While deciding on the topic for this issue, 'Fragile Ecosystems of Eastern Ghats', there was apprehension whether we would receive adequate and sufficient response from contributors. It is heartening that Dr. Ranjit J. Daniels sent us a very pertinent article on subject while Ajith K. Patnaik, IFS., has sent a case study on Chilika Lagoon, a fragile ecosystem in the Eastern Ghats terrain of Orissa.

Terminologies used in the field of Ecology sometime needs to be clarified specially to an amateur stakeholder. 'Fragile Ecosystem: A Brief' is an attempt to explain a generalised concept of the term: Fragile Ecosystem.

It is significant to recall what was mentioned in the preceding Foreword: ‘...the endeavour while bringing out the Newsletter is to give importance to data gaps...’ Fragile Ecosystem is one such issue where adequate attention of all the stakeholders, whether scientists, ecologists, policy makers, NGOs, educationalists, students, farmers, fishermen, etc is warranted to explore and pursue steps towards conservation and sustainable utilization of resources so as to save the ‘fragile’ from further irreversible damage.

ENVIS Coordinator

REQUEST TO READERS

Our next issue of ‘The Eastern Ghats’ [Vol.11, No.3, 2005] will focus on ‘Epiphytes and Orchids of Eastern Ghats’. We solicit articles and write-ups from our readers for the same. We seek articles of a general nature so as to make our Newsletter informative to a large section of the stakeholders and not to restrict it exclusively to subject specialists.

Note: The views expressed in the article/s are of the Authors.

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ENVIRONMENT PROTECTION TRAINING & RESEARCH INSTITUTE (EPTRI), HYDERABAD
Rejuvenation of Chilika lagoon: restoration of a coastal wetland with community participation

Dr. A.K. Patnaik, IFS
Chief Executive, Chilika Development Authority, C-5, BJB Nagar, Bhubaneswar-14, Orissa, India
ajitpattnaik@hotmail.com; www.chilika.com

Chilika is the largest lagoon along the east coast of India, situated between latitude 19° 28’ and 19° 54’ N and longitude 85° 05’ and 85° 38’ E. (fig-1). The lagoon is a unique assemblage of marine, brackish and fresh water ecosystems with estuarine characters. This fragile ecosystem is a hotspot of biodiversity that shelters a number of endangered species listed in the IUCN red list of threatened species, and is a designated Ramsar site. It is an avian grandeur and the wintering ground for more than one million migratory birds. The highly productive lagoon ecosystem with its rich fishery resources sustains the livelihood of more than 0.2 million-fisher folk who live in and around the lagoon.

Hydrologically, Chilika is influenced by three subsystems: i) The distributaries of River Mahanadi, ii) minor rivers flowing in to the lagoon from the Western catchment and iii) the tidal outlet to the Bay of Bengal. Construction of major hydraulic structures upstream in the Mahanadi has altered the flow pattern into Chilika. The long shore sediment transport along the coast of Bay of Bengal estimated to be 0.1 million metric tones annually tend to shift lagoon mouth opening to the sea every year had been adversely affecting the tidal exchange. This changed flushing pattern significantly affected the salinity regime, and consequent natural recruitment of biological species. The spatial and temporal salinity gradients due to the freshwater flow from the riverine system and the seawater influx; gave it the unique characteristics of an estuarine eco-system, exercising a continuous and selective influence on its biota. The hydrological alterations leading to the transformation of the lagoon towards fresh water ecosystem was considered as a potential threat to the biota of this unique ecosystem. This could be broadly attributed to the change in the flow pattern from the lagoon basin and the changes in the coastal processes. Due to the depletion of the health of the lagoon, it was added to the list the Montreux Record (threatened list of Ramsar sites) in 1993. The lagoon encountered a combination of increased siltation, as well as partial closure the outlet channel connecting the sea. The consequent decrease in salinity caused proliferation of invasive species, increased turbidity, shrinkage of area, loss of biodiversity, depletion of the fishery resources. The overall decline in the productivity adversely affected the livelihood of the local community.

Actions taken

Being concerned with this the Government of Orissa created Chilika Development Authority (CDA) in the year 1992, for the integrated management of the lagoon. CDA adopted a holistic approach of integration of coastal processes and lagoon basin in the management planning with a wide scale stakeholder consultation. For a clear
understanding of this complex system, the services of the premier institutes of the country were commissioned to carry out targeted studies to trace the root cause of the degradation of the lagoon ecosystem. Based on the valuable data generated from the targeted studies, the Central Water and Power Research Station (CWPRS), Pune, carried out a two dimensional numerical model studies. The studies concluded that the tidal influx into the lagoon was considerably reduced because of the shoal formation along the lead channel and continuous shifting of the mouth that resulted in significant hydraulic head loss. Based on the model out put CWPRS recommended for opening of a new outlet closer to the lagoon. Following the recommendations of the CWPRS, an artificial mouth was opened on 23rd September 2000, which reduced length of the outflow channel, by 18 km. The environment impact assessment was carried out by National Institute of Oceanography, Goa, before and after the opening of the mouth.

Outcomes
Impact of the hydrological intervention on the lagoon ecosystem

The opening of the artificial mouth and the desiltation of the lead channel not only rejuvenated the ecosystem of the lagoon but also immensely benefited the community depending on the lagoon whose average annual income increased significantly.

There have been significant improvements of the salinity gradient after opening of the mouth. Before the opening of the new mouth, the salinity level of northern sector of the lagoon used to remain zero through out the year. For an ecosystem with a seasonal and the sectoral characteristics, an appropriate salinity gradient with gradual decrease from the lagoon mouth towards the lagoon proper is desirable. Ideally the seasonal changes in salinity gradient should not be abrupt, as it is considered, harmful for the biota and it should be as flat as possible. The change in salinity regime of the lagoon was abrupt prior to opening of the mouth. After opening of the new mouth less fluctuation of the salinity gradient is observed.

The gradual reduction in the salinity from the lagoon mouth to the lagoon interior after the opening of the mouth is providing the desirable sense of direction for the euryhaline forms to enter into the lagoon from the sea. This is facilitating the auto-recruitment of the fish, prawn and crab juvenile into the lagoon. As against the annual average fish (fish and prawns) landing of mere 1600 metric tons prior to opening of the mouth, the fish landing during 2003-04 touched an all time high of 14,000 M.T, thus the average fish landing increased by 8 times in comparison to the average yield prior to opening of the mouth. After opening of the new mouth six species of fish one species of shrimp of commercial importance reappeared which were thought to be extinct from the lagoon. The increase in the fishery resources facilitated the community to adopt self-initiated good practices, like regulation of the mesh size, refrain from the juvenile poaching etc.

The declining level of salinity triggered proliferation of fresh water invasive species. The weed spread area, which was only about 20 sq.km in 1972, increased to 523 sq.km by October 2000, leaving a weed free area of bare 334 sq.km. After the opening of the new mouth, weed free area assessed through image processing increased to 506 sq.km, i.e. a net increase of 172 sq km.

More than 0.20 million fisher folk directly depend on the lagoon, and about 0.80 million people live in the catchment of the lagoon. So while formulating the management plan, stakeholder consultations were done by holding village level meetings. The linkages with the community through the village level institutions, women
self help groups, community based organizations, networking of the NGOs is a mandate of the CDA. A network of the NGOs and the Community Based Organisations (CBOs) working in and around the lagoon has been established. A bi-monthly newsletter in local language is published in collaboration with a local NGO. The basic objective of the newsletter is to keep the stakeholders update with the management programme. The village schoolteachers and the natural leaders who are encouraged to come up with local issues contribute most of the articles of the newsletters. A section of the newsletter is also dedicated to the articles on wise use and good practices.

**Community based management of the lagoon basin**

The other major component of the restoration plan is the community-based management of the lagoon basin, on a micro watershed basis. The treatment of the catchment on a micro watershed basis is being carried out in a participatory manner with an objective to facilitate a community based co-management strategy for an integrated terrestrial and aquatic resource management within the watershed. Through a series of training program and exposure visits, the capacity building of the watershed community is accomplished, which paves the way for preparation of the micro plan blended with indigenous knowledge, for optimum utilisation of the natural resources. The watershed community also shares a part of the cost of the management of the lagoon basin. This is also creating an enabling environment for the local community to take decision and participate in the management.

**Ecological outcomes**

Considering the sensitive ecosystem of the lagoon, a close monitoring of the lagoon is carried out to assess the impact of various management interventions on the lagoon. This is carried out from 30 fixed stations covering all the four ecological zones, and data collected at 30 days intervals. A number of performance indicators are selected to track the ecosystem. Remote sensing and GIS tool are used for monitoring the lagoon ecosystem. The monitoring result indicated that after opening of the mouth there is expansion of the sea grass meadows and their species diversity has also improved. The expansion of the habitat of the critically threatened Irrawady dolphin is also observed.

A clear understanding of the hydrological process i.e. integration of the coastal processes and the river basin provided the clue for the restoration interventions and its sustainability. Community participation is crucial for sustainability of the restoration and management of the lagoon. Capacity building of the watershed community facilitated the formulation of the micro plan at the grass root level blended with the indigenous knowledge, a bottom up approach. The micro plan not only envisaged the appropriate land use and soil moisture conservation measures but optimum utilisation of all the natural resources including the human resources in a sustainable manner.

Chilika was removed from the Montreux record by the Ramsar bureau with effect from 11th November 2003. Chilika lagoon is the first wetland from Asia to be removed from Montreux record. The prestigious Ramsar Wetland Award 2002 and Indira Gandhi Paryavaran Purashkar were also conferred on CDA for the impressive way in which the restoration was carried out with the active participation of the community.
Introduction

Biological diversity (= biodiversity) manifests itself at many ecological scales that begin at the level of simple genes and run through populations, species, communities and ecosystems (Solbrig, 1991). In the biological hierarchy, ecosystems are treated as rather distinct units of life that are located within larger landscapes (Heywood, 1995). In practice however, defining ecosystem boundaries and delimiting them structurally and spatially have posed much greater difficulty than have populations or species, for instance. Hence, despite the array of definitions that have been popularised in ecological literature during the past 5-6 decades, field ecologists worldwide have had to adopt ‘ad hoc’ and ‘artificial’ definitions of ecosystems that are merely synonyms of landscape elements such as ponds, lakes, rivers, estuaries, mangroves, marshes, grasslands, forests, farms, cities, etc. - natural habitats and vegetation types whose boundaries can be readily traced on a map.

In reality, ecosystems are huge ‘machines’ whose structure, function and longevity are controlled by sets of living organisms and their interactions. It may require hundreds of species and their populations to structure and sustain an ecosystem. The important roles that the living organisms play in the ecosystem are however not always proportional to their conspicuousness. Thus simple viruses or single-celled planktons may assume greater significance in the sustenance of an ecosystem than ecological ‘flagships’ like the elephant in a forest or a whale in the ocean. And since it was understood that even simple viruses or planktons that might serve as ‘keystone’ species in an ecosystem do not behave in a predictable manner, ecosystem ‘eccentricities’ have become every serious ecologist’s nightmare.

Ecosystem Fragility

Ecosystems are dynamic and eccentric. The hundreds of species and their populations in an ecosystem constantly adjust their life-styles to survive amidst the odds of having to co-exist with others and the vagaries of the local non-living environment. In this process, species that have very similar ecological needs tend to be in conflict with each other and the not-so-similar species often form symbiotic associations by which they can survive against the many ecological odds (including those induced by the competitors) in an ecosystem. At the same time despite conflicts (and competition), all species in an ecosystem work together to create hospitable habitats for themselves. Thousands of years of such ecological adjustments, adaptation and evolution have helped every ecosystem develop a characteristic called ‘integrity’ and insulate itself against environmental odds (as that brought about by changes in climate). Ecosystems that are totally in tune with the local environmental conditions (soil, moisture, temperature and the biotic environment) are often called ‘climax’ ecosystems.

Climax ecosystems are however not totally immune to environmental disturbances. They are only able to withstand certain forms of environmental disturbances (eg storms, floods, fires, drought, epidemic diseases, pest and parasite outbreaks, etc) through their long-built integrity and come back to their original state (both structurally and functionally) after the natural catastrophe is past. The inherent ability of an ecosystem to return to its original state after experiencing one or another form of environmental disturbance is known as ‘ecological resilience’. Ecological resilience is brought about by sets of intricately woven linkages between species, their populations, their habitats and the local physical and chemical environment. Ecologists have shown that where
there is a greater diversity of species, there is likely to be more sets of ecological linkages (many of which remain unknown to science). And ecological research that focused on the role of disturbance in sustaining ecosystems has asserted that ‘moderate’ levels of disturbance are essential to maintain higher species diversity, especially in the tropical region (Connell, 1978).

The greatest diversity of species lies within the tropical region. Estimates suggest that not less than 50% of the earth’s 8-13 million species may well be found within the tropical region and many of these species may never be known outside the tropical limits. Despite arguments that tropical speciation is ‘excessive’ and that a large number of tropical species could be ecologically ‘redundant’, community ecological studies carried out during the past 4 decades have pointed to the fact that species are ‘not expendable’ (Kareiva and Levin, 2003). Just as Erhlich and Erhlich (1981) highlighted the non-expendability of species using the analogy of an aircraft and the insane ‘rivet popper’, it is real that with the loss of each species the machinery of the ecosystem loses its viability. With the loss of a species (or even a drastic reduction of its population that renders it a functionally ‘dead’ component of the ecosystem’s machinery), one or more vital linkages that contribute to an ecosystem’s resilience are lost. Ecosystems that have lost their resilience tend to ‘flip’ into another ecological state (Daniels and Vencatesan, 1998). Ecosystems that are on the verge of a flip are ‘fragile’.

The Eastern Ghats

South Indian hills are amongst the oldest in the world. These came into existence due to a geological process known as ‘uplift’ between 50 and 100 million years before present (Radhakrishna, 1991 & 1993). Due to the uplift, the underlying rocks (that are over 2 billion years old) have been exposed and preserved as such. The hill ranges south of Maharashtra and the eastern segments that run through Tamil Nadu and parts of Andhra Pradesh till about Vizagapatnam are the result of the uplift and of the same age and hence in most geological characteristics similar. However, traditionally (despite the absurdity) the south Indian hills have been differentiated as the Western Ghats and the Eastern Ghats and consequently managed as two distinct ecosystems.

That the south Indian hills of Goa, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh are part of a single large ecosystem (hence ecologically comparable) is evident in the number of species of plants and animals that are common to them and the structural similarities that the plant and animal communities exhibit. Many species of plants that are endemic to peninsular India are patchily distributed in the south Indian hills. The endemic and endangered legume Crotalaria longipes is found only in the Nilgiris Plateau and Kolli Hills of Tamil Nadu (Jayanthi and Daniels, 1996). The genus of tree frog Philautus that diversified in Sri Lanka and the south-western hills of India is also represented by a few species in the Kolli Hills and Shevaroy Hills of the north central Tamil Nadu and in Andhra Pradesh (Daniels, 2005). The primitive subterranean ponerine ant in the genus Amblyponge that is known only from the rainforests of southwest India and the Australian region was once collected from a ‘wasteland’ between Chennai and Kancheepuram (Daniels, personal observation).

There is no dearth of examples of sedentary, rare and endemic species that the hills of south India share to support the view that the traditional bifurcation of the ghats’ ecosystem into Eastern and Western is not ecologically sound. However, since the focus of the present discussion is on fragile ecosystems and not on the validity of the traditionally adopted bifurcation, we shall not argue any further on this aspect, instead analyse the factors that render ecosystems fragile and highlight the common indicators of fragility in tropical ecosystems. For the sake of the present analysis and discussion, we have chosen two of the hill ranges of Tamil Nadu that are traditionally treated as the Eastern Ghats – the Kolli Hills and the Shevaroy Hills.

The diversity and distribution of plant and animal communities within the hill ecosystem of south India are influenced primarily by the number of rainy months and altitude. Geological studies have shown that the more extensive rainforest ecosystem of south India got
fragmented and isolated in the hills due to early changes in the local temperature and patterns of rainfall. Whereas the western peninsula continued to be moderate in temperature, wet and less seasonal, the Deccan Plateau and the eastern hills gradually became warmer, drier (due to the rain shadow created by the taller western hills) and more seasonal during the past 15 million years or so (Radhakrishna, 1991 & 1993). In addition to the gradual changes in the climate that the Indian peninsula experienced since the establishment of the ‘Western Ghats’ and the more recent ice ages (starting 1.5 million years before present) that depressed the temperature locally in the tropical region, human beings played a role in fragmenting rainforests. A shift from the hunter-gatherer mode of survival to agriculture (largely in the form of slash-and-burn) in early human societies some 12,000 years ago fragmented rainforests throughout peninsular India as in the rest of South Asia (Subash Chandran, 1997).

Relic fragments of rainforests thus isolated continue to precariousely survive in the south Indian hills. Fragments that are found on south-western hills that are over 1500m ASL are known as wet montane forests (the more popular ‘shola’ forests). These rainforests are dominated by plants that represent rather unique families of flowering plants such as Magnoliaceae, Lauraceae, Clusiaceae, etc. There are also a handful of representatives of cold adapted plants like Rhododendron, Rhodomyrtus, Mahonia and others that have survived higher up in the south Indian hills. While the ‘shola’ forests of the south-western hills (eg Nilgiris, Palnis, Anaimalais, etc) have attracted a lot of attention and recognition as ecologically fragile, higher elevation forests of the Kolli and Shevaroy Hills of Tamil Nadu (and also other easterly hills of Tamil Nadu and Andhra Pradesh) have not been managed with similar concern.

Forests in the higher elevations of Kolli Hills and Shevaroy Hills are structurally very similar to the ‘shola’ forests. They share many species of plants (trees for instance) in the families and genera listed above. Michelia champaca (Magnoliaceae) is fairly common in Kolli Hills. Canarium strictum (Burseraceae) is yet another example. The late Fr K M Mathew has listed several cold adapted and ‘relic’ species of trees such as Mahonia leshenaultii (Berberidaceae), Capparis nilgiriensis (Capparidaceae), Pittosporum floribundum (Pittosporaceae), Elaeocarpus glandulosus (Elaeocarpaceae), Ilex denticulata (Aquifoliaceae), Meliosma simplicifolia (Meliosmaceae), Viburnum punctatum (Caprifoliaceae), Eurya nitida (Theaceae), Vaccinium neilgherrense (Vaccinaceae), Daphniphyllum neilgherrense (Daphniphyllaceae), etc that the Kolli and Shevaroy Hills share with the south-western hills (the Western Ghats) (Mathew, 1990). These hills are also home to a number of species of rare, endemic and threatened (RET) plants including Vernonia shevaroyensis, Brachystelma brevitubulatum, Ceropogia spiralis, Crotalaria priestleyoides, Hildegardia populifolia, Lilium neilgherrense and Habenaria decipiens (Nayar and Sastry, 1987, 1988 & 1990; Henry et al, 1980). More careful studies will certainly reveal the presence of many other species of RET plants and animals in the easterly hills of south India. Unfortunately, however, human interventions have severely interfered with the ecology of these hills. The ‘shola’ forests of Kolli, Shevaroy and other easterly hills of south India have already lost a number of species of plants and animals that sustained the ecosystem (Daniels and Vencatesan, 1998; Jaishree, 2000).

Assessing ecosystem fragility

Fragility of any ecosystem does not become apparent readily. It starts in the form of local ‘decay’. The first sign of decay in an ecosystem is the loss of species. Loss of species leads to the breakdown of ecological integrity. Globally, signs of decay in biodiversity rich ecosystems led to the designation of certain landscapes as ‘biodiversity hotspots’. And since Norman Myers and colleagues first proposed the concept in the late 1980s (Myers et al, 2000), there have been attempts to designate areas around the globe not only as hotspots, but also as ‘hot-specks’ and ‘warm-spots’.

Small patches (not more than a few tens of square meters in size) within tropical rainforests are known to provide habitats to a large number of species of insects and other invertebrates, herbs and lower plants such as bryophytes. Many of these species have proved to be endemic and new to science. Dr. P T Cherian, formerly a senior
entomologist of the Zoological Survey of India, first proposed that biodiversity-rich locations that are small in geographical scale be designated as ‘hot-specks’ (personal communication). Even as the concept is gaining popularity, a large number of hot-specks are apparently vanishing along with the species that have ceased to exist locally. So if local loss of species is the first indication of decay in an ecosystem, the degeneration of hot-specks could be considered as the next stage in the process.

Elsewhere, Nayar (2004) has drawn the attention of ecologists (botanists in particular) to the Vavilovian centres of plant domestication. Often, these centres do not qualify as hot-spots as defined by Myers et al (2000) as they fall within grasslands and woodlands that are poor in endemic species. Centres of plant domestication are located within ‘cultural landscapes’ where the original ecosystem characteristics have been lost due to some amount of ‘ecological taming’ that humans have traditionally brought about (Daniels and Vencatesan, 1998). The Kolli Hills of Tamil Nadu are good examples of cultural landscapes where crop plants have diversified during the past 3000 years (Jaishree, 2000). However, most of the birds and larger mammals have disappeared due to human pressures in the Kolli Hills (Daniels and Vencatesan, 1998). Although Nayar (2004) has proposed that local centres of crop diversification be designated as ‘warm-spots’, in reality, these localities are only large-scale indicators of an ecosystem that has already flipped. Within cultural landscapes there are habitats characterized by frequent conflicts between humans and wildlife. Warm-spots, despite their value as ‘centres of agro-biodiversity’ are those that eventually render an ecosystem ‘cold’. Within the peninsular Indian hill ecosystem, the ‘Eastern Ghats’ may well be designated as ‘cold-spots’ unless further ecological degradation is prevented.

Reference


Ecology is the study of relationships of organisms to their physical environment and to one another. Within the science of ecology, various terms and terminologies are often used and apparently their meaning appears to be familiar and overlapping to a layman. However, technically speaking these terms have very specific scientific meanings attached to them.

In this context if we consider “Ecosystem”, it is an ecological community together with its environment, functioning as a unit. The term ecosystem first appeared in a 1935 publication by the British ecologist Arthur Tansley. An ecosystem is a dynamic and complex ecological unit. In an ideal ecosystem organisms are usually well balanced with each other and with their environment. However, at times due to various pressures this balance is disturbed and in this situation such a delicately balanced ecosystems with unique features and resources is termed particularly “at greatest risk”, i.e. the most vulnerable, described as “Fragile Ecosystems”.

Fragile ecosystems include deserts, semi-arid lands, mountains, wetlands, small islands and certain coastal areas (Box 1). Most of these ecosystems are regional in scope, as they transcend national boundaries. Sensitive and fragile ecological environment is caused by an unbalanced distribution of ecological system substances and energy in a specific geographical setting. In a fragile ecosystem even a small additional change or disturbance can create huge losses because within such ecosystems the loss of one species alone can create a probability of survival collapse for many others through the symbiotic chain.

Fragile ecosystems are very important for the health of our planet. Thus, considering the vulnerability of the fragile ecosystems, there is a need to promote awareness about the concept itself and to ensure that the ecological resources are conserved for better management and sustainable utilization of any fragile zone.

**Arctic regions**

Very fragile eco-systems with slow decomposition of wastes and thin acidic soil. Precipitation falls in desert-like quantities. There is little species diversity - of 30,000 types of fish, only 50 live in the Arctic. Large populations of few species (caribou, seals) are very vulnerable to environmental stress.

**Coral Reefs**

World's richest ecosystems, second only to rainforests in the diversity of plants and animals they support. They are also fragile ecosystems, whose health can be affected by even slight natural or man-made changes in temperature, salinity, light, available oxygen and nutrients, or sediments flowing from the upstream parts of watersheds.

**Deserts**

Lack of rainfall, coupled with undeveloped soils that fail to retain moisture and high rate of evaporation due to low humidity create a desert. An area is a desert if it receives less than 10 inches/year of erratic precipitation. Plant and animal life are often on the edge of disaster due to these extreme conditions. Many species are extremely rare. Thus, deserts are actually very fragile and susceptible.

**Estuaries**

Areas where saltwater and freshwater meet are known as estuaries. These are fragile ecosystems with unique physical, chemical and biological features. They are dynamic and productive, supporting unique but diverse fauna and flora. The seasonal variations in the water quality and the biological component of these systems are influenced heavily by anthropogenic stresses.
Mangroves

Mangroves are salt-tolerant plants of tropical and subtropical inter-tidal regions of the world. Regions where these plants occur are termed as 'mangrove ecosystem'. These are highly productive but extremely sensitive and fragile with high adaptability to the fluctuating water quality.

Mountains

Cover a significant part of the world's surface inhabited by about 10 per cent of the world's population. Physical isolation has excluded the mountains from development, resulting in political and economic marginality. Mountain people suffer from unemployment, poverty, poor health, and insufficient sanitation. These ecosystems are fragile and susceptible to soil erosion, landslides, and loss of genetic diversity.

Semi-arid lands

Characterized by low erratic rainfall (up to 700mm/anum), periodic droughts and different associations of vegetative cover and soils. About one third of the earth's surface is arid or semi-arid lands and particularly fragile ecosystems. About 70% of the world's dry lands are susceptible to desertification, threatening billions of hectares of rangelands and croplands and one billion of mostly poor people.

Small islands

Viewed as an ecosystem in which the natural boundaries of one feature are inextricably linked with another. A small island environment can be summarized as an ecosystem with the properties of a coastal zone and whose environment is relatively isolated, limited in geographical size & resources (human and natural), limited in diversity, vulnerable (economically & ecologically) and fragile. The natural resource base of small islands is so fragile and vulnerable that even minuscule changes can result in irreversible environmental damage.

Wetlands

 Transitional areas between the inland and aquatic habitats. Wetlands are land areas that tend to be wet or are regularly flooded with a water table that is at or above the surface for at least part of the year. They perform in our ecosystem what our kidneys do for our bodies: serve the indispensable function of protecting and purifying the most fragile and precious systems.

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ABSTRACTS AND NEWS ITEMS

Undermining India: A report by Kalpavriksh assesses the impact of mining across the country

Since the economic liberalisation phase in the 1990s, the mining sector has opened up thousands of sq. kms. of the country for reconnaissance and prospecting activities, many of which are taking place in some of our most ecologically fragile areas. Mining activities are impacting some of the most ecologically sensitive areas of the country. A new report by Kalpavriksh states that at least 90 sanctuaries and national parks and hundreds of other ecologically sensitive areas across the country including Eastern Ghats, are threatened by existing or proposed mining activities. A few examples of mining threats to ecologically sensitive areas which are water catchments are: proposed bauxite mining in the Eastern Ghats in Andhra Pradesh which will impact the catchment of the Machkund, Sileru, Gosthani and Sharada rivers.

Bhitarkanika
(Source: http://www.wildlifeorissa.org.in/Bhitarkanika1.htm)

In a bid to conserve the complex and fragile mangrove ecosystem and the endangered flora, fauna associated with it, the Government of Orissa constituted the ex-zamindary forests of Kanika Raj as a Bhitarkanika Wildlife Sanctuary. The area has also been designated as the second Ramsar site (i.e. Wetland of International importance) of the State during August 2002. It is a unique area with rich biodiversity as it covers different ecosystems such as the landmass, tidal waterbodies of the deltaic region, estuaries and territorial waters of the Bay of Bengal along with their associated flora and fauna.

Bhitarkanika is endowed with a very complex and dynamic ecosystem and is highly fragile in nature. The ecosystem is complex in a sense that all the sub ecosystem namely fresh water, marine and terrestrial are intricately mixed with each other. The essential factor for maintenance of such ecosystem is regular influx of fresh water from adjoining land and tidal inflow from the sea. Any change in the regime of either factor is likely to effect a corresponding change in the mangrove ecosystem. It is, essential to provide alternative means of livelihood for the people living in about 100 villages in the sanctuary area to reduce their dependency on this eco-fragile ecosystem and to take measures so that the land use pattern and also livelihood issues of the rest of the villages shall not exert any negative influence on the existence and survival of this coastal mangrove ecosystem.

The Role of Biotechnology in the Conservation, Sustainable Use and Genetic Enhancement of Bioresources in Fragile Ecosystem

Prashanth S. Raghavan and Ajay Parida,
M.S. Swaminathan Research Foundation, Chennai
(Source: http://www.fao.org/biotech/docs/raghavan.pdf)

The coastal ecosystem is one of the most productive ecosystems. The tropical and the subtropical coastlines of the world are characterized by specialized littoral plant formations, the mangroves.

The coastal regions are also regions where there is intense agricultural activity. Increased soil erosion and water pollution caused by intensive farm practices in the inland area gets transported through the river and canal and adversely affect the coastal agro-ecosystem. This has given rise to an increase in the level of abiotic stresses such as salinity, alkalinity, and drought. Climate change and consequent rise in sea level is one of the major impending dangers affecting the coastal ecosystem. In order to combat abiotic stress effects, studies have been taken up to conserve the mangrove genetic resources, characterize and harness the genes involved in salinity/abiotic stress tolerance from mangroves and transfer these genes to crop plants so as to generate crops with enhanced stress tolerance.

Coastal Management Issues and Concerns of Pulicat Lake, Tamil Nadu, Sarah Coulthard, Centre for Coastal Management, Newcastle University United Kingdom
(Source: http://www.annauniv.edu/ceg/iom/iomour/th2o.pdf)

India’s wetlands are amongst some of the most threatened eco-systems in the continent. Pulicat Lake situated at the border between Tamil Nadu and Andhra Pradesh is India’s second largest brackish water lagoon, covering 600km square. 52,000 people depend upon the lake for their daily livelihood, and this number is increasing. Meanwhile, available evidence suggests that the life-supporting fishery of the lake is in decline, jeopardizing the survival of the fishing communities that have inhabited its shores for generations, and threatening an important national economic and ecological asset. The complexities surrounding the environmental and social structures of Pulicat Lake are such that a multi-disciplinary, cross-departmental approach in its research and management is now vital in order to establish the true picture of what is happening to the lake and its people, and why. For the past two years PhD research has been carried out which aims to
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Contribute to the ongoing national and international efforts to understand the social and environmental dynamics of Pulicat Lake and the problems its people face.

Case Studies On Coastal Fragile Areas
[Funded by: Central Pollution Control Board, GOI, 1994 – 1997]
(Source: http://www.annauniv.edu/iom/Research%20Projects%20completed.htm)

This project aimed at identifying the fragile coastal areas of the country including the estimation of its area and to bring out the environmental status of each fragile area and management plans. It also identified the important species in the area and those requiring conservation, assessing the human interference and socio-economic problems. Central Pollution Control Board, GOI, publishes the report of the project as a book.

Psammophytic Flora and its Role in Stabilizing the Coasts A Case Study at Paradip and Gopalpur of Orissa
(Source: http://www.rrlbhru.res.in/envis/psammo.htm)

About 85% of the coastal zone of Orissa is under very fragile condition due to deforestation and conversion of forest patches to agricultural purposes. The coastal biota is under serious threat from human activities that lead to destruction of natural ecosystems at an alarming rate. There has been a phenomenal increase in vegetational loss during the last few decades and this has greatly outstripped the pace of regeneration by adversely affecting the species diversity. Studies related to the morphodynamics of Orissa coast reveal that the psammophytic vegetation plays a pioneer role in sand dune formation. Sea currents, waves, winds etc. move large amounts of sand beyond the tidal region. The rolling sand gets collected around obstacles of various origin and form small ‘sand heaps’ which can be termed as ‘embryonic dunes’. Lack of humus, salinity, high temperatures, high wind velocity, deep ground water level, constant sand shifting etc. are primarily responsible for non occurrence of normal plants in these areas and species equipped with morphological, physiological, reproductive, anatomical, and ecological adaptations can only survive.

OBITUARY

We record, with regret, the sad demise of Prof. V.B.N.S. Madduri, Department of Economics, University of Hyderabad and Prof. M.V. Nayudu, Former Head of the Department of Virology, Sri Venkateswara University, Tirupati, AP. They had been associated with ENVIS Centre on Eastern Ghats and participated in the National Seminar on Conservation of Eastern Ghats, 2002 as members of the Technical Committee.

Prof. V.B.N.S. Madduri was associated with EPTRI in the preparation of State of Environment Report for Andhra Pradesh and also in the World Bank sponsored project ‘Regulatory Reforms in Water Pollution Management under Andhra Pradesh Environment Programme’.


For further information:
Contact : ENVIS Coordinator, baquer@eptri.com
Visit : http://envis-eptri.ap.nic.in

ENVIS CENTRE ON EASTERN GHATS
ENVIRONMENT PROTECTION TRAINING & RESEARCH INSTITUTE

91/4, Gachibowli, Hyderabad - 500 032, A.P, India
Ph.: +91-040-23000489, 23001241, 23001242 ; 23001707; Fax No: +91 - 23000361,
e-mail : info@eptri.com;
URL: http://www.eptri.com; http://envis-eptri.ap.nic.in

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