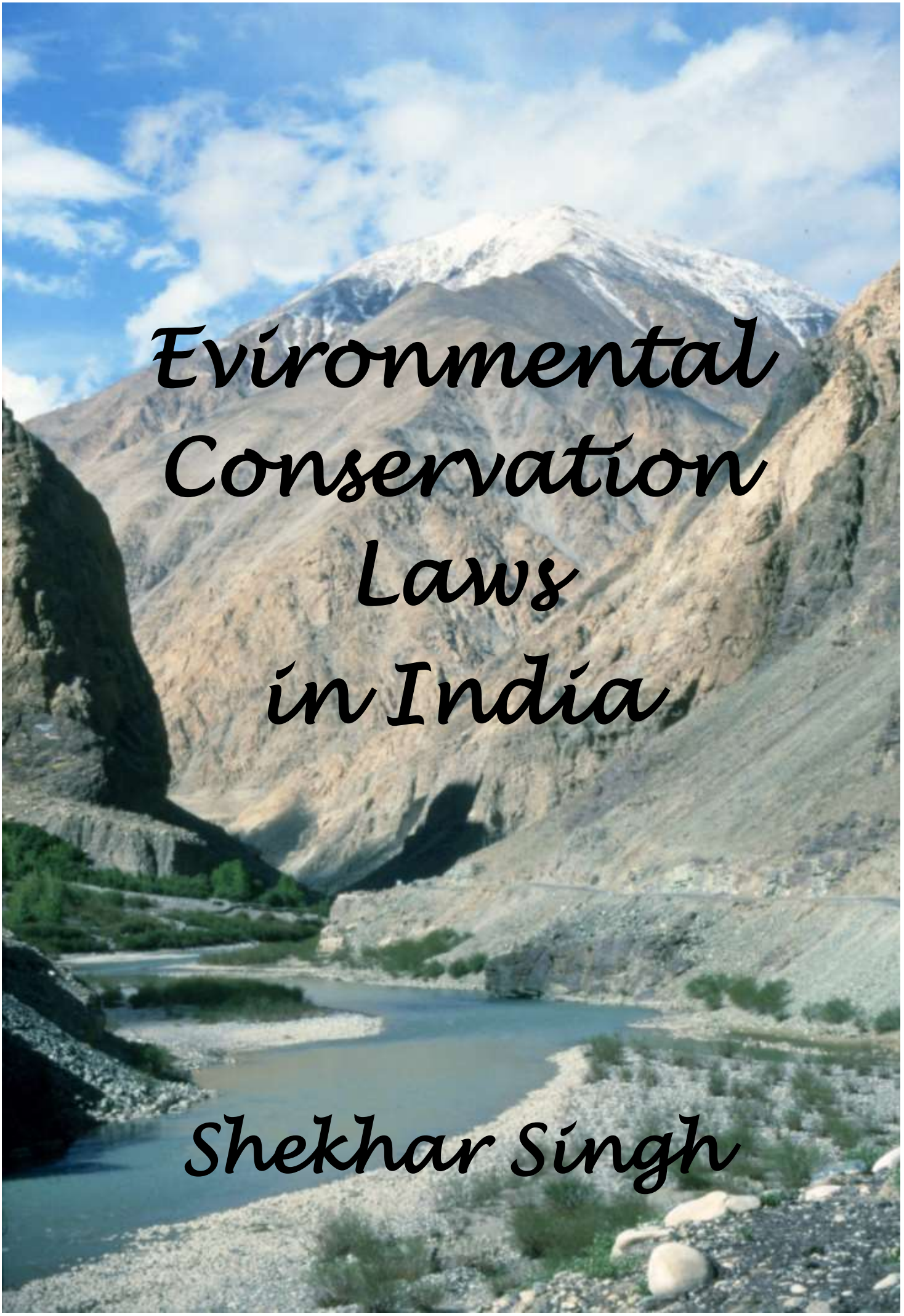
Evironmental
Conservation
Laws
in India
Shekhar Singh

Evironmental Conservation Laws in India

A report prepard for the Planning Commission of India, as an input into the process of preparing the Xth five-year plan

Cover photograph of Leh, Jammu & Kashmir, taken by Vishaish Uppal

Shekhar Singh

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This report focuses on laws and related instruments aimed at the conservation of natural resources, especially biodiversity. In order to coherently assess the comprehensiveness and appropriateness of the relevant laws, the report first discusses the wider context of conservation and its objectives. It then describes the pressures on natural resources that need to be controlled through legal instruments and goes on to discuss the possible thrusts that the legal framework can adopt. It finally indicates the types of legal instruments available.

1. CONSERVATION OBJECTIVES

Conservation objectives for nature and natural resources can be seen to be as follows:

- *Maintenance of certain areas as genepools, without any direct or indirect human pressure or intervention.*[1]
- *Protection and regeneration of certain endangered species and ecosystems by protecting them in their natural surrounds or through ex situ methods.*
- *Regulating the use of multiple use areas to within the bounds of sustainability.*
- *Enhancing the productivity of natural resources in multiple use areas.*
- *Regenerating and restoring damaged and degraded ecosystems.*

The overall goals can be the furtherance of human health and well being, for the present and future generations and the recognition of the right of animals and plants to exist and thrive, irrespective of their utility to human beings.

[1] This excludes ecosystems where human communities are living in total harmony with nature. In India there are few examples of this: perhaps the Jarawas and the Sentinalese of the Andaman Islands being the two.

2. ELEMENTS OF THE ENVIRONMENT

For the purpose of this report, assessment of the adequacy and appropriateness of environmental laws in India would be undertaken on the following elements of the natural environment:

- Biomes, ecosystems and landscape features
  - Forests
  - Grasslands
  - Coasts including Mangroves and Coral Reefs
  - Deserts
  - Oceans
  - Fresh and Brackish Water Bodies
  - Mountains
  - Islands
- Species
  - Fauna
  - Flora
  - Micro-organisms

3. CONSERVATION PERSPECTIVES

In assessing the adequacy of the coverage of the legal instruments in India, for all the elements of the environment listed above, the effort would be to ensure that all the three major perspectives on the basis of which conservation is attempted are addressed. These are:

- The ethical perspective
- The biological perspective
- The managerial perspective

Each of these is described below.

3.1 The Ethical Perspective

Conservation activities must promote and be in consonance with accepted ethical perspectives. Some of the important ethical issues relating to conservation efforts are listed below.

3.1.1 Social justice and equity: conservation efforts must ensure that the costs and benefits of conservation are equitably distributed. Special attention has to be paid to the poorer and weaker segments of society and to gender based concerns. It must be ensured that the costs of conservation, especially in terms of denying access to natural resources, should not be borne inequitably by the local communities living in and around biodiversity rich areas. This is especially so because, in many cases, these communities themselves have been instrumental in protecting the biodiversity of such areas over hundreds of years.

3.1.2 Rights of future generations. At the same time, the rights and opportunities of future generations, yet unborn, cannot be sacrificed to meet the consumption needs of the present generation.

3.1.3 Rights of animals and other non-human living creatures. There is no reason to believe that the earth was created for human beings alone. The right of other creatures to exist happily on this earth and to prosper and flourish, must also be recognised.

3.2 The Biological Perspective

While dealing with biodiversity, one must understand the nature of all living things, at the level of genes, species and ecosystems. The conditions under which biodiversity is sustained and nature thrives must be studied and such an understanding must form the basis of any conservation action. In a crowded yet biodiversity rich country like

India, some of the main biological issues relating to conservation efforts are listed below:

3.2.1 *Acceptable levels of disturbance and human use.* In a densely populated country like India, it is not always desirable to prohibit all human uses and disturbance from large areas. However, human use and disturbance might not be conducive, beyond a point, to the maintenance of biodiversity. It is, therefore, essential to ensure that the levels of use and disturbance in biodiversity conservation areas remain within the limits of acceptability.

3.2.2 *Minimum viable populations.* To ensure that a species thrives and flourishes and that, as a species, it retains its genetic variability, its population must not fall below a minimum number. This can be achieved either by ensuring that in any area the population of all species is above the required minimum, or by linking smaller than required populations through physical and/or genetic corridors.

3.2.3 *Minimum viable size.* In order to maintain minimum viable populations and to ensure that ecosystems are conserved in large enough patches to be viable, it has to be ensured that conservation areas are not smaller than the minimum required size.

3.2.4 *Required ecological conditions.* If species and ecosystems are to flourish and retain their vigour, it must be ensured that the environment within which they exist is conducive to their growth and survival.

3.2.5 *Carrying capacity.* To ensure that natural resources are used sustainable manner, their use should not exceed their carrying capacity.

3.3 Managerial Perspective

Within a complex and ever-changing social structure, where multiple demands and perceptions have to be reconciled, effective strategies for managing biodiversity and natural resources while meeting all the other demands of society need to be developed. Some of the contemporary managerial issues are listed below.

3.3.1 *Participatory management.* In a vibrant democracy like India, it is difficult to conserve nature and maintain biodiversity without the involvement of the local people who not only live in and around biodiversity rich areas but also have a stake in its conservation.

3.3.2 *Transparency.* It is increasingly being recognised that unless the government and other sectors of the society are more open and transparent in their functioning, it would be difficult to control corruption and ensure that the benefits of governance and development go to those who most deserve it.

3.3.3 *Decentralisation.* In order for local community participation to be meaningful and ongoing, and also to ensure that action taken is appropriate to the specific local conditions, power and control over natural resources and conservation processes must be decentralised.

3.3.4 *Social and economic stake.* It is increasingly being realised that sustainable conservation is difficult, especially when dealing with poor and marginalised communities, unless the concerned community has some long-term economic and social stake in conservation. This is even truer when sacrifices are made by the poor and benefits are reaped by the rich.

3.3.5 *Sense of ownership.* To build the confidence, in the concerned local communities, that their efforts and

sacrifices for conserving biodiversity and natural resources would not be reaped by others, it is important to give them a sense of ownership over the resources they are helping conserve.

4. LEGAL COVERAGE TO ECOSYSTEMS

This section contains description of the various ecosystems, their status, and the major threats. It then assesses the legal protection that each of these elements are currently getting.

4.1 Forests

Forest ecosystems are the richest terrestrial ecosystems in terms of biodiversity. They also perform various other ecological functions including those of a watershed, of soil conservation and replenishment, of cleansing the atmosphere, producing oxygen, regulating climate and controlling pollution. In much of India, especially in the hilly areas, popular perception considers the health of the forests to be the most important indicator for the health of the environment.

Current estimates indicate the status of forests in India as follows:

Category	Area (in million ha.)	% of the total area of the country
Area legally classified as forest area	76.52	23.27
Closed forest (canopy cover of 40% and over)	3.67	11.17
Open Forest (canopy cover of 10% to 40%)	2.61	7.95
Scrub (canopy cover of under 10%)	0.57	1.74
Mangroves	0.05	0.15

The policy requirement is that the forest cover should be 33% of the area of the country, and all of this should be closed forest. Clearly we are far from achieving this figure. The latest FSI report (1997) also shows that there has been a net loss of over 5000 sq km of forests since the last assessment (1995).

Limitations of the data

Though macro forest statistics have become available, via satellite imagery, for the last ten years or so, the data available hide as much as they reveal. Some of the major limitations are listed below.

- The forest cover is classified into only three categories. As the highest category has a huge range: 40% to 100%, a correct picture of how much of the forest is pristine or totally closed is not available.
- A related limitation is the fact that due to this very broad classification it is not possible to clearly see the changing status of the forests unless they cross the boundary of 10% or 40%. In other words, the data might suggest that much of the forest is stable whereas in reality it might be rapidly moving from 100% canopy cover to 40% canopy cover. This fact only becomes obvious when it falls below 40%, by which time much of the forest cover has already been lost and reversing the trend becomes very difficult.
- The forest cover data only bring out the state of the canopy. Such data do not indicate the state of the forest. For example, a forest might be dead in the sense that there might be no regeneration, yet if the existing trees are standing with their canopies in tact, it would appear through satellite imagery as very good forest.
- Similarly, such data do not indicate the biodiversity status of the forest. They do not bring out whether it

is a natural forest or a plantation and whether the natural diversity of fauna and flora still exists or whether it has been taken over by a few plants.

Threats to the Forest

There are many types of threats that the forests of India face and that have been responsible for their degradation and decline. Some of the major ones are listed below.

- Impact of commercial activities
- Impact of development activities
- Conversion of land to non-forestry use
- Pressures for forest resources from local communities
- Grazing of livestock
- Attacks from forest pests
- Invasion of exotics and weeds
- Poaching of fauna and flora
- Impact of chemicals
- Forest fires
- Droughts and floods

Legal Coverage

Three of the most important laws related to forests are:

- The Indian Forest Act of 1927 (IFA)
- The Forest Conservation Act of 1980, as amended in 1986 (FCA)
- The Wild Life (Protection) Act of 1972, as amended in 1991 (WLPA)

The other national laws and other legal instruments that have a bearing on forests include:

- The Environment (Protection) Act of 1986 (EPA)
- Notification on Coastal regulation Zone, 1991 as amended upto 1997 (CRZ)

Given below is a n assessment of the protection and coverage these acts provide to the forests of India.

Summary of Legal Coverage for Forests : General Parameters

Aspects	IFA	FCA	WLPA	EPA	CRZ	remarks
Safeguarding social justice and equity	No	No	No	No	No	June 1990 letter of the MoEF permits joint forest management
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this
Safeguarding animal rights	No	No	Yes	No	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable	No	No	No	No	Partl	The CRZ specifies the quantum of area to be kept free

size is maintained					y	of disturbance, eg. 500 m above high tide line.
Determining required ecological conditions	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	No	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Yes	
Ensuring participatory management	No	No	No	No	No	
Ensuring transparency	No	No	No	No	No	
Decentralising control	No	No	No	No	No	
Ensuring socio economic stake of local communities	No	No	No	No	No	
Ensuring a sense of ownership in local communities	No	No	No	No	No	

Specific to Forestry management

Aspects	IFA	FCA	WLPA	EPA	CRZ	Remarks
Impact of commercial activities	Yes	No	Yes	Yes	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it
Impact of development activities	Yes	No	Yes	Yes	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it
Conversion of land to non forestry use	No	Yes	Yes	No	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it
Pressures from communities	Yes	No	Yes	Yes	No	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it
Grazing	Yes	No	Yes	No	No	Only the WLPA prohibits it, and that also only in national parks, The others only regulate it, as does the WLPA in sanctuaries
Prevention of attacks from forest pests	Yes	No	Yes	No	No	
Prevention of invasion from exotics/ weeds	Yes	No	Yes	No	No	

Poaching	Yes	No	Yes	No	No	
Impact of chemicals	No	No	No	Yes	No	Also relevant are the laws pwertaining to air and water pollution and hazards
Forest fires	Yes	No	Yes	No	No	
Droughts and floods	No	No	No	Partly	No	None of the laws provide the ability to regulate activities autside forest areas that might have a dleterious impact on the forests. Indirectly, the EPA could be used for this.

Of all the ecosystem types that we will examine, forests are certainly the one with the greatest amount of legal coverage. This is partly due to the fact that there has been a specialist forest department in this country for over a hundred years. It is also the best understood of the ecosystems and, along with the ocean, the most visible as a distinct ecosystem. The fact that there are two national laws specific to forests and others, like the WLPA, which deal primarily with forest ecosystems, has ensured that many of the aspects relevant for the conservation and management of forests have been legally provided for.

However, an analysis of the coverage given in the table above establishes that various critical aspects are still without legal cover. The most important one perhaps relates to safeguarding social justice with regards to the use of forest resources. In fact, all the relevant acts militate against the sharing of resources with the local communities. Though some access is allowed under the IFA, it is not mandatory. Similarly, under the FCA there is a specific prohibition of handing over forest land to NGOs or local communities even for the purpose of afforestation (1986 amendment). The only saving grace is the June 1990 circular of the GOI which at least allows for the setting up of joint forest management arrangements, though there is still no legal requirement to do so.

Similarly, there are no legal provisions to ensure that people have a right to participate in forest management, that the management of forests is done in an open and transparent manner, that there is decentralisation of control, the establishment of a socio economic stake of local communities, or a sense of ownership for them. Given the criticality of these aspects, it might be desirable to make relevant provisions in the laws pertaining to forests.

On the biological front, as there is no legal obligation to determine acceptable levels of disturbance, minimum viable populations, minimum viable size, required ecological conditions, there is little ability to ensure that these aspects are taken care of. Ideally speaking, these should be done even without a legal mandate but, the fact that they have not yet been done and that, even where they have been done, they are not enforceable, indicates to the need for having a legal mandate even for these activities.

4.2 GRASSLANDS

Olson et al. (1983) put the spread of grass and shrubland in India at 12% of its total landmass; however, the Planning Commission (1989) estimates grassland coverage at 3.7%, and scientists at the Indian Grasslands and Fodder Research Institute, Jhansi, give an estimate of 3.9%, or about 120 lakh (12 million) hectares (Singh and Misri, 1993, in press). The discrepancy in figures between Indian sources and Olson may not be due only to the difference in period of estimation (a full decade's gap), but also due to difference in definition, and to the fact that Olson has included shrubland in his category. The working figure for this report will be 120 lakh ha., given by Singh and Misri.

The distribution of grasslands is quite uneven in India. For instance, in the western region, Rajasthan and Gujarat have 5.4 and 3.5%, respectively, of their land area under grasslands. In the eastern region, grasslands and pastures comprise less than 1% of the area, except in Sikkim, where they cover 13.3% of the land.

STATUS

Unfortunately, due to a greater neglect than even forests, the status of grasslands is not so well known and accurate figures for India are not available, largely because no base data exists for grassland coverage in the past, but also because grassland monitoring has been virtually non-existent even in the recent past. To some extent, the analysis of Gadgil and

Meher-Homji (1990), though focusing on forest types, is relevant for grasslands too. Thus, for instance, it is known that the semi-arid grasslands of western India are severely threatened, and are now restricted to a few small protected tracts only. This is also the case with the tall swamp grasslands of the terai belt, which have been seriously threatened with fragmentation and conversion to various human-dominated land uses.

THREATS

Extensive stretches of grassland have been destroyed or degraded in most parts of the country. Given below is a list of the major threats:

- Conversion to agriculture
- Human settlement
- Flooding by dams
- Diversion for other development projects
- Surface irrigation
- Fire
- Tree\bush plantation
- Introduction of exotics
- Grazing
- Grass cutting

In addition to the above human-generated factors, **droughts and floods** also seriously affect grasslands in many parts of the country.

As stated earlier, at present only 11-12 million ha., or about 3.7 to 3.9% of India's land mass, is under permanent pastures and grasslands (Planning Commission, 1989; Singh and Misri, 1993). As in the case of forests, the absence of an earlier database makes it difficult to estimate the total loss of grasslands. However, trends in the last few years give some indication. The semi-arid grasslands of western India, for

example, face amongst the world's heaviest biotic pressures (CAZRI, 1993). Livestock density here is very high (over 4 heads per ha., taking semi-arid and arid rangelands together; and there are clear signs of **overgrazing** in many areas.

The high-altitude grasslands in the Himalayas face heavy seasonal **grazing pressure** from nomadic herds. In Jammu and Kashmir, for instance, pastures have to bear a pressure of 7.70 Adult Cattle Units (ACU) per ha., while their carrying capacity is only 0.31 ACU per ha. (Singh and Misri, 1993). The result is a serious loss in regeneration capacity as soil gets compacted by livestock hooves and new growth is hampered; also resulting are changes in composition favouring species which are not palatable to, or favoured by, livestock.

The tall grasslands of the Indo-Nepal border and the north-east states, have faced extensive **diversion for agricultural purposes**, e.g. for sugarcane cultivation in the Uttar Pradesh terai area. Where cultivation has not reached, other development related diversions have taken place for urban spread, industrial infra-structure, and energy projects.

Large parts of grassland systems in both the north and the south have been subjected to **commercial plantations**, in a bid to "improve" the area's productivity. Teak *Tectona grandis*, eucalyptus hybrid, and Wattle *Acacia auriculiformis* have been consciously promoted on grasslands in south India, at times with the plea that these lands are wastelands !

South Indian shola grasslands (typical of the Western Ghats) have been subjected to another serious threat: **invasion by exotics**. The exotic `weed' *Chromolaena odorata* is extremely widespread, even inside relatively untouched national parks such as Eravikulam in the Western Ghats of Kerala.

Finally, **fire** has been a major threat to the grassland ecosystem, especially in semi arid and arid regions of the country. Not only does fire directly destroy grasslands, it also paves the way for weeds which eventually may cause as much damage as the fire itself. Unfortunately, regular burning is resorted to by villagers for a variety of reasons, and also by the wildlife and forest authorities to benefit some big mammals .

CURRENT LEGAL COVERAGE

Grasslands continue to be one of the most neglected ecosystems in India. Some of the major threats and the conservation measures taken, in relation to grasslands, are described below. The description is relevant for those grasslands which are not a part of any protected area.

A. **Converstion to agricultural land:**

There is no law or regulation preventing or regulating the conversion of grasslands into agricultural lands. In the 1950s and 1960s, under the grow more-food programme, such conversion was actually encouraged. Even today, many grasslands are being converted into agricultural lands.

B. **Fire:**

Where as natural fires are a part of the ecological process, accidental and deliberate fires cause huge damage to grasslands. Though accidental fires cannot be easily prevented, unfortunately there is little regulation or control over the practice of deliberately setting fire to grasslands. This is often done either to prevent accidental fires or for making the collection of certain types of seeds easier. Firing of grasslands is also common in order to have access to new grass for grazing.

C. **Afforestation:**

Very often grasslands are seen as "forest blanks" or, worse, as "wastelands". This leads to their being planted up with trees. Unfortunately, there is no law or regulation to prevent or

control this. Infact, for many development projects and for meeting social forestry & compensatory afforestations targets, grasslands are being increasingly seen as "available lands".

D. **Introduction of exotics:**

Various species of grasses have and are being promoted for soil conservation (eg. Khus), commercial use (eg. bhabbar, lemon grass), aesthetics etc.

There is no ability, at present, to control or regulate the introduction of exotic species of grasses(or other flora) into grasslands, and also little concern.

E. **Grazing:**

There is little regulation or control of grazing in grasslands outside protected areas. Though many villages in India have "ghasnis" or community grasslands, most of these are extensively grazed.

Even within PAs, grazing can be, and often is, permitted within reserved forests and sanctuaries. Only in national parks grazing is prohibited, but even then it is prevalent in many.

F. **Diversion for development projects:**

Unlike forests, where there is a law regulating diversion for non-forestry purposes, there is no such regulation for grasslands. Consequently, where grasslands are being submerged under the waters of a dam, or otherwise being diverted for some other purpose, there is no special scrutiny nor a consideration of the biological value of the particular grassland.

However, where the grassland is within a forest or wildlife protected area, its diversion is regulated by various acts including the Forest (Conservation) Act and the Wildlife (Protection) Act.

Summary of Legal Coverage for Grasslands : General Measures

Aspects	IFA	FCA	WLPA	EPA	remarks
Safeguarding social justice and equity	No	No	No	No	no legal regulation on use of grasslands outside protected areas
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this, but only within PAs.
Safeguarding animal rights	No	No	Yes	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Only for grasslands within PAs. The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable	No	No	No	No	

size is maintained					
Determining required ecological conditions	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Only within PAs.
Ensuring participatory management	No	No	No	No	No legal regulation outside PAs.
Ensuring transparency	No	No	No	No	
Decentralising control	No	No	No	No	No legal regulation outside PAs.
Ensuring socio economic stake of local communities	No	No	No	No	No legal regulation outside PAs.
Ensuring a sense of ownership in local communities	No	No	No	No	No legal regulation outside PAs.

Measures specific to grasslands

Threat From	Legal control	Other regulations
1. Conversion to agricultural land	N	N
2. Deliberate fires	N	P
3. Afforestation	N	N
4. Introduction of exotics	N	N
5. Grazing	N	P
6. Diversion for development projects	N	P[1]

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1. Environment clearance is required for certain categories of Projects.

4.3 COASTS, INCLUDING MANGROVES AND CORAL REEFS

India has over 7,000 km of coasts. These areas assumed special importance since 1983 when the Ministry of Environment & Forests issued their environmental guidelines for development of beaches. These areas assumed even greater importance once the CRZ Notification was issued in February 1991 by the Ministry of Environment & Forests.

4.3.1 Coasts

STATUS

The available information points to an alarming situation. India's coastal areas are subjected to severe pressures from reclamation, dredging, siltation, pollution, mining, over-exploitation, construction on or near the coast, salt-extraction and other factors. The backwaters of Kerala, the kayals, are degraded or destroyed by dredging, pollution, water withdrawal for industrial and power station use, and siltation from degraded catchments (Kurup and Samuel, 1987; Gopalan, et al. 1983). They have also been subject to reclamation for various purposes (Das and George, 1993), with Vembanad backwaters, western India's largest estuarine system, having been reduced to one-third its original size.

Off the coast, ecologically unsound techniques like large-scale trawling have caused drastic ecosystem damage, destroying marine beds and breeding grounds of aquatic organisms (Bensam, et al. 1993: 10).

THREATS

Some of the major threats are:

- Dredging
- Collection of sand, corals and other material
- Pollution
- Oilspills
- Unsuitable construction

- Excessive and inappropriate tourism
- Aquaculture

Pollution of various kinds has been a major threat to coastal waters in India. About 17 crore (170 million) people, 25% of India's population, live on the country's coastline. (Sen Gupta and Qasim, 1985).

An estimated 513 million tonnes of oil are transported across the Arabian Sea to or from different parts of the world, annually. Small amounts of oil are constantly leaking from ship ballasts and engine rooms, totaling up to nearly 2.1 million tonnes yearly (Sen Gupta, 1984).

There have been several **oil spills** in Indian waters, including one of 5,500 tonnes in 1989 off the coast of Bombay (Chengappa, 1993). One of the first such accidents, in 1974, was when the US tanker Transhuron ran aground and spilled about 3000 tonnes of furnace oil in the Lakshadweep Islands, causing substantial (though largely undocumented) ecological damage (Singh, D. 1993).

One of the recent spills was by far the most serious in Indian waters: a spill of 40,000 tonnes of lightcrude about 110 km south of the Great Nicobar Island (Chengappa ,1993). The other was of lesser magnitude, in the Arabian Sea off the coast of Bombay (Anon., 1993).

The impact of **aquaculture projects**, along the South-east coast of India, on the natural marine ecosystem is yet to be adequately assessed.

Besides overexploitation, **pollution from land-based sources** is another major threat to marine resources. It was estimated at the global level that 70 percent of the marine pollution is due to land based sources, while 10 percent each is contributed by maritime transport and dumping activities. In an interesting study on world wide tanker oil spills, it was estimated that for every million tonnes transported, 12 tonnes were spilled within 80 km of the coast.

Construction near the high tide line also threatens the coastal ecosystem, apart from blocking public access to the sea and contributing to the depletion of ground water resources in the coastal region.

The **population influx and increased tourism** in some coastal places are responsible for indiscriminate destruction of marine biological resources.

CURRENT LEGAL COVERAGE

Coastal zone management and conservation of marine diversity are of recent origin. The first Marine Sanctuary was constituted by the state Government in 1980 in the Gulf of Kutch. Coastal and marine ecosystem are poorly represented among the protected areas network in India. Except for the Andaman & Nicobar Islands, where there area over a hundred parks and sancturies containing coastal ecosystems (though only two with marine ecosystems) , the rest of the country has only two other marine national parks and a handful of parks and sanctuaries protecting the coasts.

The Government of India notified, in 1991, the coastal regulation rules which regulate activities in coastal regions. The main features of these rules are:

Prohibited Activities:

The following activities are declared as prohibited within the Coastal Regulation Zone, namely:

(i) setting up of new industries and expansion of existing industries, except those directly related to water front or directly needing foreshore facilities:

(ii) manufacture or handling or storage or disposal of hazardous substances as specified in the Notifications of the Government of India in the Ministry of Environment & Forests No. S.O. 594(E) dated 28th July, 1989, S.O. 966(E) dated 27th November, 1989 and GSR 1037(E) dated 5th December, 1989.

(iii) Setting up and expansion of fish processing units including warehousing (excluding hatchery and natural fish drying in permitted areas);

(iv) setting up and expansion of units mechanisms for disposal of waste, and effluents, except facilities required for discharging treated effluents into the water course with approval under the Water (Prevention and Control of Pollution) Act, 1974; and except for storm water drains;

(v) discharge of untreated waste, and effluents from industries, cities or towns and other human settlement. Schemes shall be implemented by the concerned authorities for phasing out the existing practices, if any, within a reasonable time period not exceeding three years from the date of this notification;

(vi) dumping of city of town waste for the purposes of landfilling or otherwise; the existing practice, if any, shall be phased out within a reasonable time not exceeding three years from the date of this Notification;

(vii) dumping of ash or any wastes from thermal power stations;

(viii) land reclamation, bunding or disturbing the natural course of sea water with similar obstruction, except those required for control of coastal erosion and maintenance or cleasing of waterways, channels and ports and for prevention of sandbars and also except for tidal regulators, storm water drains and structures for prevention of salinity ingress and for sweet water recharge;

(ix) mining of sands, rocks and other substrata materials, except those rare minerals not available outside the CRZ areas;

(x) harvesting or drawal of ground water and construction of mechanisms therefore within 200 m of

HTL; in the 200 m to 500 m zone it shall be permitted only when done manually through ordinary wells for drinking, horticulture, agriculture and fisheries;

(xi) construction activities in ecologically sensitive areas as specified in Annexure-I of this Notification;

(xii) any construction activity between the Low Tide Line and High Tide Line except facilities for carrying treated effluents and waste water discharges into the sea, facilities for carrying sea water for coolines and facilities essential for activities permitted under this Notification; and

(xiii) dressing or altering of sand dunes, hills, natural features including landscape changes for beautification recreational and other such purpose, except as permissible under this Notification.

3. Regulation of Permissible Activities:

All other activities, except those prohibited in para 2 above, will be regulated as under:

(1) Clearance shall be given for any activity within the Coastal Regulation Zone only if it requires water front and foreshore facilities.

(2) The following activities will require environmental clearance form the Ministry of Environment & Forests, Government of INdia, namely:

(i) Construction activities related to Defence requirements for which foreshore facilities are essential (e.g. slipways, jetties etc.); except for classified operational component of defence projects for which a separate procedure shall be followed. (Residential buildings, office buildings, hospital complexes, workshops shall not come within the definition of operational requirements except in very special cases and hence shall not normally be permitted in the CRZ);

(ii) Operational constructions for ports and harbours and light houses requiring water frontage; jetties wharves, quays slipways etc. (Residential buildings & officer buildings shall not come within the definition of operational activities except in very special cases and hence shall not normally be permitted in the CRZ);

(iii) Thermal power plants (only foreshore facilities for transport of raw materials facilities for in-take of cooling water and outfall for discharge of treated waste water cooling water); and

(iv) All other activities with investment exceeding rupees five crores.

(3) (i) The coastal State and Union Territory Administrations shall prepare, within a period of one year from the date of this Notification. Coastal Zone Management Plans identifying and classifying the CRZ areas within their respective territories in accordance with the guidelines given in Annexures-I and II of the Notification and obtain approval (with or without modifications) of the Central Government in the Ministry of Environemnt & Forests;

(ii) Within the framework of such approved plans, all development and activities within the CRZ other than those covered in para 2 and para 3(2) above shall be regulated by the State Government. Union Territory Administration or the local authority as the case may be in accordance with the guidelines given in Annexures-I and II of the Notification; and

(iii) In the interim period till the Coastal Zone Management Plans mentioned in para 3(3)(i) above are prepared and approved, all developments and activities within the CRZ shall not violate the provisions of this Notification. State Governments and Union Territory Administrations shall ensure adherence to these

regulations and violations, if any, shall be subject to the provisions of the Environment (Protection) Act, 1986.

By virtue or this notification, the State Governments and Union Territory Administrations were supposed to prepare Coastal Zone Management Plans within a period of one year. However, even though more than five years have elapsed, till recently very few States/Union Territory Administrations had prepared these vitally important Coastal Zone Management Plans. This was, consequently, the subject of considerable litigation in the Supreme Court. It is only after the Supreme Court orders that the process of preparing these management plans has been speeded up and it is understood that almost all the states have submitted their plans by 30 September, 1996, which was the deadline set by the Supreme Court.

Summary of Legal Coverage for Coastal Zones : General Parameters

Aspects	IFA	FCA	WLPA	EPA	CRZ	remarks
Safeguarding social justice and equity	No	No	No	No	No	
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this
Safeguarding animal rights	No	No	Yes	No	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable size is maintained	No	No	No	No	Yes	The CRZ specifies the quantum of area to be kept free of disturbance, eg. 500 m above high tide line.

Determining required ecological conditions	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	No	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Yes	
Ensuring participatory management	No	No	No	No	No	
Ensuring transparency	No	No	No	No	No	
Decentralising control	No	No	No	No	No	
Ensuring socio economic stake of local communities	No	No	No	No	No	
Ensuring a sense of ownership in local communities	No	No	No	No	No	

Parameters Specific to Coastal Zones

Threats from	Legal Control	Other Regulations
Pollution	P	N
Oil spills	P	P
Aquaculture projects	P	P
Construction	P	P
Population influx	N	N
Tourism	P[2]	P
Dredging	P[3]	N
Collection of sand/ corals/other material	P[4]	P
Trawling	P	P
Over-fishing	N	P
Erosion	p	n

[2] Only with regards to tourism infrastructure in the CRZ.
[3] Only regulated in the CRZ
[4] Only regulated in the CRZ

4.3.2 **Corals**

The precise area covered by Indian coral reefs is not known. A rough estimate of 19,000 sq.km. is given by Wafar (1992). These are distributed patchily off some parts of the mainland coast (the Gulf of Kutch in the northwest, and off the southern and central western coast), and around the two island clusters of Andaman and Nicobar, and Lakshadweep. A break-up of the areas is given below (no estimate given for the patchy reefs off the central western coast):

Gulf of Mannar:	100 sq.km.
Gulf of Kutch:	1,000 sq.km.
Lakshadweep Islands:	4,200 sq.km.
Andaman Islands:	11,000 sq.km.
Nicobar Islands:	2,700 sq.km.

STATUS

There appears to be no estimate available of the extent of reefs which have been degraded or destroyed, either worldwide or in India. It is, however, known that there has been considerable loss. Some assessments for this loss throughout the world are given in UNEP/IUCN (1988). In the case of India, it is known that the reefs at Gulf of Mannar and Gulf of Kutch are severely threatened (Wafar, 1992), with the latter having declined to only 30 to 40% of its former extent (WWF,1992).

THREATS

Major threats to coral reefs are from:

- Mining of corals to use for construction of roads and buildings, and for industrial use. For example, an estimated 25,000 tons were removed annually from the Gulf of Mannar and Palk Bay for use in calcium carbide production,
- Blasting and dredging.
- Collection of corals for decoration and sale.
- Siltation due to inland deforestation.

- Pollution from industry, agricultural runoffs and from towns and cities.
- Effluents from desalinisation plants.
- Pollution from ships and oil spills..
- Destruction by star fish.

Mining has been a major threat. In the Gulf of Mannar, some 25,000 tonnes of coral were mined every year in the 1970's and 1980's (Wafar,1992: 280-82). Particularly damaging was the fact that much of the mining was in waters less than 1 m. deep, thus affecting live corals more. Similarly, at Tuticorin (Tamil Nadu), annual mining of 15,000 tonnes of coral blocks and 10,000 tonnes of coral debris takes place, while in the Gulf of Kutch, the removal of about 0.6 to 1 million tonnes to feed a local cement factory In the latter area, the reef size has diminished from 11,100 ha. to 5,300 ha. within a decade (Baqri, 1993). Corals has destroyed over half the live coral (Wafar, 1992: 280-82 : Kothari, et al.). Corals near Mandapam (Tamil Nadu) were always used for preparing lime, but a severe blow was dealt with the establishment of the calcium carbide factory in Tirunelvelli district (Pillai,1993). During the 1960's about 250 to 300 cubic meters of coral were removed every day. Today, the area is covered with sand, and the coral reefs almost obliterated.

Dredging has had a serious effect on the reefs of Lakshadweep Islands, especially in the Minicoy lagoon and Kiltan atoll (Pillai, 1993). So too has siltation in almost all of the reefs of India. The absence of Acropora in the Gulf of Kutch is probably due to this; in the Andaman Islands, excessive silt deposition on reefs, caused by deforestation further inland and mining of sand from the shore for construction, has resulted in severe localised damage to Acropora, Montipora, and Porites formations (Pillai, 1993).

Pollution from various sources are another serious threat to Indian reefs. Heavy damage is reported in the Andaman

Islands, due to effluents from timber and match factories around Port Blair and in Middle Andaman Island (Dorairaj et al., 1987). Recent studies on the corals of Manauli Island has shown that they are heavily infected with coliform bacteria, E. coli, which could be a result of sewage deposition on the reefs. In the Gulf of Mannar, disappearance of live coral reefs near Tuticorin harbour is partly a result of oil and industrial pollution (Wafar 1992). Oil spillages are also reported to have affected reefs near Great Nicobar Island and the Kavaratti atoll in Lakshadweep Islands (WCMC, 1988).

Other current threats include **destructive fishing practices**, such as the breaking off of branched corals to drive out resident fish; it is feared that the recent encouragement of fishing for aquariums by the Lakshadweep Administration, for export, could cause widespread reef destruction (Wafar, 1992).

Potential future threats include the **rise in global sea temperature**, which has caused coral mortality all over the world and could already have started doing so in India (Pillai, 1993).

Also threatening is the **spread of diseases** (Williams & Williams 1990, quoted in Pillai 1993, in press); the White band disease, in which a 1 cm. wide band advances from the base to the tip of the coral formation and weakens or kills it, has been noticed in the Wandoor area of Andaman Islands (Wood 1989).

Finally, **predator infestations** could be serious in the future; the crown of thorn Acanthaster planci, a star fish, which preys on coral polyps, has spread in unnaturally large numbers and killed vast reefs in the Indo-pacific region. In the Andamans too, it is spreading and has caused localised damage (Dorairaj et al., 1987). Though recent surveys by CMFRI scientists indicate that the situation is not yet alarming, they also warn that a "severe catastrophe" could result if the A. planci population shoots up. A possible connection between silt (including nutrient) inflow into the

coastal waters from degraded forest areas inland, and the explosion of the A. planci population, needs to be seriously investigated (Soundararajan, 1989).

Corals are extensively **collected for presentation**, decoration, fancy sale and **educational study**. In some islands, large quantities of live corals were used for the **construction of roads**.

The construction of jetties, wharfs, harbours and dredging activities deposit large quantity of **silt**, which destroy the ecologically sensitive corals in those areas. One NGO, Society for Andaman and Nicobar Ecology (SANE) reported in 1987 that Military Engineering Service (MES) had been extracting thousands of cubic metres of coral off Kamorta islands, near Naval Helipad at INS Kardip, for use in construction of shore protection pillars (Kothari, 1989).

CURRENT LEGAL COVERAGE

As already mentioned, the major threats to coral reefs, requiring general protection measures, are from various types of pollution, especially from

- industrial and agricultural chemicals
- desalinisation effluents
- Oil from ships
- domestic sewage
- silt from degraded/worked land and construction activities

There are various laws for controlling industrial and domestic pollution. However, the standards prescribed, even when they are enforced, do not take in to consideration the fragile nature of coral reefs. Often, therefore, coral reefs can be damaged by effluents which meet the prescribed standards.

There are no laws regulating desalinisation effluents, oil spillage from ships,or silt flow. Also, there are weak laws

regulating agricultural pollution, especially non-point run-offs.

Specific measures required to conserve coral reefs include those aimed at controlling physical destruction through mining, blasting, dredging, filling etc., and through the collection of corals for souvenirs. Except for those coral reefs which are within protected areas and within the CRZ, there is no legal protection against physical destruction of corals in much of India. However, in the Andaman & Nicobar Islands, which contain one half of the coral reefs in India, there are regulations which prohibit the collection and destruction of corals.

A project has been undertaken by Deptt. of Oceans Development through Space Application Centre, Ahmedabad for mapping and characterisation of coral reefs in the country. The project is under implementation. However, based on the recommendations of the National committee on Wetlands, Mangroves and Coral Reefs, following four areas have been identified for conservation and management:-

i. Andaman & Nicobar

ii. Gulf of Kutch (Gujarat)

iii. Gulf of Mannar (Tamil Nadu)

iv. Lakshadweep

Management action plan for Andaman and Nicobar has been prepared and was recommended for financial assistance by the National Committee on Wetlands, Mangroves and Coral Reefs. The project is expected to survey and monitor corals and take of their protection. [MOEF 1994b]

The MOEF has initiated activities to conserve specific coral reefs, through their National Coral Reefs Programme.

NATIONAL CORAL REEFS PROGRAMME

A national strategy for the conservation of corals and coral reefs in India has been developed in recognition of the fact that these constitute the most productive marine ecosystems, which are deteriorating rapidly, The main elements of the strategy are:

- *Survey and demarcation of coral reefs*
- *Identification of problems afflicting reefs*
- *Detailed study of flora and fauna*
- *Preparation of a status report on corals in India*
- *Control of over-exploitation of corals for industry and other activities by administrative notification and, later, legislation*
- *Investigation of the impacts of pollutants on corals and determination of point and non-point sources of pollution*
- *Regulation of fisheries in coral reef areas*
- *Establishment of marine parks (three have already ;been created: Gulf of Kutch, Gulf of Mannar and South Andaman)*
- *Education and awareness programmes*

Management action plans are in the process of finalisation for the coral reefs of the Andaman & Nicobar Islands, Gulf of Kutch, Gulf of Mannar, and Lakshadweep Islands. The National Institute of Oceanography, Panjim (Goa), has been identified as the nodal research institution for the first two areas, and the Central Marine Fisheries Research Institute, Cochin (Kerala), for the others. [Adapted from WWF 1992]

Unfortunately, despite all the good intentions, not much progress seems to have been made at least partly due to the paucity of funds.

Summary of Legal Coverage for Coral Reefs: General parameters

Aspects	IFA	FCA	WLPA	EPA	CRZ	remarks
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this
Safeguarding animal rights	No	No	Yes	No	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable size is maintained	No	No	No	No	Partly	The CRZ specifies the quantum of area to be kept free of disturbance, eg. 500 m above high tide line.

Determining required ecological conditions	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	No	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Yes	
Ensuring participatory management	No	No	No	No	No	
Ensuring transparency	No	No	No	No	No	
Decentralising control	No	No	No	No	No	
Ensuring socio economic stake of local communities	No	No	No	No	No	
Ensuring a sense of ownership in local communities	No	No	No	No	No	

Legal measures specifc to coral reefs

Threats from	Legal control	Other regulations
General		
1. Industrial pollution	Y	N
2. Domestic pollution	Y	N
3. Agricultural pollution	P	N
4. Oil pollution	N	N
5. Silt Pollution	N	N
Specific		
6. Physical destruction from mining, dredging, etc.	P[1]	P[2]
7. Physical destruction for souvenirs	P[1]	N

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1. Within CRZ and in Andaman & Nicobar Islands
2. Environmental clearance required for certain types of activities

4.3.3 Mangroves

In India, various figures have been given for the total area under mangroves. WCMC (1992) provides a figure of 3,560 sq.km., with about 3,060 sq.km. along the mainland coast, and about 500 sq.km. surrounding the Andaman and Nicobar Islands. An expert committee set up by the Government of India provided a figure of 674,000 ha., about 7% of the world's mangroves (GOI,1987). This committee based its estimate on "field surveys, studies and information available in the field".

However, the latest available satellite imagery interpreted by the Forest Survey of India, shows a mangrove cover of 482,700 ha. (FSI, 1997). This wide difference between various figures is not entirely explainable, especially considering the fact that the GOI committee estimate appears to have been very carefully put together. It is not known whether this committee availed of the first round of satellite estimates (based on imagery of 1981-83 period) which, though published only in 1987, must already have been available with the relevant authorities. These estimates put the Indian mangrove coverage at 404,600 ha.

Mangroves are widely distributed in India, though on the west coast they are comparatively scattered, degraded and small in area. The area of mangroves in different parts of India as estimated by both the GOI committee as also by FSI, is given below:

State	Area in hectares	
	FSI (1997)	GOI (1987)
West Coast		
Gujarat (Narmada, Tapti, Gulf of Khambat)	99,100	26,000
Maharashtra (Ratnagiri, Vijayadurg, Malvan, Devgad)	12,400	33,000
Goa	500	20,000
Karnataka (Coondapur, Malpe, Karwar, other patches)	300	6,000
Kerala (stray patches)	0	Negligible
East Coast		
Tamil Nadu (Cauvery and adjacent coastal stretch)	2,100	15,000
Andhra Pradesh (Godavari and Krishna delta)	38,300	20,000
Orissa (all deltaic and coastal)	21,000	15,000
West Bengal	212,300	420,000
Andaman & Nicobar Islands	96,600	119,000
Total	482,700	674,000

STATUS

In India, the reduction in mangroves area has been drastic, about 40% of the original cover having been lost or badly degraded (GOI, 1987), though the basis of this estimate is unclear.

There appears to be plenty of evidence that there has been a serious loss of mangroves all over India. The Sunderbans mangroves (combined for India and Bangladesh), are recorded to have the following areas in the last three centuries (GOI, 1987):

End of 18th century: 36,000 sq.km.

End of 19th century: 24,000 sq.km.

Current (1987?): 12,000 sq.km.

Two-thirds of these forests have therefore been destroyed. This is not an isolated occurrence, as severe losses have characterised most of the mangrove patches in India. The GOI document estimates about 6000 ha. of mangroves, in patchy distribution, off the coast of Karnataka, which the FSI interpretation does not have at all; this could be an indication of a real loss rather than a computational or methodological error. Similarly, extremely patchy stands of

mangroves in Kerala are a testimony to what was possibly a much larger coverage in the past.

Looking at satellite imagery alone, the situation is mixed, with the early 1980s heralding a reversal in the declining trend, but the decline setting in again at the end of the decade. Satellite imagery since 1981-83 shows the following changes in mangrove extent:

Year of estimate	Area (in ha.)
FSI 1987	404,600
FSI 1989	425,500
FSI 1991	424,000
FSI 1997	482,700

This increase in mangrove area (over 60 thousand hectares or over 12% of the total), if indeed it has taken place on the ground and is not a result of interpretational changes or mistakes, is heartening.

THREATS

Mangrove ecosystems have been subjected to serious attack in most of the zones of their distribution in India. As mentioned earlier, over 40% of India's mangroves have already been lost (GOI, 1987: p.3). The factors behind this loss have been more or less the same that affect mangroves worldwide, though in varying degrees of intensity (GOI, 1990).

The major threats to mangroves are:

- Clearfelling.
- Felling for firewood.
- Diversion of freshwater flowing into mangrove areas, especially for agricultural use.
- Coversion of mangrove areas into farmland.
- Conversion of mangrove areas into aquaculture ponds.
- Conversion to salt pans.

- Coversion for urban use.
- Destruction due to the construction of harbours and shipping channels.
- Destruction or degradation due to mining in and around the area.
- Pollution from urban areas, industry, agriculture and transport.
- Oil and chemical spills.

In India, **reclamation for urban development** has claimed large stretches of mangroves, e.g. those flanking the Vembanad Lake in Kerala (De Roy 1990), those off and near Bombay and Cochin, and those around Port Blair in the Andaman Islands. In the mangals, the rich mangroves of the Krishna estuary, Andhra Pradesh, the Forest Department logged trees from the 1920s to the 1970s, to provide fuelwood to nearby urban areas (Prasad, 1992: 219). The result was widespread destruction, including the near eradication of one species, Suaeda monoica and its replacement by the exotic Prosopis juliflora.

The same mangals are today threatened by **overgrazing**, wood collection by local villagers, and a proposed road cutting across some of the habitat. This situation is particularly alarming in view of the significance of these mangroves - they are one of the only two places where three species of Avicennia marina, A.officinalis, A.alba) occur together, and the only habitat for the endangered plant Myriostachya wightiana.

In the Gulf of Kutch, mangroves have been severely depleted **by fuelwood and fodder collection** (allowed from inside the Marine National Park and Sanctuary during the drought years of the mid-1980s), **chemical and thermal pollution, urban and agricultural reclamation, expansion of salt works, overgrazing, and oil spillages around ports**; the result has been a reduction of mangrove coverage from 13,900

ha. to just 3,300 ha. within a decade (Chavan 1985; Baqri, 1993; Kothari, et al.); A similar multiplicity of activities has reduced the mangroves off the coasts of Karnataka, Goa, and Maharashtra (WCMC, 1988), and affected the stretches in the Mahanadi delta off Orissa.

Mangroves, like other wetland areas, have also been severely affected by **inappropriate aquaculture**, including conversion into shrimp and prawn culture farms and pollution by fertilisers and other inputs (WWF-I,1992). This is likely to be greatly intensified in future as the country goes in for a major thrust in export-oriented aquaculture.

CURRENT LEGAL COVERAGE

Of the threats requiring general measures, watershed degradation and soil erosion, pollution, and tourism are the same for mangroves for wetlands, and the status of conservation is as described for wetlands.

Threats requiring specific measures are also mostly common with wetlands, especially threats from drainage and dredging. In addition, mangroves are also threatened by clearfelling for development projects and activities, by human habitation and by diversion of land for various other uses.

Fortunately, the Coastal Regulation Zone (CRZ) declared under the Environment (Protection) Act, covers coastal regions upto 500 m above the high tide line of the sea or 100 m from the banks of rivers, creeks, or backwaters (or their width, whichever is less) and, thereby, covers virtually all the mangrove areas in the country. In this zone, various activities are banned or regulated.

Unfortunately, though protecting mangroves from various threats, the CRZ notification does not explicitly protect them from felling, nor can it protect them from the impact (like pollution) of activities outside the CRZ.

Mangroves which are within protected areas (reserved forests, sanctuaries, national parks) get protection under the

laws governing these areas. However, there are mangroves outside protected areas and, to ensure conservation of these, MOEF has started the National Mangroves Programme. There is also a central scheme :Conservation and Management of Mangroves (Centrally Sponsored (100%)): This scheme proposes to assist state governments to protect and regenerate the mangroves and coral reefs in their states.

NATIONAL MANGROVES PROGRAMME

On the basis of the National Committee's recommendations, 15 mangrove areas have been identified for conservation and preparation of management action plans. The selected mangrove areas are:

Coringa, Godavari delta and Krishna estuary (Andhra Pradesh); coastal Goa (Goa); Gulf of Kutch (Gujarat); Coondapur (Karnataka); Vembanad (Kerala); Achra/Ratnagiri (Maharashtra); Mahanadi delta and Bhitarkanika (Orissa); Pichavaram and Point Calimere (Tamil Nadu); Sunderbans (West Bengal); and North Andaman and Nicobar (Andaman and Nicobar Islands).

Action plans have been developed for all these areas. The plans address issues related to survey and demarcation, natural regeneration in selected areas, afforestation, protection measures (such as fencing, watch and ward facilities), and awareness programmes.

Nodal academic/research institutions have been identified for each area. Some examples are Andhra University, Waltair, for Coringa, Godavari delta and Krishna estuary mangroves; Annamalai University, Annamalai (Tamil Nadu) for Pichavaram; and Department of Marine Sciences, Calcutta University for Sunderbans. These institutions are taking up research with a view to providing inputs for the development of mangrove ecosystems on sound ecological lines.

[Adapted from WWF 1992]

Summary of Legal Coverage for Mangroves : General parameters

Aspects	IFA	FCA	WlPA	EPA	CRZ	remarks
Safeguarding social justice and equity	No	No	No	No	No	
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this
Safeguarding animal rights	No	No	Yes	No	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable	No	No	No	No	Partl	The CRZ specifies the quantum of area to be kept free of disturbance, eg. 500 m above high tide

size is maintained					y	line.
Determining required ecological conditions	No	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	No	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Yes	
Ensuring participatory management	No	No	No	No	No	
Ensuring transparency	No	No	No	No	No	
Decentralising control	No	No	No	No	No	
Ensuring socio economic stake of local communities	No	No	No	No	No	
Ensuring a sense of ownership in local communities	No	No	No	No	No	

Parameters specific to mangroves

General Threat from	Control	Legal regulations	Other
1. Watershed degradation and soil erosion		N	N
2. Pollution		Y	Y
3. Tourism		P[1]	N
Specific			
4. Clearfelling		N	N
5. Diversion of water		P[2]	N
6. Conversion to other uses		Y[2]	N
7. Development projects		Y	P
8. Human habitation		Y[2]	P[3]

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1. Construction of tourist facilities regulated in CRZ
2. Regulated/prohibited within CRZ
3. Regulated in public lands.

4.4 DESERTS

In India, deserts extend over about 2% of the landmass (Olson et al.,1983). At least three distinct kinds of desert are noticeable:

1. The sand desert of western Rajasthan and neighbouring areas,
2. The vast salt desert of Kutch in Gujarat, and
3. The high-altitude cold desert of Jammu & Kashmir and Himachal Pradesh.

The first two form a part of Indian Desert biogeographic zone distinguished by Rodgers and Panwar (1988), and by Gadgil and Meher-Homji (1990). Together, they are the eastern extremity of the Great Palaeatropical Desert which extends from North Africa (Sahara) via the Arabian Desert and Pakistan to North-west India.

Sprawled over a vast area north of the Himalayan ranges, the cold desert is an ecosystem of exceptionally low temperatures (down to -75` C) and rainfall (500-800 mm annually). It forms a plateau at the height of 4,500 to 6,000 mts above sea level, and is encompassed by the Trans-Himalayan Biogeographic Zone of Rodgers and Panwar (1988). This zone extends into the Tibetan plateau, to cover an area of 2.6 million sq km, from which originate the great river systems of Indus, Sutlej, Brahmaputra and Yangtze.

In India, cold deserts cover a vast area of 1,09,990 sq.km., about 87,780 sq.km. in Ladakh (Kashmir), and 22,210 sq.km. in Lahul-Spiti and Kalpa (Himachal Pradesh). The Great Himalayan Range divides the better watered mountain systems of the Himalayas from this cold arid desert area, which itself contains three mountain ranges - Zanskar, Ladakh and Karakorum. To the east, the Ladakh and Zanskar ranges diminish to the southern margin of the Tibetan plateau and the beginning of an internal drainage marsh and lake system. To the north, much of the area is above the

snowline. Throughout the area, precipitation is mostly in the form of snow.

STATUS

Desert ecosystems in India have not been subjected to as severe pressure as the other ecosystems described earlier. Nevertheless, various human activities have posed localised threats which, if intensified, could in future create serious damage.

As is the case worldwide, no overall estimate is available on the loss of each of these types, though it is clear that such loss has taken place especially in the Indian (sand) desert. In the estimation of Gadgil and Meher-Homji (1990), almost none of the hot desert of western India remains intact, but this seems to be an overstatement. Certainly vast areas of the salt desert are still relatively untouched, though much of its sparsely wooded stretches along the Rann periphery and on the bets has been transformed into exotic Prosopis scrub. Much of the sand desert has also been similarly transformed or severely degraded, and very little has been left intact.

Unfortunately, not even a cursory assessment of the status of the cold desert appears to be available.

THREATS

The major threats to the desert ecosystem are form:

- Rapid increase in human population, especially in the desert regions of Rajasthan. The population in this region is increasing at nearly twice the rate of the national average.
- A rapid increase in livestock population, resulting in the over utilisation of the grass lands and decrease in the population of wild herbivores.
- Water logging, especially by the Indira Gandhi Canal, and the change in the natural vegetation due to increase in soil moisture and salinity.
- Indiscriminate mining.

The sand desert of western India, primarily in the Thar region of Rajasthan, is in fact the most densely populated of the world's deserts, with a density of 75 persons per sq.km. (compared to an average of 3-5 per sq.km. in other deserts). In addition, the livestock population is also far in excess of the desert rangelands' carrying capacity, about 10 times the carrying capacity of 0.43 heads per ha. There is therefore **heavy biotic pressure**.

This pressure has now been compounded by **developmental activities: irrigated cropping, mining, oil exploration, industrialisation, and urbanisation**. Changes in food webs, energy flows, and biochemical cycles due to these activities are not yet well known (CAZRI, 1993). The Indira Gandhi Canal is reported to be bringing about drastic changes in the desert ecosystem, including waterlogging, salinisation, and introduction of new weeds and pests (Baqri and Kankane, 1993).

The salt desert of Gujarat, the Rann of Kutch, has been relatively secure from human pressures due to its inaccessibility and inhospitable terain. But even here damage has been caused of late, by a combination of activities. An increasing number of **salt works**, producing over 10 million tonnes of salt, have encroached into the Rann, bringing with them serious **human and vehicular traffic** (Sinha and Goyal, 1993; Baqri, 1993, in press).

Army activities, including **target practice and vehicular movement**, have caused widespread disturbance, and the exotic tree *Prosopis juliflora* has spread like wildfire (Baqri 1993, in press; Kothari et al.,). Nomadic maldharis, once probably living sustainably off the meagre resources of the desert, are beginning to overuse and degrade the isolated bets (islands of non-saline grassland inside the Rann), the monsoon home of the Wild ass (Baqri, 1993).

Coupled with all these anthropogenic factors are the **periodic droughts**, including amongst the century's worst

drought period in the mid-1980s, which reduced forage and water availability for the desert's wildlife.

The major threats to the cold desert ecosystem include:

- *Road construction. In the last thirty five years, especially after the war with China, in 1961, there has been extensive road building activities in the cold desert areas, which are on the Indian border with China. One estimate suggests that between 40,000 and 80,000 sq. m. of debris is removed from the mountains for every km of road constructed.*
- *Though the human population in the cold desert region is sparse, in recent times tourist demands and demands from the armed forces for milk and meat has resulted in increases in livestock population, resulting in overgrazing.*
- *Demand for firewood, mainly from outsiders, has resulted in the over extraction of fuelwood.*
- *Pressure from tourists.*
- *Disturbance due to activities of the armed forces.*

CURRENT LEGAL COVERAGE

Different State Governments have declared a number of areas as protected in the Thar desert region. They are as follows:-

State	Name of Protected area	Legal Status	District	Area sq. km.
Rajasthan	Tal Chappar	Sanctuary	Churu	7.90
	Todgarh	do	Ajmer	405.27
	Desert	National Park	Jaisalmer	3162.00
Gujarat	Balram Ambaji	Sanctuary	Banaskantha	542.82
	Barda	do	Junagarh	192.31
	Kutch Desert	do	Kutch	7506.22
	Khijadiya	do	Jamnagar	6.05
	Nalsarovar	do	Ahmedabad & Surendranagar	120.82
	Rampura	do	Rajkot	15.01
	Thol	do	Mehsana	6.99
	Gir	National Park	Junagarh	258.71
Punjab	Abohar	do	Ferozpur	185.50

The Hemis National Park in J&K and the Pin Valley National Park in Himachal Pradesh give some modicum of protection to the cold desert ecosystem.

Summary of Legal Coverage for Deserts : General Aspects

Aspects	IFA	FCA	WLPA	EPA	remarks
Safeguarding social justice and equity	No	No	No	No	no legal regulation on use of deserts outside protected areas
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this, but only within PAs.
Safeguarding animal rights	No	No	Yes	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	Only for grasslands within PAs. The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary
Determining minimum viable populations	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	There is no legal requirement to determine this

Ensuring that minimum viable size is maintained	No	No	No	No	
Determining required ecological conditions	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary
Determining carrying capacity	Yes	Yes	Parly	Yes	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	Only within PAs.
Ensuring participatory management	No	No	No	No	No legal regulation outside PAs.
Ensuring transparency	No	No	No	No	
Decentralising control	No	No	No	No	No legal regulation outside PAs.
Ensuring socio economic stake of local communities	No	No	No	No	No legal regulation outside PAs.
Ensuring a sense of ownership in local communities	No	No	No	No	No legal regulation outside PAs.

There are no other provisions of law covering any of the specific threats to deserts.

4.5 OCEANS

India has an exclusive economic zone estimated to be about 2.02 million sq. km. Of this, the west coast including Lakshadweep constitutes the maximum (42.5 percent), followed by Andaman and Nicobar islands (29.7 per cent) and east coast (27.8 percent).

THREATS

Same as those listed for coastal regions above. Mainly pollution, especially oil spills.

CURRENT LEGAL COVERAGE

Although marine ecosystems in India cover nearly as much area as terrestrial ecosystem, these are poorly represented among protected areas. In India, there are few marine parks and sanctuaries. Some of the prominent ones are Wandoor National Park and Lohabarak Sanctuary in the Andaman and Nicobar islands, Marine national Park in Gujarat, and the Marine National Park (Gulf of Mannar) in Tamil Nadu. Apart from these, the remaining marine areas in the country have no specific legal protection.

Summary of Legal Coverage for Oceans : *General Parameters*

Aspects	***IFA***	***WLPA***	***EPA***	***CRZ***	***remarks***
Safeguarding social justice and equity	*No*	*No*	*No*	*No*	*No legal regulation outside PAs*
Safeguarding rights of future generations	*Yes*	*Yes*	*Yes*	*NO*	*In so far as these acts try and regulate use and prevent destruction, they do this. but IFA and WLPA do this only within PAs*
Safeguarding animal rights	*No*	*Yes*	*No*	*No*	*Also relevant is the Prevention of Cruelty to Animals Act of ??*
Determining acceptable levels of disturbance	*No*	*No*	*No*	*No*	*There is no legal requirement to determine this*
Ensuring disturbance levels are within acceptable limits	*Yes*	*Yes*	*Yes*	*No*	*The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only within PAs.*
Determining minimum viable populations	*No*	*No*	*No*	*No*	*There is no legal requirement to determine this*
Ensuring that minimum viable populations are maintained	*No*	*No*	*No*	*No*	*This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.*
Determining minimum viable size	*No*	*No*	*No*	*No*	*There is no legal requirement to determine this*

Ensuring that minimum viable size is maintained	No	No	No	No	
Determining required ecological conditions	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only within PAs.
Determining carrying capacity	No	No	Yes	No	There are provisions under this act to have an impact assessment done.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	No	IFA/WLPA only within PAs.
Ensuring participatory management	No	No	No	No	No legal regulation outside PAs
Ensuring transparency	No	No	No	No	
Decentralising control	No	No	No	No	No legal regulation outside PAs
Ensuring socio economic stake of local communities	No	No	No	No	No legal regulation outside PAs
Ensuring a sense of ownership in local communities	No	No	No	No	No legal regulation outside PAs

There are no other provisions of law covering any of the specific threats to oceans.

4.6 FRESH AND BRACKISH WATER ECOSYSTEMS

Some of the most critical and yet most threatened ecosystems in India are the fresh and brackish water aquatic ecosystems. These can be divided into two broad categories: fresh water bodies which include wetlands, rivers and streams, and brackish water bodies which include estuaries and backwaters.

4.6.1 Wetlands and Rivers

Estimate of wetlands in India, excluding brackishwater, backwater and esturine bodies, is as follows:

WETLANDS

Wetland type	Area (in ha.)
Freshwater	1,600,000
Area of capture fisheries	2,900,000
Human-made impoundments	3,000,000
Area under paddy cultivation	40,990,000
Total	**48,490,000**

[IIPA, 1994]

STATUS

No accepted figure for the loss or degradation of wetlands is available for India. This is mainly because monitoring of wetlands remains minimal. A very rough estimate is that one-third of Indian wetlands are already wiped out or severely degraded (Agarwal and Chak,1991). In the Asian Directory of Wetlands, Scott and Poole (1989) estimated that of the 88 Indian wetlands they had listed, as many as 45 were facing moderate to high threats to their existence. Of these, the following are among those short-listed for special concern:

1. Dal Lake, Kashmir
2. Wular Lake, Kashmir

3. Haigam Rakh, Kashmir
4. Mirkund Lake, Kashmir
5. Hokarsar, Kashmir
6. Harike Lake, Punjab
7. Dahar and Sauj jheels, Uttar Pradesh
8. Southern Gulf of Kutch, Gujarat
9. Gulf of Khambhat, Gujarat
10. Wetlands of eastern Uttar Pradesh
11. Chaurs of North Bihar and West Bengal
12. Khabartal, Bihar
13. Dipor Bheel, Assam
14. Logtak Lake, Manipur

Jheels in the vicinity of Haidergarh in Barabanki district of Uttar Pradesh, and the Salt Lake swamps near Calcutta are "considered to be already too degraded to merit any special conservation effort" (GOI, 1990).

THREATS

Wetlands, especially freshwater wetlands, have been severely abused in many parts of India. Some of the major threats are described below.

Siltation is extremely high in many water bodies in India, steadily increasing as catchments get degraded. Studies, on both natural lakes and artificial reservoirs, have shown a drastic reduction in capacity and a shrinkage in waterspread as a result of excessive silt inflow (Chatrath, 1992:2-6).

Freshwater wetlands all over India have been severely degraded by **pollution**. By the late 1970s, over 70% of the country's surface freshwater bodies were polluted in various degrees (CSE, 1982). With increased urban and industrial growth and a sharp rise in the use of agricultural chemicals since then, the situation today is probably worse. Entire

waterbodies are, as a result, simply dying - eutrophied to the point of turning into dry land, or rendered devoid of most of their living constituents.

Reclamation has been another major threat to wetlands. The Kerala backwaters and the Salt Lake swamps near Calcutta have shrunk to half their original spread in the last 30 years, due to urban reclamation and conversion to paddy cultivation (De Roy, 1990).

The introduction (deliberate or accidental), of exotic species into water bodies has affected them, either through changes in constituent elements, or physical damage. The South American plant, water hyacinth *Eichhornia crassipes*, introduced for its decorative flowers, has spread unchecked in a vast number of lakes and rivers in India, greatly helped by the creation of artificial reservoirs all over the country (Ramakrishnan, 1991). Many wetlands have simply been choked to death; the decrease in dissolved oxygen has been detrimental to fish populations and phytoplankton production (Baruah and Singh, 1989: 63).

CURRENT LEGAL COVERAGE

The discussion on legal coverage is divided into two parts. The first part is a discussion of those general measures which help in the conservation of wetlands but are not exclusively aimed at wetland conservation and, in actual fact, conserve much else besides. These include measures such as pollution control, soil conservation or the regulation of hunting.

The second part of the discussion deals with those measures which are exclusively aimed at the conservation of wetlands, like the regulation of dredging, of fishing and trawling, or on the withdrawl of water from wetlands. This part also includes a discussion of those measures which are aimed at the conservation of a specific wetland, even though the measures themselves may be general.

Many of the wetlands are within national parks, sanctuaries, reserved/protected forests, or other legally protected areas. Such wetlands get the benefit of the protection that the law provides for such areas. The measures being described below, therefore, are relevant for only those wetlands that are not a part of any protected area.

General Measures

a. **Disturbance from human settlements:**

There is no law regulating human settlements across the country. However, specific areas have regulations, like municipal areas or certain designated ecologically fragile areas (like the Doon valley or the Aravallis in Haryana and Rajasthan, and the Dahanu Taluka and Murud Janjira region of Mahrashtra).

There is no law or regulation regulating human habitation around wetlands, except for the Coastal Regulation Zone (CRZ) notification, notified under the Environment (Protection) Act. Within the CRZ various activities, including construction, are regulated.

Apart from this, many of the wetlands, especially most of the wetlands identified as ecologically vulnerable, are on or surrounded by public lands where adequate legal authority exists to regulate various types of activities, including habitation, and to prevent encroachments. Unfortunately, the relevant laws and provisions do not appear to be adequately used, as is witnessed by the fact that a large proportion of the surveyed wetlands record disturbance due to human habitation and encroachments.

The Ministry of Environment and Forests, in its "National Conservation Strategy" states that:

> "The steps to be taken for sustainable use of land and water should include the following:

Protection of land near water bodies and prevention of construction thereof' [MOEF 1992: 5.2.1.4]

However, apart from the coastal regulation zone earlier mentioned, no other action seems to have been taken towards this end.

b. **Watershed degradation and soil erosion:**

Again, there are no universal laws protecting watersheds or soils across the country. The earlier mentioned "National conservation Strategy" identifies "enactment of laws for appropriate land uses to protect soil from erosion.." as a step that needs to be taken. However, there are various schemes of the Central Government and state governments aimed at watershed and soil conservation. Though these schemes are not explicitly aimed at conservation of wetlands, in so far as they are successful, their benefits will accrue also to the wetlands.

c. **Pollution:**

Wetlands are affected by both water and air pollution. Five types of water pollutants contaminate wetlands,

- Silt - due to soil erosion and degraded catchments

- Domestic Waste - from cities, towns and other human settlements

- Industrial effluents- from industries, thermal power stations and other polluting enterprises.

-Agricultural Pollutants - especially run-offs of chemical pesticides and fertilizers.

- Oil from spills and leaks.

As already discussed, there is almost no legal regulation relating to siltation. However, there are various schemes for protecting watersheds and for soil conservation.

There are fairly comprehensive laws and procedures regulating domestic and industrial effluents. However,

despite these laws and the attendant regulatory mechanisms, a very large proportion of the wetlands surveyed reported threat from pollution. This is partly due to the fact that, laws notwithstanding, the enforcement of standards has been poor in relation to many of the industries and municipalities. Also, laws relating to solid waste pollution, which often results in toxic run-offs into wetlands, and those relating to non-point pollution (like much of agricultural pollution) are still weak.

Air Pollution also affects wetlands, especially by raising the acidity level and by increasing the load of particulate matters. In extreme cases, high levels of air pollution can block the sunlight and can interfere with the process of oxidisation.

As in the case of water pollution, stringent laws exist for regulating air pollution. However, the levels of air pollution, especially in some of our cities and in industrial belts, continue to be much above the permissible standards.

d. **Grazing:**

Another very common threat was overgrazing by livestock. As many of the wetlands are inundated only during a part of the year, in the remaining months they often get a lush vegetation which attracts livestock. Perennial wetlands often have rich vegetation around them, especially along the banks during the dry seasons. This also attracts livestock.

Except in national parks, grazing is allowed in all other categories of protected areas. In sanctuaries and in reserved forests there is a legal ability to regulate and even prohibit grazing, keeping in mind the requirements of ecological conservation. However, outside protected areas there is no law which can effectively control or prohibit grazing (see section on grasslands for greater details).

There are various schemes of the government of India and of the state governments which aim at replacing conventional scrub cattle by high yielding varieties of cattle

which, are stall fed. There are also various schemes for enhancing availability of fodder by developing fodder plantations (for details see section on grasslands).

e. **Hunting:**

Though over the years hunting appears to have lost its popularity, a significant proportion of the wetlands surveyed indicated hunting to be a threat. Hunting of most species of animals is either prohibited or regulated under the Wild Life (Protection) Act, 1972. Unfortunately, shooting of certain species of water fowl is permitted, in season, on the basis of a licence. However, ability to ensure that shooting is restricted to the licensed amount or period is difficult as the regulatory machinery, especially outside protected areas, is almost non-existent and regulation or prevention difficult. Besides, even licensed shooting can often negatively affect the ecological balance of a wetland especially by searing away birds and animals critical to its ecological balance.

f. **Tourism**

Over 10% of the wetlands surveyed reported threat from activities related to tourism and recreation. Though coastal regions are protected to some extent from infrastructure related to tourism, like hotels, by the earlier mentioned CRZ notification, there is no legal regulation in other areas. In fact, in most cases, there is a move towards developing tourism and tourist infrastructure as this is seen as a revenue earning activity.

SPECIFIC MEASURES

It is important to note here, that most of the threats listed below are regulated or prohibited in the Coastal Regulation zone.

a. **Drainage for agricultural, urban or industrial development.**

Wetlands, especially marshes and shallow lakes, have often been seen as potential agricultural land. Many of these

areas, when drained, make very rich agricultural lands due to high levels of soil moisture and rich silt deposits. This has encouraged the conversion of large tracts of wetlands into agricultural land.

Contemporary land hunger for urban and industrial development was also led to "land reclamation" schemes where coastal areas, marshes, creeks, lakes and even portions of river-beds have been colonised.

Unfortunately, despite the ecological damage that such activities do, there is no legal control over such activities, especially when they are being executed, as they often are, by the government or with its support.

b. **Dredging:**

Wetlands, including rivers and waterways, are often dredged either to deepen them and thereby facilitate the storage or movement of water, the passage of ships and boats, or for collecting earth-fill material.

Except where a wetland has been choked up with silt far beyond what is natural and in excess of its carrying capacity, dredging can be very damaging to the of the wetland. Despite this, there is no legal ability to regulate or prohibit dredging of wetlands, except for those lying between the low and high tide lines which are covered by the CRZ notification, especially if this dredging is being carried out by, or with the approval of, the government.

c. **Fishing:**

Over 25% of the wetlands surveyed reported threats from activities connected with fishing. In coastal areas there is the additional threat by trawling.

Generally speaking, there is little legal ability to control fishing in wetlands. For trawling, certain laws have been framed keeping in mind the spawning seasons of fish and the interests of the small fisher-folk. However, reports suggest that these laws are not being vigorously applied.

d. Extraction of Salt

Many saltwater wetlands face degradation from **excessive salt extraction**. The Sambhar Lake in Rajasthan, declared a Ramsar Site for its impressive biotic diversity including amongst the country's largest congregations of flamingos, is also one of India's major salt sources. Salt pans now cover almost 8000 ha. of the lake, severely affecting its ecosystem (WWF-I, 1992).

e. Exploitation of Corals and Shells

This is a major threat primarily to marine areas and is discussed in the section on coral reefs. However, it is banned in the areas covered by the CRZ notification.

RIVERS

India has been blessed with an extensive network of rivers and streams, many of which are snow fed and have their origins in the high Himalayas. These rivers not only provide life and sustenance to the whole country but are also habitat to a large number of plants, fish and animal species. The rivers of India have a high capacity to regulate their own ecological balance by cleansing themselves, assimilating waste and oxygenating their waters.

Status

Unfortunately, in the last few decades the riverine ecosystems of the country are facing significant threats. The major threats include:

- Industrial, urban and agricultural pollution.
- Degradation of catchments leading to enhances silt runoffs and erratic water runoffs.
- Over extraction of water
- Impoundement and diversion leading to disturbance of the ecological balance
- Introduction of exotic species

- Extraction of sand, stone and mud.
- Dredging
- Pressures from river transport systems.
- Encroachments for agriculture and habitation on river beds and banks.

Current Legal Coverage

The Government of India launched, in 1985, an ambitious Ganga Action Plan with the objective of cleaning the Ganga river. This plan was later transformed into the National River Action Plan with many more rivers being covered. Though it is perhaps too early to assess the National River Action Plan, unfortunately the Ganga Action Plan seems to be falling much below expectations. Various assessments suggest that it has failed to raise resources from state and local governments, to make polluters to pay for cleaning up pollution, to involve people in the conservation efforts, and to come up with a sustainable strategy for progressively improving the water standards in rivers.

The Ministry of Water Resources, Government of India, has a policy statement on water which, however, while listing the various priority uses of rivers, unfortunately does not mention the maintenance of the rivers ecological balance as a priority objective. Consequently, rivers in many parts of the country are being diverted of water to such an extent that their internal ecological balance is being disrupted and in some cases destroyed.

Summary of Legal Coverage for Wetlands and Rivers: General Measures

Aspects	IFA	WLPA	EPA	Water Pollution Act	remarks
Safeguarding social justice and equity	No	No	No	No	No regulation on use outside PAs.
Safeguarding rights of future generations	Yes	Yes	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this. IFA/WLPA only in PAs.
Safeguarding animal rights	No	Yes	No	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Yes	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only in PAs.
Determining minimum viable populations	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable	No	No	No	No	There is no legal requirement to determine

size					this
Ensuring that minimum viable size is maintained	No	No	No	No	
Determining required ecological conditions	No	No	No	Partly	Pollution standards are defined.
Ensuring that the required ecological conditions are maintained	Yes	Yes	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only in PAs.
Determining carrying capacity	Yes	Parly	Yes	No	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries. IFA/WLPA only in PAs.
Ensuring carrying capacity is not exceeded	Yes	Yes	Yes	Yes	IFA/WLPA only in PAs.
Ensuring participatory management	No	No	No	No	No regulation outside PAs
Ensuring transparency	No	No	No	No	
Decentralising control	No	No	No	No	No regulation outside PAs
Ensuring socio economic stake of local communities	No	No	No	No	No regulation outside PAs
Ensuring a sense of ownership in local communities	No	No	No	No	No regulation outside PAs

Aspects Specific to Wetlands and Rivers

General threats from	Legal Control	Other regulations
1. Human Settlements	P[1]	P[2]
2. Development activities	P[3]	P[3]
3. Watershed degradation & soil erosion	N	N
4. Pollution	Y	Y
5. Logging	Y	N
6. Grazing	N	N
7. Hunting	Y	N
8. Tourism	N	P

2. Power to control on government land/municipal land/ coastal regulation and designated ecologically fragile zones
2. Impact assessment required for certain categories of human settlements, like industrial townships. Controlled in coastal regulation zone
3. Environmental clearance mandatory for certain categories of public sector Projects. Legally controlled in coastal regulation zone

Y=Yes,N=No,P=Partial

Specific threats from	Legal control	Other regulations
1. Drainage	N	N
2. Dredging	N	P[1]
3. Diversion of water	N	N
4. Fishing	P[2]	P[3]

3. Environmental clearance required in relation to certain public sector projects like industry, power, or ports and harbours.
4. For trawlers
5. Fishing permits given in certain areas/seasons

4.6.2 BRACKISH WATER BODIES: ESTUARIES AND BACK WATERS

Given the huge coastline India has of over 7000 kms and the large number of rivers and streams flowing into the sea, India also boasts of a very rich and varied estuarine ecosystem.

STATUS

Though the national status of estuaries and back waters is not known, detailed information exists regarding the estuarine ecosystem and the back waters of certain parts of the country, especially the western coast. This suggests that there is rapid deterioration of these ecosystems affecting not only biodiversity values but also the fisheries potential of the coastal regions.

THREATS

Estuaries and backwaters have been significantly affected by urban, agricultural and industrial pollution, by dredging, by landfills, by extraction of water for thermal power stations and other industrial uses, and sometimes by over fishing. Use of these areas as waterways and the consequent heavy traffic of barges, boats and ships, have also taken their toll especially through pollution, physical disturbance, dredging and flushing.

CURRENT LEGAL COVERAGE

The coastal regulation zone notification of the Ministry of Environment and Forests gives some protection to estuaries and back waters (see section on Coastal zones). However, this notification only regulates physical construction and use adjacent to these estuaries and backwaters. Much of the damage is done by pollutants coming from further away and flowing into these waters. The passage of boats and ships and the consequent pollution and disturbance is also not subject to regulation under this notification.

A very limited proportion of these ecosystems has been covered by wildlife protected areas in India (See section on

Marine ecosystems). Consequently, much more needs to be done to protect these areas, especially considering their acute fragility and their huge value both as "biodiversity hotspots" and as seed banks for our fisheries.

MOUNTAINS

Apart from Himalayas, which can be further sub divided into the eastern and the western Himalayas, some of the most significant mountains and hill ranges in India include the Aravallis, the Western Ghats and the Eastern Ghats.

CURRENT STATUS

Despite the fact that each of these mountain and hill ranges have exceptional environmental value, especially the Western Ghats and the Eastern Himalayas, which are considered "biodiversity hotspots", these areas are under significant pressure.

THREATS

The most significant threat to these mountain and hill ranges is from **deforestation** and the destruction of other vegetative cover due to commercial, infrastructural and other human pressures. Historically, the very valuable forests, especially of the Himalayas, have been extensively exploited for timber. Given the fragility of the ecosystem, regeneration is slow and not always possible due to clear felling and significant soil erosion.

Another major threat to the mountain and hill ecosystems is from extensive **quarrying and mining**, especially when these are done unscientifically.

In addition, the **building of an extensive road network** in the hilly regions has taken its toll, especially because very often the roads have been inappropriately aligned, and constructed in a manner careless to the environment. The rapid expansion of **human populations**, especially the huge influx of seasonal **tourists**, and the **infrastructure** and **pollution** that goes with them, have also taken a significant

toll of the hill areas having the misfortune of being in the vicinity of a popular hill station.

The construction of **river valley projects**, especially dams, and the pursuance of inappropriate **agricultural and animal husbandry practices** has also threatened the ecosystem. **Plantations**, usually in monoculture formations, of exotic species of commercial value, and the **over exploitation pine trees for resin**, have been other significant factors in the degradation of mountain and hill ecosystems.

CURRENT LEGAL COVERAGE

Apart from banning green felling in some parts of the Himalayas there seems little focused attention at protecting these fragile ecosystems.

Integrated Action Oriented Research Demonstration and Projects for Himalayan Regions

G.B. Pant Institute of Himalayan Environment and Development was established at the end of the Seventh Five Year Plan. The Institute has been identified as the focal agency for studying development strategies and technologies for achieving ecologically sound development of the Himalyan region. The present efforts revolve around six core programmes, viz. land and water resource management, sustainable development of rural ecosystems, conservation of biological diversity, ecological economics, environmental impact analysis, environmental physiology & bio-technology, institutional networking and human investment. However, due to a lack of laws specific to the protection of the mountain and hill ranges, many of the findings of this and other such efforts remain only on paper without any capability of acting upon them.

In recent times, at least two reports have been produced on the Himalayas, one by the Planning Commission and the other by the G.B. Pant Institute of Ecology (Planning Commission 1993).

Though in the Planning Commission and through the North Eastern Council, special focus has been sought to be given to the planning and development process of the Western Ghats and the Eastern Himalayas respectively, ecological concerns, though supposedly an important part of such a special focus, are rarely evident in the resultant schemes, programmes, and activities.

Fortunately, there are a significant number of national parks and sanctuaries in the mountain and hill ecosystem. Himachal Pradesh, itself, has 31 protected areas, most of which cover representative Western Himalayan ecosystems. Similarly, there are many PAs in the North Eastern states covering the Eastern Himalayas, and in U.P. and Jammu and Kashmir. There are also various protected areas in the Western Ghats.

Summary of Legal Measures for the Protection of Mountains : General Parameters

Aspects	**IFA**	**FCA**	**WLPA**	**EPA**	**remarks**
Safeguarding social justice and equity	No	No	No	No	June 1990 letter of the MoEF permits joint forest management in forest areas.
Safeguarding rights of future generations	Yes	Only in forests	Yes	Yes	In so far as these acts try and regulate use and prevent destruction, they do this. IFA/WLPA only applicable in PAs.
Safeguarding animal rights	No	No	Yes	No	Also relevant is the Prevention of Cruelty to Animals Act of ??
Determining acceptable levels of disturbance	No	No	No	No	There is no legal requirement to determine this
Ensuring disturbance levels are within acceptable limits	Yes	Only in forests	Yes	Yes	The fact that the acceptable limits of disturbance have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only applicable in PAs.
Determining minimum viable populations	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable populations are maintained	No	No	No	No	This is not legally mandatory. In any case, in the absence of the minimum viable populations being determined, it is irrelevant.
Determining minimum viable size	No	No	No	No	There is no legal requirement to determine this
Ensuring that minimum viable size is maintained	No	No	No	No	The CRZ specifies the quantum of area to be kept free of disturbance, eg. 500 m above high tide line.

Determining required ecological conditions	No	No	No	No	There is no legal requirement to determine this
Ensuring that the required ecological conditions are maintained	Yes	Only in forests	Yes	Yes	The fact that the required ecological conditions have not been determined makes the enforcement of this aspect arbitrary. IFA/WLPA only applicable in PAs.
Determining carrying capacity	Yes	Only in forests	Parly	Yes	There are provisions under these acts to have an impact assessment done. In WLPA only for sanctuaries.
Ensuring carrying capacity is not exceeded	Yes	Only in forests	Yes	Yes	IFA/WLPA only applicable in PAs.
Ensuring participatory management	No	No	No	No	No regulation outside PAs.
Ensuring transparency	No	No	No	No	
Decentralising control	No	No	No	No	No regulation outside PAs.
Ensuring socio economic stake of local communities	No	No	No	No	No regulation outside PAs.
Ensuring a sense of ownership in local communities	No	No	No	No	No regulation outside PAs.

Specific to Mountain management

Aspects	IFA	FCA	WLPA	EPA	Remarks
Impact of commercial activities	Yes	No	Yes	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it. IFA only in forest areas.
Impact of development activities	Yes	No	Yes	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it. IFA only in forest areas.
Soil erosion	No	No	No	No	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it
Pressures from local communities	Yes	No	Yes	Yes	Only the WLPA prohibits it, and that also only in national parks and sanctuaries, The others only regulate it. IFA only in forest areas.
Grazing	Yes	No	Yes	No	Only the WLPA prohibits it, and that also only in national parks, The others only regulate it, as does the WLPA in sanctuaries. . IFA only in forest areas.
Prevention of invasion from exotics/ weeds	Yes	No	Yes	No	IFA /WLPA onli in PAs.
Poaching	Yes	No	Yes	No	IFA /WLPA onli in PAs.
Impact of chemicals	No	No	No	Yes	Also relevant are the laws pwertaining to air and water pollution and hazards
Droughts and floods	No	No	No	No	

4.7 ISLANDS

India has two major group of islands, the Andaman & Nicobar islands in the Bay of Bengal and the Lakshadweep islands in the Arabian sea. The Andaman & Nicobar group comprises of 349 islands of which only 34 are inhabited. The Lakshadweep group comprises of 36 islands, of which 10 are inhabited and one is used partially as a tourist resort.

CURRENT STATUS:

The Lakshadweep islands are currently under great pressure, with forest cover disappearing, beaches and coral reefs are eroding and degrading and both land and water pollution is on the increase.

Relatively speaking, much of the Andaman & Nicobar Islands are still in good condition, primarily because of their inexcessibility and the lack of human population in most of the islands. However, the inhabited portion of these islands and also others relatively more accessible islands have significant pressures. Deforestation, destruction of coral reefs, pollution of the waters, soil erosion, and the destruction of mangroves are all pervalent.

THREATS:

These islands are comprised primarily of forests, coastal ecosystems, mangroves, and oceans. The threats and recommendations regarding these can be found in the sections specifically dealing with these types of ecosystems. However, general threats to these island ecosystems are primarily from:

- Excessive and inappropriate tourism. This is especially true of the Lakshadweep islands, where there is a proposal to develop tourism and other activities even in the uninhabited islands. It is also a long standing threat to the Andaman and Nicobar Islands, where there is great commercial interest, supported sometimes by the government, to expand tourism activities.

- *Increase in human population. Various scientific studies suggest that the human populations, both in Lakshadweep and in the Andaman & Nicobar islands, have already exceeded the carrying capacity of the islands. Despite this, their continues to be, almost unchecked, immigration of people from the mainland to the Andaman & Nicobar islands. These immigrants are known to colonise forest areas, not only destroying the forests but also causing severe soil erosion.*
- *Pollution. Given the fragility ecosystems of these islands, their ability to assimilate solid and liquid pollutants is limited. Unfortunately, due to the growing human population, increase in tourist traffic and increase in the per capita waste produce, the island ecosystems are facing a significant threat.*
- *Inappropriate land use. In the Andaman & Nicobar islands natural forests have been cleared in the past to develop agriculture and for plantations, including palm oil plantations. Unfortunately, such activities are not conducive to the agro climatic profile of the islands. Agricultural activities are also not sustainable in most part of the islands, as also are not plantations like palm oil.*
- *Fresh water shortages. Despite heavy rainfall, there has been little effort at water conservation and harvesting in these islands. This has resulted in acute water shortages during the dry spells.*
- *Inappropriate building practices. Buildings constructed in Andaman and Nicobar islands were earlier mostly made of wood, extracted from the local forests. Given the rising value of wood current construction is of brick and concrete. Unfortunately, corals and sand are being excavated and used for construction purposes, causing serious ecologicaldamage.*

- Inappropriate industrialisation. There have been a spate of forest based industries set up in the Andaman & Nicobar islands. These industries have put heavy pressure on the forests of the islands.
- Excessive forest working. Despite a decision taken by the Island Development Authority (IDA), Chaired by the then Prime Minister, in the mid 1980s, to phase out forestry operation in the Andaman and Nicobar islands, after an initial reduction the current levels of extraction are even higher than before.
- Inadequate exploitation of sea based resources. Pressure on the land in the Andaman and Nicobar Islands also comes from the local inhabitants who do not have many ways of earning a livelihood. This is despite the fact that the Andaman and Nicobar Islands have, around them, oceans very rich in marine resources.
- In Andamans, there is a proposal to import and breed exotic fish, thereby significantly endangering the ecosystem.

CURRENT LEGAL COVERAGE

The Government of India set up, in 1985, an Island Development Authority (IDA), Chaired by the Prime Minister, to oversee the development activities in these islands and to ensure that they were sustainable and within the ecological carrying capacity. Initially, a large number of studies were sponsored by the IDA and almost every important aspect relating to the social and economic development, and the ecosystems, of these islands were studied. However, in the last some years the IDA seems much less effective and, in any case, the recommendations made as a part of various studies have by and large not been acted upon.

In the late 1980s, the protected areas network was significantly enlarged and the Andaman and Nicobar Islands currently have over 100 national parks and

sanctuaries. However, despite this the resources available to manage these national parks and sanctuaries are woefully inadequate, resulting in many of these areas being protected areas only in name.

Rules and regulations have been formulated to prevent extraction of corals and extraction of shells in the islands. Much of the island's area are also covered under the coastal regulation zone. However, all reports indicate that there are inadequate facilities and institutional resources to enforce these rules and regulations and sometimes, perhaps, inadequate will on the part of the local administration.

No special legal cover is accorded to island ecosystems in India. The laws relating to national parks and sanctuaries, forests, and coastal regions are the most pertinent for Island ecosystems. Also, laws pertaining to the control and prevention of pollution have relevance.

5. SPECIES

The only law providing some protection to wild species of fauna and flora is the Wild Life (Protection) Act of 1972, as amended in 1991. However, even this provides legal coverage to only some of the parameters related to the conservation of fauna and flora, and none to the conservation of species of micro-organisms. A summary statement of what legal coverage is required and what is currently available is given below.

Parameter	Fauna	Flora	Micro-organisms
Identification	N	N	N
Protection in situ	Y	Y	N
Protection ex situ	P	N	N
Access/extraction	P	P	N
Use	Y	N	N
Trade	Y	Y	N
Breeding/cultivation/ multiplication	Y	P	N
Introduction/ augmentation and reintroduction in the wild	P	P	N
Release	N	N	N
Movement	Y	P	N
Intellectual property rights	N	N	N

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The details of the relevant acts pertaining to the eleven aspects listed above, are given below.

a) 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, universities and many independent organisations and individuals are involved in such identification.

b) In Situ Protection

Several acts are relevant to the protection of species in situ, either through stipulating restrictions or prohibitions in 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 1972 and its 191 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, the Wild Life (Protection Act of 1972, the Forest (Conservation) Act of 1980, the Territorial Waters, Continental Shelf, Exclusive Economic Zone, and Other Maritimize Zones Act of 1976, and the Environment (Protection) Act of 1986. In situ protection is also indirectly provided for in the Fisheries Act of 1894, the Water (Prevention and Control of Pollution) Act of 1974, the Air (Prevention and Control of Pollution) Act, of 1981, and the Prevention of Damage to Public Property Act of 1984, in so far as these regulate damage to, or destruction of, natural habitats, though not explicitly with the purpose of protection biodiversity.

c) Ex Situ Protection

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

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

d) Access and Extraction

With the exception of the legal rights vested in individuals, communities, and governments, by virtue of their ownership of property, there seem to be few central acts governing access to, and modes of extraction of, wild fauna and flora. The few acts which regulate extraction, and methods of extraction, of wild flora and fauna inside 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.

e) Use

There are not many acts which regulate the way in which biodiversity components are to be used, though there are 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 zoos). The Prevention of Cruelty to Animals Act of 1960 extends protection against misuse of animals in captivity or under human use, including those being used for performances or for experimentation.

f) Trade

Within India better 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 Export (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 banned the export of all birds for a period of three years. Indications are that this ban will be extended beyond this period. On the other hand, a 1993 notification has taken some other biodiversity components off the list of items for export, including cultivated orchids, parts and derivatives of wild plants.

g) Breeding, Cultivation and 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 mentioned above, there seem to be no central law which governs botanical gardens in general, such as the Wild Life (Protection) Act of 1972 that governs zoological parks.

h) Introduction, Augmentation and Reintroduction

There appears to be no central act governing the introduction, augmentation or reintroduction 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

i) Release

There appears to be no central act covering this aspect.

j) Movement

Control over the mode of transportation of specified biodiversity components is provided for in all the acts relevant to trade. In addition, the Prevention of Cruelty to Animals Act of 1960, and its subsequent rules, regulate conditions of transportation of animals.

k) IPRs

Protection of knowledge, innovations and other forms of intellectual property relating to biodiversity is not covered under any central law. The patents Act of 1970 leaves out of its purview life forms, "on the ground of law, morality, and health".

6. LEGAL COVERAGE FOR THE CONVENTION ON BIODIVERSITY

Perhaps the most important Global instrument for the conservation of biodiversity world wide is the Convention on Biological Diversity. India is a party to this convention but, in order to fully conform to its provisions, it needs to ensure that the various actions required under the convention have, as far as relevant, the force of law. Given below is an analysis of how far this has been achieved.

ACTION POINTS EMANATING FROM THE BIODIVERSITY CONVENTION

No.	Action	Legal Instruments	Remarks
B1	To conserve biological diversity (1)	Some	Adequate for protected areas (PAs). Some for designated forests, wild fauna, wild flora and marine areas
B2	To ensure sustainable use of components of biological diversity (1)	Some	Adequate for PAs and forests
B3	To ensure fair and equitable sharing of the benefits of genetic resources (1)	None	
B4	Ensuring appropriate access to genetic resources (1)	None	
B5	Ensuring appropriate transfer to relevant technologies (1)	None	
B6	Ensuring appropriate funding (1)	Not applicable (NA)	
B7	To exploit one's own resources according to environmental	None	

No.	Action	Legal Instruments	Remarks
	policies without damage to other states or international commons. (3)		
B8	To co-operate with other parties for conservation and sustainable use of biological diversity in international commons, and in other matters of mutual interest (5)	NA	
B9	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)	NA	
B10	To integrate the conservation and sustainable use of biodiversity into sectoral/cross sectoral plans, programmes and policies (6b)	None	
B11	To identify components of biodiversity important for their conservation and sustainable use with reference to annexure I (7a)	None	
B12	To monitor identified biodiversity components, especially those requiring urgent conservation measures and with potential for sustainable use (7b)	None	
B13	To identify activities that have adverse impacts on conservation and sustainable use of the biodiversity and to monitor their effects (7c)	Some	Adequate for PAs and Forests

No.	Action	Legal Instruments	Remarks
B14	To maintain and organize information derived from the above listed monitoring activities (7d)	NA	
B15	To establish a system of protected areas or special areas to conserve biological diversity (8a)	Some	Adequate for wild biodiversity
B16	To develop guidelines for selection, establishment and management of protected areas/special areas (3b)	NA	
B17	To regulate or manage biological resources important for conservation of biological diversity, within or outside protected areas (8c)	Some	Adequate within PAs. Some for designated forests and marine areas
B18	To promote protection of ecosystems and natural habitats and the maintenance of viable populations of species in natural surroundings (8d)	Some	Adequate in PAs. Some for marine areas, designated forests.
B19	To promote sustainable development in areas surrounding protected areas (8e)	None	
B20	To promote rehabilitation of degraded ecosystems and recovery of threatened species (8f)	Some	Adequate in PAs and forests
B21	To regulate risks associated with use and release of living modified organisms that may have adverse environmental or human impacts (8g)	None	
B22	To prevent introduction of (and control or eradicate) alien species threatening ecosystems	Some	Mostly for insects and pests.

No:	Action	Legal Instruments	Remarks
	(8h)		
B23	To strike a balance between present uses of biological diversity and sustainable use and conservation of its components (8I)	Some	Ability to control in PAs
B24	To respect and preserve knowledge, innovation and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity (8j)	None	
B25	To promote their wider application (8j)	NA	
B26	To encourage the equitable sharing of benefits arising from this (8J)	NA	
B27	To develop and maintain legislations/regulations for protection of threatened species and populations (8k)	NA	
B28	To regulate activities and processes having significant adverse effects on biodiversity (as identified in article 7) (8l)	None	
B29	To get (from Global Community) financial and other support for in-situ conservation (8m)	NA	
B30	To adopt measures for ex-situ conservation of components of diversity, particularly in country of origin 9(a)	Some	Adequate for wild fauna, some for wild flora, none for domesticated species.
B31	To establish and maintain facilities for ex-situ conservation of and research on plants,	NA	

No.	Action	Legal Instruments	Remarks
	animals and micro-organisms (9b)		
B32	To adopt measures for recovery and rehabilitation of threatened species and for reintroduction into natural habitats (9c)	Some	Adequate for wild fauna, some for wild flora
B33	To regulate and manage collection of biological resources from natural habitats for ex-situ conservation without damage to in situ populations and ecosystems (9d)	Some	Adequate in PAs
B34	To get (from the Global Community) financial and other support for ex-situ conservation (9e)	NA	
B35	To integrate conservation and sustainable use of biological resources in national decision making (10a) (See 6b)	None	
B36	To use biological resources so as to avoid impacts on diversity (10b)	Some	Adequate for species listed in the Wildlife (Protection) Act.
B37	To protect and encourage traditional and customary uses of biological resources which are sustainable (10c) (see 8j)	None	
B38	To support local populations in ranking remedial action in degraded areas with reduced biodiversity (10d)	None	
B39	To encourage cooperation between government and private sector for developing methods for sustainable use of the biological	NA	

No.	Action	Legal Instruments	Remarks
	resources (10e)		
B40	To adopt socio-economic incentives for conservation and sustainable use of the components of biodiversity (11)	NA	
B41	To establish and maintain programmes for scientific and technical education and training in identification, conservation and sustainable use of biodiversity and its components (12a)	NA	
B42	To get funds (from the Global Community) for such education and training (12a)	NA	
B43	To encourage research into conservation and sustainable use of biodiversity (12b)	NA	
B44	To promote, and cooperate in the use of, scientific advances for conservation and sustainable use of biological resources (12c)	NA	
B45	To promote an understanding of the importance of, and conservation measures for, biodiversity conservation through media and educational programmes. (13a)	NA	
B46	To develop educational and awareness programmes in biodiversity conservation, along with other states and international organisations (13b)	NA	
B47	To introduce procedures for environmental impact assessments of proposed projects that have an impact on	None	

No.	Action	Legal Instruments	Remarks
	biological diversity, and to allow public participation (14, 1a)		
B48	To ensure that impact on biodiversity of programmes and policies are taken into account (14, 1b) (see 6b)	None	
B49	To promote exchange of information and consultation on activities like to affect biodiversity of international commons or of other states, through international arrangements (14, 1c)	None	
B50	To notify concerned states in the event of imminent danger/damage to their biological diversity or to the diversity of international commons (14, 1d)	None	
B51	To initiate action to minimise such damage (14, 1d)	None	
B52	To promote national arrangements for emergency/disaster management (14, 1e)	Some	
B53	To encourage international cooperation in disaster management (14, 1e)	NA	
B54	To set up joint contingency plans with other states for disaster management (14, 1e)	NA	
B55	To retain sovereign rights over, and access to, genetic resources (15, 1)	Some	Ability to control access in PAs, some ex-situ facilities. Ability to control export.

No.	Action	Legal Instruments	Remarks
B56	To facilitate access to genetic resources for environmentally sound uses by other parties, as per the convention (15,2)	None	
B57	Regulate access to genetic resources (15, 5)	Some	some for wild flora and fauna. Adequate for PAs.
B58	To ensure that research, on genetic resources provided by other parties, is with their participation (15,6)	None	
B59	To ensure the fair and equitable sharing of the results of such research (15, 7)	None	
B60	To facilitate access to and transfer of biotechnologies relevant to conservation and sustainable use of biodiversity and the environment (16, 1)	None	
B61	To get (access to) technology on fair and most favourable terms (16,2)	NA	
B62	Safeguarding of intellectual property rights (16, 2)	None	
B63	To ensure access technology to suppliers of biological resources (16,3)	None	
B64	To see that the private sector facilitates access to, joint development and transfer of technology, especially to governmental institutions (16,4)	None	
B65	To ensure that intellectual property rights are supportive of and do not run counter to objectives of convention (16, 5)	NA	

No.	Action	Legal Instruments	Remarks
B66	To facilitate exchange of information, from public sources, relevant to conservation and sustainable use of biodiversity (17,1)	NA	
B67	To facilitate exchange especially of results of technical, scientific and socio-economic research, indigenous and traditional knowledge, and repatriation of information (17, 2)	None	
B68	To promote international technical and scientific cooperation in conservation and sustainable use of biodiversity (18,1)	NA	
B69	To promote technical and scientific cooperation through the development and implementation of national policies (18,2)	NA	
B70	To develop and strengthen national capabilities by means of human resources development and institution building. (18,2)	NA	
B71	To cooperate in the development and use of technologies including indigenous and traditional technologies especially through training and exchange of experts (18 ,4)	NA	
B72	To establish joint research programmes and ventures for technology development (18, 5) [Rep]	NA	
B73	To take legislative and administrative measures to ensure participation in	NA	

No.	Action	Legal Instruments	Remarks
	biotechnological research of suppliers of biological resources (19, 1) (see 16, 3)		
B74	To provide priority access, to the concerned parties, to results and benefits arising from biotechnologies based on genetic resources provided by those parties (19, 2)	None	
B75	To ensure safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effects on diversity (19, 3)	Some	Rules under the EPA regulating release of genetically altered materials
B76	To provide information on use and safety regulations in handling modified organisms, and on potential adverse impacts of organisms, to countries where they will be introduced (19, 4)	None	
B77	To provide, according to capability, financial support and incentives to achieve objectives of the convention. (20, 1)	NA	
B78	To get funds (from the global community) for implementing measures (20, 2)	NA	
B79	To avail of financial resources through bilateral, regional and multilateral channels (20, 3)	NA	
B80	Report on implementation of convention 926)	NA	

REFERENCES AND BIBLIOGRAPHY

Agarwal, A. and Chak, A. (eds.) (1991): Floods, Flood Plains and Environmental Myths. State of India's Environment: A Citizens' Report. Centre for Science and Environment, New Delhi.

Arora, R.K. (1983): 'Threatened Plants of India: Some Considerations on Native Genetic Resources'. In Jain and Rao 1983.

Arora, R.K. and Nayar, E.R. (1983): 'Distribution of Wild Relatives and Related Rare Species of Economic Plants in India'. In Jain and Rao 1983.

Ayensu, E. (1983): 'The World's Diminishing Plant Resources'. In Jain and Mehra 1983.

Baqri, Q.H. (1993): 'Status Report on Biodiversity of the Rann of Kutch'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Baqri, Q.H. and Kankane, P.L. (1993): 'Status Report on Biodiversity Conservation of the Indian Desert'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Bell, D.J. and Oliver, W.L.R. (1992): 'Northern Indian Tall Grasslands: Management and Species Conservation with Special Reference to Fire'. In other Singh and Singh 1992.

Bennet, S.S.R. and Gaur, R.C. (1983): 'A Few Highly Exploited Species Needing Special Attention of Conservationists'. In Jain and Rao 1983.

Berwick, N.L. (1990): 'Guidelines for the Analysis of Biophysical Impacts to Tropical Coastal Marine Resources'. In Daniel and Serrao (eds.) 1990.

BSI (1993): 'Medicinal Plant Resources: Biodiversity and Conservation'. Botanical Survey of India, Calcutta. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

CAZRI (1993): 'Nature and Extent of Biodiversity in Arid and Semi-arid Regions of India'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Chatrath, K.J.S. (1992): Wetlands of India. Ashish Publishing House, New Delhi.

Chauhan, A.S. (1993). 'Plant Diversity in North-east India and Its Conservation'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Chavan, S. (1985): 'Status of Mangrove Ecosystems in Gulf of Kutch'. Paper presented at the Symposium on Endangered Marine Animals and Marine Parks, Cochin, 12-16 January 1985.

Chengappa, R. (1993): 'Oil Spill: Leaky Controls'. India Today, New Delhi. 28 February.

CSE (1982): The State of India's Environment: First Citizens' Report. Centre for Science and Environment, N. Delhi.

CSIR (1990): Birds. The Wealth of India, Raw Materials Volume 2B (Revised Series) Supplement. Publications and Information Directorate, Council of Scientific and Industrial Research, New Delhi.

Daniel, J.C. and Serrao, J.S. (eds.) (1990): Conservation in Developing Countries: Problems and Prospects. Proceedings of the Centenary Seminar of the Bombay Natural History Society. Bombay Natural History Society and Oxford University Press.

Daniels, R.J. Ranjit, Joshi, N.V., and Gadgil, M. (1990): 'Changes in Bird Fauna of Uttara Kannada, India, in Relation to Changes in Land Use Over the Past Century'. Biological Conservation No. 52, Great Britain.

Daniels, R.J. Ranjit, Gadgil, Madhav, and Joshi, N.V. (1992): 'Impact of Human Extraction on Tropical Humid Forests of Western Ghats in Uttara Kannada, South India'. In Workshop on Biodiversity Conservation in the Western Ghats, 9-10 November, 1992, Bangalore: Scientific Contributions from Centre for Ecological Sciences. Centre for Ecological Sciences (IISc), Jawaharlal Nehru Centre for Advanced Scientific Research, WWF-India Data Centre for Natural Resources.

Das, P. and George, J. (1993): 'Biodiversity of Fishes'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

De Roy, R. (1990): 'Whither Wetlands'. WWF-I Quarterly No. 74-75, July-December 1990. World Wide Fund for Nature - India, Bombay.

Dhar, U. and Kachroo, P. (1983): 'Some Remarkable Features of Endemism in Kashmir Himalayas'. In Jain and Rao 1983.

Divyabhanu Sinh (1987): 'The Wild Ass'. The India Magazine, October 1987.

DOE n.d.: The Nilgiri Biosphere Reserve. Programme on Man and the Biosphere Project Document 1. Indian National Man and Biosphere Committee, Department of Environment, Government of India, New Delhi.

Dorairaj, K., Soundararajan, R., and Singh, N.T. (1987): Corals of Andamans and Nicobar Islands: A Status Report. Central Agricultural Research Institute, Port Blair.

Ehrlich, P.R. (1988): 'The Loss of Diversity: Causes and Consequences'. In Wilson 1988.

Fowler, C. and Mooney, P.R. (1990): Shattering. University of Arizona Press, Tucson.

FE 9.10.93. Financial Express

Franklin, I.R. (1980): 'Evolutionary Change in Small Populations'. In Soule and Wilcox (eds.) 1980.

FSI (1987): The State of Forest Report 1987. Forest Survey of India, Government of India, Dehra Dun.

FSI (1989): The State of Forest Report 1989. Forest Survey of India, Government of India, Dehra Dun.

Gadgil, M. and Guha, R. (1992): This Fissured Land. Oxford University Press, Delhi.

Garson, P. (1983): 'The Cheer Pheasant Catreus wallichii in Himachal Pradesh, Western Himalayas: An Update'. World Pheasant Association Journal.

GOI (1987): Mangroves: A Status Report. Government of India.

GOI (1990): Wetlands of India: A Directory. Government of India.

Goldsmith, E. and Hildyard, N. (1984): The Social and Environmental Effects of Large Dams. Wadebridge Ecological Centre.

Gopalan, U.K., Vengayil, D.T., Udayavarma, P., and Krishnankutty, M. (1983): 'The Shrinking Backwaters of Kerala'. J. Mar. Biol. Ass. India Vol. 25, No. 1&2.

Green, M.J.B. (1991): 'Conserving the "Jewel" of India', WWF-I Quarterly No. 69, Delhi. January-February 1991.

Guha, R. (1983): 'Forestry in British and post-British India: A Historical Analysis'. Economic and Political Weekly, Bombay. 29 October and 5-12 November.

IIPA 1994. Conservation of Wild Biodiversity in India : A Status Report, Indian Institute of Public Administration, New Delhi, February 1994.

IUCN/UNEP/WWF (1991): Caring for the Earth: A Strategy for Sustainable Living. World Conservation Union, United Nations Environment Programme, and World Wide Fund for Nature.

Jain, S.K. and Mehra, K.L. (ed.) (1983): Conservation of Tropical Plant Resources. Botanical Survey of India, Calcutta.

Jain, S.K. and Sastry, A.R.K. (1981): 'Techniques and Constraints in Survey and Conservation of Threatened Plants and Habitats in India'. In Synge 1981.

Jhingran, V.G. (1991): Fish and Fisheries in India. Hindustan Publishing Corporation, Delhi.

Kalpavriksh (1991): What's That Bird?. N. Delhi.

Kothari, A. (in press): Birds in India: Status and Conservation. Lustre Press, New Delhi.

Kothari, A and Shekhar Singh (1995): "Biodiversity and Indian National Law: A conceptual Framework', in Widening Perspectives on Biodiversity, Ed, Jeff McNeeley, IUCN, Gland, Switzerland

Kothari, A., Pande, P., Singh, S., and Variava, D. (1989): Management of National Parks and Sanctuaries in India: A Status Report. Indian Institute of Public Administration, New Delhi.

Kurup, B.M. and Samuel, C.T. (1987): 'Ecology and Fish Distribution Pattern of a Tropical Estuary'. Proceedings of the National Seminar on Estuarine Management, Trivandrum.

Lahan, P. (1992): 'Forest Ecosystems of North-east India and Their Endangered Fauna'. In Singh and Singh 1992.

Lal, R., Kothari, A., Singh, S., and Pande, P. (in press): Directory of National Parks and Sanctuaries in Karnataka: Management Status and Profiles. Indian Institute of Public Administration, New Delhi.

Lande, R. and Barraclough, G.F. (1987): 'Effective Population Size, Genetic Variation and Their Use in Population Management'. In Soule (ed.) 1987.

Mackinnon, K. and Mackinnon, J. (1986): 'Review of the Protected Areas System in the Indo-Malayan Realm'. IUCN, Gland.

Meher-Homji, V.M. (1992): 'Vegetation and Hydrological Cycle: Possible LInks to Climate Change'. In Singh and Singh 1992.

Meher-Homji, V.M. (1993): 'Forest Types of Peninsular India and Their State of Conservation'. In press.

Mehra, K.L. and Arora, R.K. (1982): Plant Genetic Resources in India: Their Diversity and Conservation. NBPGR Science Monograph No. 4. Indian Council of Agricultural Research, New Delhi.

MOEF 1987. Ministry of Environment and Forests, Government of India, Mangroves in India: A Status Report, Delhi.

MOEF 1989. Ministry of Environment and Forests, Government of India, Wetlands, Mangroves and Biosphere Reserves, Delhi

MOEF 1989a. Ministry of Environment and Forests, Government of India, Conservation of Wetlands in India, New Delhi.

MOEF 1990. Ministry of Environment and Forests, Government of India,Wetlands of India - A Directory, New Delhi.

MOEF 1990a. Ministry of Environment and Forests, Government of India, Conservation of Mangroves in India, Delhi

MOEF 1992. Ministry of Environment and Forests, Government of India, National Conservation Strategy and Policy Statement on Environment and Development.

MOEF 1994. Typed note given by the Ministry of Environment and Forests, Government of ndia, regarding the current status of wetlands in India.

MOEF 1994a. Typed note given by the Ministry of Environment and Forests, Government of ndia, regarding the current status of mangroves in India.

MOEF 1994b. Typed note given by the Ministry of Environment and Forests, Government of India, regarding the current status of coral reefs in India.

MOEF (1990): National Strategy for Conservation and Sustainable Development: Report of the Core Committee. Government of India. April.

Murti, S.K. (1993): 'Biodiversity of Indian Cold Desert: Status and Conservation'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Myers, N. (1993): 'Questions of Mass Extinction'. Biodiversity and Conservation. Vol. 2 No. 1. Chapman and Hall, London.

Nagulu, V., Anjaneyulu, M., and Rao, J.V. Ramana (1992): 'Conservation of Kolleru Wetland in Andhra Pradesh: Problems and Solutions'. In Singh and Singh 1992.

Nair, S.A., Devassy, V.P., Dwivedi, S.N., and Selvakumar, R.A. (1972). 'Preliminary Observations on Tar-like Material Observed in Some Beaches'. Current Science. Quoted in Qasim and Kureishy 1986.

Nair, S.C. (1984): Natural Resources Conservation and Development in Andaman and Nicobar Islands. Department of Environment, Government of India, N. Delhi.

Narayana, pers. comm. (1992): Correspondence with S.S. Narayana, Central Institute for Cotton Research.

Nayar, M.P. and Sastry, A.R.K. (1990): Red Data Book of Indian Plants Vol. 3. Botanical Survey of India, Calcutta.

Osman, S.M. (1991): 'Wings of Destiny'. WWF-I Quarterly No. 76, January-March 1991.

Pande, P., Singh, S., and Kothari, A. (1991): Directory of National Parks and Sanctuaries in Andaman and Nicobar Islands. Indian Institute of Public Administration, N. Delhi.

Pandey, J., Agarwal, M. and Narayan, D. (1992): 'Plant Response to Ozone'. In Singh and Singh 1992.

Parida, M. (1992): 'Those Nutty Robber Crabs'. The Statesman, June 20, 1992.

Parkinson, C.E. (1923): A Forest Flora of Andaman Islands. Government Central Press, Shimla. Reprint (undated), Bhishen Singh Mahendra Pal Singh, Dehradun.

Pillai, C.S.G. (1985): 'Ecological Crisis in Coastal and Marine Habitat'. In Bandyopadhyay, J., Jayal, N.D., Schoettli, U. and Singh, C. (eds.) (1985): India's Environment: Crisis and Responses. Nataraj Publishers, Dehradun.

Pillai, C.S.G. (1993): 'The Coral Reefs of India: Their Biodiversity and Status'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Planning Commission (1989): 'Report of the Steering Group on Environment and Forests and Wastelands Development for the Formulation of the Eighth Five Year Plan'. Government of India, N. Delhi.

Prakash, I. (In press): 'Conservation of Biological Resources in the Risk Prone Indira Gandhi Nahar Command Area in the Thar Desert'.

Prasad, S. N. (1992): 'An Ecological Reconnaissance of Mangals in Krishna Estuary: A Plea for Conservation'. In Singh and Singh 1992.

Prasad, S. Narendra, Nair, P. Vijayakumaran, Sharatchandra, H.C., and Gadgil, M. (1992): 'A System of Biosphere Reserves for Western Ghats of Karnataka'. In Workshop on Biodiversity Conservation in the Western Ghats, 9-10 November, 1992, Bangalore: Scientific Contributions from Centre for Ecological Sciences. Centre for Ecological Sciences (IISc), Jawaharlal Nehru Centre for Advanced Scientific Research, WWF-India Data Centre for Natural Resources.

Planning Commission 1993, National Policy for Integrated Development in Tne Himalayas : Report of the Expert Group, Planning Commission, Governmant of India, New Delhi.

Qasim, S.Z. and Kureishy, T.W. (1986): 'Biological Diversity in the Seas Around India: Present Status and Major Threats'. Proceedings of the Indian Academy of Sciences (Animal Sciences/Plant Sciences. Supplement, November 1986.

Rahmani, A.R. (1989): 'The Greater Adjutant Stork'. Newsletter for Birdwatchers. Vol. 29 No. 3-4, March-April.

Rai, Usha (1991): 'Mining Blasts its Way into Sariska'. The Times of India, Delhi. 3 May.

Rajagopalan, M. (1993): 'Status Report on Biodiversity Conservation of Marine Turtles'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Ramakrishnan, P.S. (1983): 'Problems and Prospects of Conservation of Plant Resources in the North-east Hill Region of India'. In Jain and Mehra (ed.) 1983.

Ramakrishnan, P.S. (ed.) (1991): Ecology of Biological Invasion in the Tropics. International Scientific Publications, New Delhi.

Rodgers, W.A. (1992): 'The Conservation of Biodiversity in India'. Report prepared for the World Bank.

Ryan, J.C. (1992): 'Global Biological Diversity Disappearing Fast'. Economic Times, 27 April, 1992.

Scott, D.A. (1989): A Directory of Asian Wetlands. WWF/IUCN/ICBP/IWRB.

Sen Gupta, R. (1984): 'Studies on Oil Pollution in the Indian Ocean'. Indian and Foreign Review, No. 11. Quoted in Qasim and Kureishy 1986.

Sen Gupta, R. and Qasim, S.Z. (1985): 'The Indian Ocean - An Environmental Overview'. In Sharma, R.C. (ed.): The Oceans: Realities and Prospects. Rajesh Publications, N. Delhi. Quoted in Qasim and Kureishy 1986.

Shyam Sunder, S. (1986): 'Problems and Opportunities for Wastelands Development in Drought Prone Areas Based on People's Participation: A Forester's Perspective'. The Indian Forester Vol. 112 No. 7, Dehradun. July.

Singh, Damandeep (1993): 'Pouring Water on Troubled Oil'. The Pioneer, Delhi. 7 February.

Singh, D.K. (1993): 'Liverwort (Hepatacae) Diversity in India and Its Conservation'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Singh, N.P. and Pandey, R.P. (1993): 'Conservation of Plant Diversity in Rajasthan'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Singh, P. and Misri, B. (1993): 'Biodiversity of Indian Grasslands and Its Conservation'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Sinha, B.C. and Goyal, S.P. (1993): 'Survival Struggles: Indian Wild Ass in the Little Rann'. Frontline. Madras. May 7.

Soule, M. (ed.) (1986): Conservation Biology. Sinauer Associates, Massachusetts.

Soundararajan, R. (1989): Crown of Thorns. SANE Awareness Series 3. INTACH, A&N Chapter, and Society for Andaman and Nicobar Ecology, Port Blair.

Subba Rao, N.V. (1989): 'Fauna of Andaman and Nicobar Islands: Diversity, Endemism, Endangered Species and Conservation Strategies'. In Saldanha, C.J. (1989): Andaman, Nicobar and Lakshadweep: An Environmental Impact Assessment. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Subba Rao, N.V. and Rao, G.C. (1993): 'Status Report on Biodiversity of Andaman and Nicobar Islands'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Subramanian, K.N. and Sasidharan, K.R.: 'Conservation of Biodiversity: Forest Trees'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Thothathri, K. (1962): 'Contributions to the Flora of the Andaman and Nicobar Islands'. Bulletin of the Botanical Survey of India Vol. 4 No. 1-4.

Tucker, R.P. (1988): 'The Depletion of India's Forests Under British Imperialism', in D. Worster (ed.), The Ends of the Earth: Perspectives on Modern Environmental History. Cambridge University Press, New York.

Uniyal, B.P. (1993): 'The Floral Biodiversity in Western Himalaya'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

Virmani, S.M. (1991): 'Promise of Watershed Projects'. The Hindu Survey of India Agriculture 1991.

Wafar, M.V.M. (1992): 'Management and Conservation Options for Indian Coral Reefs'. In Singh and Singh 1992.

WCMC (1988): 'Conservation of Biological Diversity: India'. World Conservation Monitoring Centre, Cambridge. Draft.

Whitaker, R. (1985): Endangered Andamans. Environmental Services Group (WWF-I) and MAB India, Department of Environment, Delhi.

Williams, H.E. and Williams, L.B. (1990): 'The World Wide Coral Bleaching Cycle and Related Source of Coral Mortality'. Atoll. Res. Bull. No. 335. Quoted in Pillai 1993.

Wilson, E.O. (ed.) (1988): Biodiversity. National Academy Press, Washington.

Wood, E. (1989): Corals: Wandoor Marine National Park. SANE Awareness Series 4. INTACH, A&N Chapter, Port Blair.

WRI/IUCN/UNEP (1992): Global Biodiversity Strategy. World Resources Institute, World Conservation Union, and United Nations Environment Programme.

WWF-I (1992): India's Wetlands, Mangroves, and Coral Reefs. World Wide Fund for Nature - India, for the Ministry of Environment and Forests, Government of India, New Delhi.

Yazdani, G.M. (1993): 'Status Report on Biodiversity Conservation of Western Ghats'. Paper contributed to Conservation of Biological Diversity in India Vol. II. Indian Institute of Public Administration. In press.

ZSI (1991): Animal Resources of India: From Protozoa to Mammalia. Zoological Survey of India.