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EDITORIAL

Long back in the library of IIT Kharagpur, I have read on compendium of Indian states and I have forgotten the name of that great author. However I vividly recollect his introductory lines about Orissa, my own state i.e. if you have not seen Orissa you have not seen India. Now after traveling nook and corners of my state, I am convinced that it is true. The deep virgin forests, mountains, hills, streams, water bodies, wetlands, beautiful sea coasts, the tribes, magnificent wild animals and plants, its rich heritage, culture making a kind of wonderland not only in the country but in the world. If you have seen the beautiful orchids in the north- east and compare our orchid diversity of Similipal its no way less of a beauty. If you have not seen snowfall of Kashmir, well you can atleast seeS Daringibadi of Phulbani District.If you have seen musk deer of the Himalayas then please donot miss to see the artistic black bucks of Orissa and then you can draw a comparision.The magnificient Royal Bengal Tigers of Similipal Tiger Reserve, the salt water crocodiles of Bhitarkanika mangroves, beautiful blue jay at coastal Orissa, giant squirrel of Satkosia and medicinal plants of Gandhamardan Hills, you can really assess; Orissa is not lagging behind with its abundance of rich flora and fauna diversity. To add to it, the dense forests of Orissa, the migratory birds and dolphins of Chilika, the olive ridleys of Gahirmatha and Rushikulya mouth, leopards, sloth bears, mouse deer, pangolins and peafowls at most part of Orissa make it one of the biological hot spot of the Indian sub-continent. If you take the scenario hundred years back, the statement of the said author must have been more than correct. Now as our visionary president and the other world leaders foresee India's economic development by 2020,the environmentalists see the other side of the coin i.e. some ecological disaster is in the offing inviting perils. Economical development is directly related to its ecological status. Hence, always a balance should be made long before planning the developmental projects.

Present day Orissa experiences many a disaster like excessive floods, cyclones, tsunami, rise of temperature and heat waves, illicit felling, expansion of national highways, bustling of industries, population explosion, vehicular movements etc. Most disastrous thing is the reduction in number of tigers, elephants, leopards and sloth bears, which were earlier abundant in the jungles of Orissa. You must know that in the forest, mass felling of plants ultimately caused the drying of the perennial streams. In an ecosystem, tigers being in the apex of biological pyramid, it has been established if its number diminishes, it affects human health.Industrial effluents entering in to river and sea, resulting increased pollution seriously affect the aquatic ecosystem. Finally lack of awareness of conservation of species and rampant poaching may result in vanishing of some of the magnificent species from this part of the world.

I believe, this kind of seminar is a bold step by Rotary International and OPES to invite the wildlife lovers, environmentalists, biologists, representatives from government and non-government organizations and it would certainly invite a fruitful discussion and in-depth study for conservation of bio-diversity, which would create a general awareness.The expected outcome and further recommendation to the government would certainly give a chance to the planners to introspect and take necessary steps to save Orissa from an impending disaster and leave some foot-prints of yester years' biodiversity for our future generations.

Editor-in-chief
(R. K. Samantaray)

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Logo Description : It symbolizes an elephant within an ecological frame of peace and harmony moving towards prosperity and posterity.

Cover photo description : * A sick pigmy elephant having swollen left fore-leg at pastern, inside deep thickets of Satkosia sanctuary, Orissa. *Royal Bengal Tiger of Nandankanan Zoological Park- A valiant attempt towards captive breeding for further conservation. *Magnificent butterflies of Similpal tiger reserve

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   l Scientific names of genus and species should be in italics and it should not be underlined.

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7. **General Science Section :** The contributors should note that the references are also desired in this section

CONTENT

GENERAL SCIENCE

RESEARCH

CONSERVATION AND COMMUNITIES OF SATKOSIA BIOTOPE

S. K. Pradhan

INTRODUCTION

The need of environmental protection has not just a moral or ethial aspect. Today it is well known fact, that climate change, desertification, drought and other natural calamities are induced by the destruction of natural resources. They may occur on a global, regional, or local level; they do not know borders. But always there are interdependencies, which forces to think global but act local. The recession of biomass is contributing to the global green house effect as well as to lack of fuel wood in local communities. The reduction of biodiversity is disabling natural habitats to adapt to changing environmental factors, which may lead to further deterioration as well as it may affect the culture and livelihood of local communities.

Environment is not a static system and subject to constant change but socio-economic pressure plays a major role in altering this system in a finite negative direction. In a struggle between development and protection, both sides, society and environment need active support to ensure that natural resources are managed beneficially.

In India, where one can find more than 19725 (World Conservation Monitoring Center) plant and animal species with 6% of all the flowering species to one of the worlds 12 mega-biodiversity countries, 16% of the world population uses just 2.45% of the whole world's land and 4% of its water resources respectively.

Table - 1 : Different plant and animal species of India.

Group	Species India	Species World wide	Percentage %
Mammals	350	4629	7.6
Birds	1224	9702	12.6
Reptiles	408	6550	6.2
Amphibians	197	4522	4.4
Fishes	2546	21730	11.7
Angiosperm	15000	250000	6

LOCATION & STRATIGRAPHY

This paper attempts to discuss the biological wealth of Satkosia Gorge Wildlife Sanctuary and also to present brief account of conservation and livelihood scenario of Satkosia region. The Satkosia Gorge Wild Life Sanctuary is situated in Orissa. The state is lying at Bay of Bengal between 81° 24' and 87° 29' east longitudes and 17°48' and 22° 34' north latitudes. The total area of Orissa is 1,55,707 km^2, of which 30.14% is forest (46941 sq. kms) It is contributing 5.08% of the total area of India and 7.43% to its forested areas.

According to global WWF eco-region classification, the forests in Orissa consist of habitats viz : Tropical and subtropical dry broadleaf and Tropical and subtropical moist broadleaf forests, namely Chhotnagpur Dry Forests and Eastern Decan Plateau Moist Forests, of which both are found in Satkosia region. Satkosia Gorge Wild Life Sanctuary lies in the region of central river basins, where Mahanadi, Brahmani and Baitarani form fertile plains with abruptly rising hills in between. The Mahanadi River flows through the sanctuary which enhances the bio-richness of the sanctuary.

Underlain by Precambrian rocks, namely the eastern ghats group of the Archaean age, highly metamorphosed and most disturbed rocks are found. Largely present rock groups are khondalites and charnockites. Also found are quartzite, granite-gneisses, krigmatites, calc-granulites, leptynites, anorthosites, alkali-gabbro and napheline-syenites.

RAINFALL AND TEMPERATURE

Lying in the tropical zone just below the tropic of Cancer the region is exposed to high temperatures and due to its location in the belt of medium pressure has medium rainfall, in average 1421 mm per year. Rainfall varies

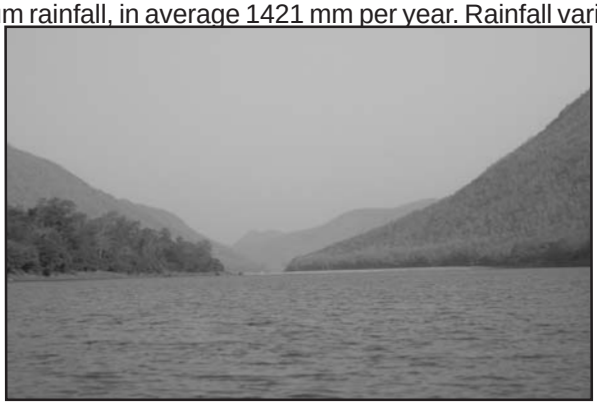

Fig. 1 : Rainfall and temperature of Satkosia

Team leader, Foundation for Ecological Security, Satkosia, Angul, Orissa, India Tel. : 9337011503

in time, though, with a range from approximately 900 to 1750 mm per year. Its spatial distribution is also erratic with droughts from time to time.

CHARACTERISTICS OF BIOTOPE

The influence of Chhotnagpur plateau and eastern ghats and the presence of the gorge ecosystem makes the biotope quite diverse both in terms flora and fauna. While all orders of plant kingdom are well reserved inside the sanctuary, the presence of the apex fauna like tiger in good number indicates a healthy food chain in the sanctuary. At the same time there is a heavy biotic pressure on the sanctuary exerted by large number of local communities in and and around the sanctuary for livelihood dependencies and also from distant community for commercial benefits.

VILLAGES

There are about 55 villages including 3 forest villages with a population over 14000 are residing within the sanctuary. Another two hundred villages situated within 10 kilometers range depend on the biotope to meet their day-to-day requirements. About more that 60% people in the area are living below poverty line. With so much of pressure and externalities, the biotope still remains as a place of serving interests of ecological communities for scientists and sociologists.

TREE BIOMASS OF THE SANCTUARY

The sanctuary is having a very healthy floral composition with wide varieties of top canopy tree species, shrubs and herbs. About 400 species of plants have been reported. A preliminary study undertaken by FES with the help of remote sensing techniques shows that the sanctuary is having a very high biomass. It was found that the overall average biomass is about 276 T/ha. The forest shows a higher stock that Bandhu (1971) gives for a dry deciduous forest of sixty years of age. The reference values for potential biomass density in these ecological zones are 450 T/ha for moist deciduous forest and 250 T/ha for dry forests in the low land. Regarding the clusterisation of microhabitats, highest average biomass as much as 303T/Ha is found in forest patches living on the edge of the forest. The dense forest shows an average value of about 272 T/ha.

Fig. 2 : Healthy floral composition of Satkosia

Higher biomass is found in the range of 200-400m. elevation. Above 400 m, the biomass is slightly less. Below 200 m biomass is considerably less. Here socio-economic pressure plays a major role as these areas are easily accessible. The middle ranges are formed by some plateaus and hill ranges and supply the habitats with optimum conditions. Above 400 m factors promoting and decreasing biomass growth may be equalized, as the higher ranges are mostly found in steep slopes with rocky terrain. Here socio-economic pressure is less but biomass increase is less than expected due to present abiotic factors.

satkosia

ies is concerned, the

about 452 kg, *Garuga*

na grandis it is about

he mean biomass of

anctuary.

Table - 2 : Mean biomass of important tree species of Satkosia Sanctuary

Sl No	Scientific name	Local name	Mean
1	*Tectona grandis*	Saguan	246.933
2	*Shorea robusta*	Sal	187.227
3	*Anogeissus latifolia*	Dhaura	169.532
4	*Terminalia alata*	Asan	250.815
5	*Diospyros montana*	Halda	113.543
6	*Emblica officinalis*	Aonla	62.085
7	*Schleichera oleosa*	Kusum	105.456
8	*Pterocarpus xylocarpum*	Giringa	233.460
9	*Syzygium cumini*	Jamun	152.620
10	*Symplocos racemosa*	Mura	28.392

11	*Lagerstromea parviflora*	Sidha	149.616
12	*Garuga pinnata*	Moi	417.330
13	*Bridelia retusa*	Kosi	119.277
14	*Ardina cordifolia*	Kurum	376.494
15	*Cassine glauca*	Chauli	55.512
16	*Strychnos nuxvomica*	Kochila	15.199
17	*Miliusa tormentosa*	Patamasu	71.724
18	*Diospyros sylvatica*	Kalicha	57.082
19	*Madhuca indica*	Mahula	452.046

BIODIVERSITY

Satkosia biotope is rich in biodiversity. As far as the floral diversity is concerned, species of different orders of plant kingdom are found in good numbers and their regenerating capacities are also found to be good. About 400 different plant species have been recorded out of which 126 are trees, 98 shrubs, 125 herbs and 51 climbers. The presence of both the arboreal life in high density and healthy ground flora depict story of bio richness inside the sanctuary. Sal and its associates are predominant species of the biotope. However, the systematic study on flora and fauna would definitely unfold many new findings. Nature lovers during trek have found more than 15 orchids in the sanctuary where as the recorded number of species in sanctury is about six only. The trek from Rasanda game tank to Kuadaoli gives an amazing exposure on orchids. We have also found a lithophytic species *Sarcomstema intermedium* on the top of the Bankmundi hill of Tikarpada. This has not been recorded in the flora of Orissa so far.

Fig. 4 : Orchids of Banknundi hill of Tikarpada

Different species associations are clearly seen in the sanctuary. The following table shows six different associations predominantly seen in various parts of the sanctuary.

Following table shows different plant species of Satkosia biotope
Table - 3 : Plants found in Satkosia Biotope

1	2	3	4	5	6
Dendrocalamus strictus	Shored robusta	Cleistanthus collinus	Aogeissus latifolia	Terminalia alata	Holorrhena pubescenes
Caesaria elliptica	Anogeissus latifolia	Anogeissus latifolia	Cleistanthus collins	Cleistanthus collins	Caesaria elliptica
Combretum roxbughil	Cassine glauca	Combretum roxbughil	Caesaria elliptica	Combretum roxbughil	Combretum roxbughil
Diospyros melanoxylon	Combretum roxbughil	Diospyros melanoxylon	Combretum roxbughil	Diospyros melanoxylon	Diospyros melanoxylon
Diospyros Montana	Dendrocalamus strictus	Symplecos racemosa	Diospyros melanoxylon	Diospyros Montana	Shorea robusta
Shorea robusta	Diospyros melanoxylon	Terminalia alata	Diospyros Montana	Shorea robusta	
	Diospyros Montana		Symplecos racemosa		
	Holarrhena pubescens		Schleichera oleosa		
	Symplecos racemosa		Shorea robusta		
	Schleichera oleosa				
	Terminalia alata				

The bamboo is found to be associated with bushy shrubs and small trees. The only significant linked big tree is *Shorea robusta*. The tree goes along well with almost every species. An impressionistic study on floral diversity shows high biodiversity of 91.25% according to Simpson's Diversity Ind

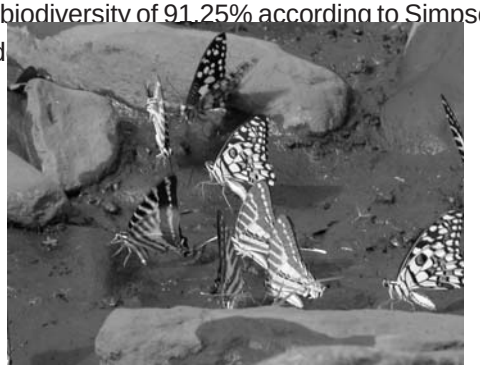

Fig 5 : Valleys of buterflies of Raiguda

The presence of apex species like tiger and elephants depicts the story of faunal richness of the sanctuary. The sanctuary has recorded 38 mammals (including 11 tigers, 19 leopards[1] , and 155 elephants), 126 birds, 28 reptiles, 4 amphibians and 183 species of fish. The recent cases of animal lifting by tiger from across all the parts of the sanctuary further confirms the presence of tiger at various parts of the sanctuary.

The beautiful giant squirrels have their strong presence in the area because of very close canopy and it is amazing to see them. The sighting is almost 100% assured near Tikarpada, Raiguda and Katarang area. It won't be inappropriate to term some parts of Raiguda region as valleys of butterflies. In spring, if one is taking a silent walk from Rasanda to Kuadoli, it is not very uncommon to find oneself amidst thousands of butterflies.

Fig. 6 : Magnificent jint squirell of Satkosia

LIVELIHOOD ISSUES

Local people living in Satkosia have a high livelihood dependency on forests and forest products in the sanctuary. Some of the reasons for this high dependency on forest is that there are very little land available for agriculture in the villages inside the sanctuary as almost 70% of the sanctuary area is covered with continuous hill ranges and dense forests. About 80% people in this region are living below poverty line. The communities are quite vulnerable and it is primarily because of unemployment for a longer period and below subsistence rainfed agriculture. Further crop depredation by animals results in much of the land fallow. 80% of small and marginal farmers are mainly engaged in wage employment and the employment opportunities are very remote. Forests and agriculture contributes more than 70% of the household. But the ban on NTFP collection has made the life of the community all the more difficult. Other outrich programmes like access to health services, education facilities and various government programmes are also very poor. Moreover the communities are living in abject poverty and this can be capitalized by external forces like timber mafia and poachers into their stride. Communities are looking at the park management negatively which would invite many problems in future. Therefore it is important to work with the communities living in and around the sanctuary on improvement of livelihoods as well.

Fig. 7 : Local tribes of Satkosia

CONCLUSION

Satkosia is a great interest of nature lovers as it offers unique floral and faunal diversity. At the same time the sociological issues and the increasing pressures from external environment holds equal importance. More so,wide

scale conversion of lands and displacement of people in nearby region along with the poverty situation of insiders make the region more vulnerable to loss of bio-mass. There is a strong need for close monitoring of resources and understanding the floral and faunal composition, distribution and association in order to have the strategic management of bio-resources. Various studies need to be taken up to assess the real potential of the Satkosia biotope. Effective protection of the sanctuary is next to impossible without the participation of communities in this process.

Policy makers at the international and national circuit have also realized that involvement of community is imperative for effective protection of our biological wealth. Agenda 21 (UN 1992 a) and Rio declaration (UN 1992 b) recognizes the critical role of indigenous people and their communities and other local communities in environmental management and development because of their knowledge and traditional practices. The Durban accord that emerged from the 5th World Parks Congress lays emphasis on the need for a new paradigm for protected areas and states. In this changing world we need a fresh and innovative approach to protected areas and their role in broader conservation and development agendas. This approach demands the maintenance and enhancement of our core conservation goals, equitably integrating them with the interests of all affected people. In this way the synergy between conservation, the maintenance of life support system, and sustainable development is forged. We see protected areas as providers of benefits beyond boundaries- beyond their boundaries on a map, beyond boundaries of nation/states, across societies, genders and generations. Further, the recent policy developments in India mphasizes the participation of local communities in the management of protected areas as well. The amendment of 2002 in the Wild Life Protection Act, Biodiversity Act 2002, Biodiversity Action Plan 2003 and Tiger Task Force report provide for biodiversity conservation through participation of local community and also highlight the conservation and development linkage for sustainable development. Satkosia Gorge Wild life Sanctuary, being a part of an IUCN category IV protected area, the conservation is to be achieved through active management intervention and that could only be possible with the active participation of all stakeholders. There is a clear need to work on reducing the pressure through livelihood diversification of local communities, building constituencies on conservation and also strengthening interactions between communities and the wild life department.

REFRENCES

Bandhu D (1971), A study of the productive structure of tropical dry deciduous Forest at Varanasi, Ph D. thesis, Banaras Hindu University.

Field report (2006), A study on Biomass and Biodiversity in Satkosia Gorge Wild life Sanctuary, Orissa by foundation for Ecological Security, India.

FAO (1993), Forest Resource assessment 1990. Tropical Countries FAo forestry paper 112.

FES (2004), Biomass assessment in Sadhukonda reserve forest and Adjoining areas, Madanpalle, Andhra Pradesh.

Ravindranath S, Premnath S (1997), Biomass studies: Field methods for monitoring Biomass.

Stirling G, Wilsey B J (2001), Empirical relationships between species richness, evenness and proportional diversity.

Satkosia Wild life division, Annual Action plan,

Tiger Census conducted by the Satkosia wildlife Division, 2004

MANAGING WILD ANIMALS OF ORISSA

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INTRODUCTION

Animals are one of the beautiest creation of God. And talking about wild animals, they are simply magnificent. Wild lives play a pivotal role in maintaining natural laws. Hence being an important component of the environment, it needs proper conservation. For this necessary management practices are required both in in-situ and ex-situ conditions. Wildlife management is the backbone of wildlife protection. It mainly covers animal feeding, breeding, housing, living condition, health care, proper rescue, transfer and rehabilitation. During these practices it is imperative to see that the animals get less stress, & injury. Many a times, wild animals are required to be treated inside their own habitat which is a difficult proposition altogether. Most often due to habitat destruction and lack of feed wild animals enter into human habitat and cause destructions. They are required to be captured, controlled or shifted to save the human life and property. In Orissa generally elephants, leopards, sloth bears, monkeys etc. enter into human habitat and create law and order situation. They require careful handling and control. In different water bodies, mostly for migratory birds necessary disease surveillance is required to be carried out in time. Ex-situ dealing with animals is mostly limited to Nandankanan which is one of the famous wildlife establishment of the country. In all such cases proper expertise, innovative ideas, technologies and knowledge play very important role for safeguarding the lives of both humans and the wild animals as well. This paper reflects the cases handled & treated during last 7 years at different locations.

WILDLIFE STATUS OF ORISSA

Wild lives and forests are interdependent. According to a latest satellite survey, Orissa is still covered by 31.06% of forest of different densities. Though most of the faunal diversity has been lost from many parts of these forests, some did have enough population to bounce back given a helping hand. There have been 18 sanctuaries and 2 national parks so far declared apart from many protected areas awaiting necessary declaration. At present the state has 86 species of mammals, 473 species of birds and 110 species of reptiles. Some of the protected areas rich with wild animal resources are Similipal, Bhitarkanika, Chilika, Satkosia Gorge WL sanctuary, Badarama, Khalasuni & Debrigarh, Chandaka, Sunabeda, Konark-Balukhanda sanctuary, Lakhari valley, Bhetnoi and the infamed Nandankanan sanctuary. Apart from these, Gandhamardan, Harishankar, Kondakameru of Malkangiri, Malaygiri near Rengali, Narayan Patna in Rayagada district are also rich with varieties of wild lives.

ABOUT NANDANKANAN

Nandankanan is one of a rare zoo in world, which also holds the status of sanctuary. It is a large zoo and presently holds 439 nos. of mammals, 625 nos. of birds and 92 nos. of reptiles and a total of 1156 animals. Out of this 117 mammals, 19 birds and 66 reptiles come under schedule-I category. All these animals come under 41 mammal, 61 birds and 25 reptile species. Species picture of schedule-I

category is 21 mammals, 6 birds and 15 reptiles. To look after the health care and management of all these animals 2 regular and one reserve doctors are presently working. Apart from looking after the animals of Nandankanan, the zoo and wildlife veterinarians use to handle animal rescue and rehabilitation, treatment and translocation in free ranging condition as and when necessary. The training, innovative methods, technological expertise, experiences have been quite helpful for doctors of Nandankanan to almost single handedly cover the entire states' wildlife emergencies, although very recently Government is planning to extend training to vets at selective pockets of the state to look after such emergencies. Here in, some of exemplary cases where specialized treatment, innovative ideas and technologies have been successfully applied are described.

MAMMALS

Handling and treating most of the mammals are very difficult considering their size and power. Wild elephants mostly strayed out due to injuries need specialized treatment. A male elephant of Daitari jungle, a pigmy elephant of Satkosia gorge sanctuary, three number of wild elephants of Chandaka sanctuary have been injured and strayed out at different time. Except 1 case i.e.the elephant of Satkosia all other cases were died after all out efforts in tranquilizing, extending specialized treatment, wooden tripod structure, fluid therapy, lifesaving drugs and what not. In these cases with many difficulties the treatment was carried out inside jungle. One of the wild elephant calf of Keonjhar forest division having severe arrow shot injuries was later shifted to Nandankanan. But it was succumbed after a couple of week. But one wild elephant wes fallen deep into a pool of mud at Banibandh reserve forest of Athagarh which was successfully lifted. But many captive elephants, which roam with mahouts at different parts of the state, were successfully controlled against musth. A makna at Dhenkanal, another elephant named Kharsel, a huge elephant of Hirakud were successfully controlled by our team through tranquilization. Later the makna was successfully treated against injuries and translocated to Chandaka sanctuary via Nandankanan. But a trained elephant doing duty for Lord Jagannath was injured & fallen. After weak long treatment it died. However, one of the exemplary case was a female elephant in comatose state at Hirakud was successfully treated and lifted by help of a krane and a conveyor belt at its belly region to be cured after a month long treatment. In this case the support from the local youth club and People for Animal were noteworthy. Number of captive elephants including rescued calves were successfully treated & cured at Nandankanan Zoo. A male wild leopard entered into Shantinagar of Brahmapur was successfully tranquilized and captured. But during the transfer of the leopard to Nandankanan it was succumbed because of severe burn injuries due to mob frenzy and fire ball thrown to the leop-

Rescue of a female elephant from pool of mud.

Elephant in comatose condition- shifting of sides

Technique of lifting of sick elephant at Hirakud

Successful excision of an eyeball carcinoma in tiger

ard during the operation. Treatment of Royal Bengal Tiger in wild may not be possible. However, in Nandankanan zoo, a good number of tigers and leopards have been successfully treated. One 3 yr. old tigress was successfully operated upon against pneumothorax and a male white tiger of 9 yr. Age , named Gaurav was successfully treated against epidermoid carcinoma of the eye lid was excised under general anaesthesia. One male white tiger and a female Normal Coloured Tigress were successfully operated for amputation of tail. From out of 7 numbers of leopard cubs rescued from wild, only 2 were successfully treared. A wild sloth bear cub from Ghumsar forest division was severely injured and almost in comatose state was successfully treated at Nandankanan and after cure it was released at its original habitat. A sloth bear entered to Subarnpur town crossing river Mahanadi created panic. Simply utilizing the experience and presence of mind it was sent back to its habitat without much fuss. The infamous captive sloth bear, which was shot by personal security officer of collector, Nuapada, was successfully transferred to Nandankanan zoo. After month long treatment it was cured. Many spotted deer, pangolins, ratels, civets have been rescued in injured state and transferred to Nandankanan. Most of them have been cured and rehabilitated at Nandankanan. Some have been successfully released to nature. Through out the state many a time the Hanuman langurs and rhesus monkeys have reported to be completely erratic and bitten many people and caused panic in different villages. Among them rhesus monkeys of Konark, Chhatrapur and Brahmapur, hanuman langurs of vill. Bhaichuan, Gandarpur, Phulnakhara, V.S.S Nagar of Bhubaneswar city and Delang area have been successfully captured and released to nature. The newly formed Anti-Depredation Squad of Nandankanan has been instrumental in controlling the monkey menace of the state. The members of the squad have got life bating and nerve raising incidences and shown exceptional skill and dare devil attitude to accomplish. Also many a time innovative ideas and presence of mind have repayed to a great extent.

Radiogram performed on a sick leopard of Nandankanan

Tranquilization technique-A demo to forestry students

A rhesus monkey released to nature

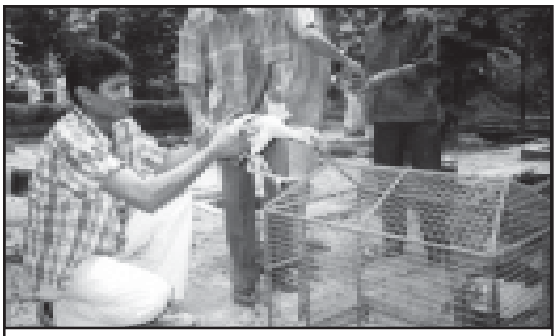
BIRDS

Even through Orissa inhabits many wild species of birds, still it has enhanced its beauty by inviting thousands of migratory birds. Apart from Bhitarkanika, Ansupa and Hirakud, Chilika, the big-

Team of scientist on bird flu surveillance at Chilika

B/S collected from an openbill stork for bird flu screening

gest brakish water lagoon of Asia invite large number of migratory birds like brahminy duck, bar headed geese, pintails, shovellers, flamingos, pelicans, poachards, spoon bills and painted storks . Recently India was affected with bird flu stigma. When it was confirmed at Nandurpur of Maharastra, the country was charged with confusion. Government of India declared high alert at different sensitive pockets. Hence, the team from Nandankanan in collaboration with Venkateswar Hatcheries Group, Pune made a preliminary sero-surveillance at Chilika and Nandankanan Zoo. The faecal samples and blood samples were collected and sent to Pune. Later it was declared to be negative by V.H. group after necessary testing. Many a time wild birds like Pariah kites, peacocks, doves, barn owls etc. have been injured and successfully treated and rehabilitated at Nandankanan Zoo. Once at Nandankanan sanctuary due to



An open bill stork rescued and rehabilitated

Thomas slint fitted to leg of a pea fowl

heavy storm, from a banyan tree, there was heavy birds fall out. In the early morning it was noticed that number of open bill storks died, eggs were broken and many a chicks also died. Another 8 numbers of young ones were completely drenched and in state of shivering were awaiting gruesome death. Under the state all these 8 birds were rescued and rehabilitated to zoo hospital, Nandankanan. Necessary tyreatment was imparted. After a couple of week 2 birds were survived and kept for more than a year at

Damaged wing of peacock surgically corrected

Successful surgery on wing of a rosy pelican

Enclosure No.76 and later released to nature successfully. A peacock of Nandankanan faced an accident, severely damaging its leg. It was surgically intervened and a modified Thomas splint was fitted to its leg. After extensive treatment it could not be survived. One more peacock rescued from Nandankanan sanctuary was having extensive damaged in its wings, which was successfully operated upon, and release to nature. A rosy pelican of Nandankanan also had damaged its wings which was successfully operated upon under anesthesia and fluid therapy taking assistance from surgical wings Orissa veterinary college. Now this particular rosy pelican lives a happily live in newly built aviary unit. During hot summer days a large number of birds are affected by severe heat stress at Nandankanan but with timely intervention and emergent treatment they have been cured.

REPTILES

Feeding of deworming tabs to a python

Many a times we have to handle dreaded snakes like King cobra, vipers, kraits etc. Recently a researcher rescued a huge king cobra from a city house. Later it was rehabilitated at Nandankanan.. We have to routinely deworm the cobra, pythons, kraits, vipers etc by catching it and introducing de-worming tabs through mouth. Also treatment is mostly imparted without using anesthesia, which happens to be a risky job. A technique is displayed to handle gharial crocodile. Recently two rescued elongated turtles were produced to Nandankana zoo with severe leg injuries. They were successfully treated and now the female one has laid eggs and we expect successful breeding there of. Since Gharial breeding is successful at Nandankanan, many a time number of young ones are required to be transported. With proper technique a gharial is captured before translocation.

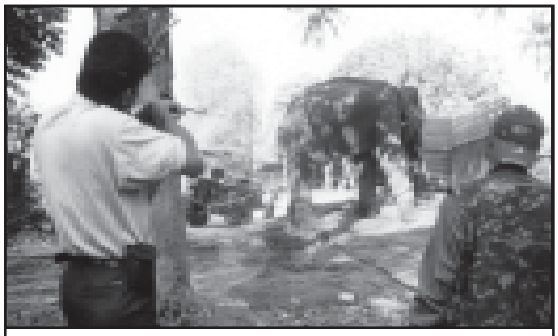
Physical capture technique of a crocodile

AQUATIC ANIMALS

Rescue and rehab of an Irrawady dolphin at Paradeep

As we know Chilika is housed to quite a few number of Irrawady dolphins. Many are also seen at Puri and Paradeep sea coast. Once a dolphin swam to the sea shore, then to a narrow stretch of water body of a farm house at Paradeep. It was completely sand trapped. With intervention of local forest officials and our technical assistance it was lifted and released to the sea successfully. Very recently another dolphin at Puri sea coast was possibly heat by a trawler and injured in the process. But before treatment was rendered it was succumbed.

INVOLVEMENT OF NATIONAL BODIES ON RESCUE & REHAB AT ORISSA



Mild sedation to a wild tuskar before translocation

We greatly owe to People for Animal the apex body at New Delhi for timely intervention and a strong support and back up. The state chapter of People for Animal also is not lagging behind. In sensitive cases like the wild tusker that entered into Biraramchandrapur, the bullet shot sloth bear that badly bitten to collector, Nuapada, the female elephant of Hirakud which was in comatose condition, excellent support in terms of finance, deputation of doctors and other logistics were provided by PFA. Inside the state among NGOs the notable ones like Wildlife Society of Orissa, Wild Orissa , OPES, NWCSO have done excellent job towards wildlife conservation and management. From national front CZA (Central Zoo Authority), New Delhi ,C.C.M.B.(Center for cellular and Molecular Biology), Hyderabad, W.I.I.(Wildlife Institute of India) BNHS (Bombay National History Society), DRDO (Defence Research and Development Organization, WTI (Wild Trust of India), Wildlife SOS at Agra have immensely helped towards wildlife rescue and rehabilitation, research, health caremanagement and conservation at large.From among private concerns, Venkateswar Hatcheries Group, Pune has been instrumental for serro-surveillance of bird flu at Chilika and Nandankanan. International bodies like WWF (Worldwide Funds for Nature and Natural Resources), IFAW (International Fund for Animal Welfare) have come a big way in serving wildlife resource of the state.

SIGNIFICANT ACHIEVEMENTS

1) Trypanosomiasis, Tuberculosis and Anthrax have been controlled at Nandankanan. with taking up routine prophylactic and curative measures. Overall animal mortality have been reduced to a greater extent at Nandankanan.

2) With best possible treatment, application of newer technologies the elephant of Hirakud was given a second lease of life.

3) The female elephant at Banibandh Reserve Forest of Athgarh Forest Division was successfully lifted from pool of mud.

4) The wounded sloth bear of Nuapada (Gun shot by Personal Security Officer) was successfully translocated, treated and rehabilitated

5) The pigmy elephant of Satkosia Gorge Sanctuary was treated inside jungle and was cured.

6) A huge tusker entered possibly from Chandaka sanctuary into thickly populated village Biraramchandrapur, killed two people and injured many was successfully tranquilized from distance of 80 meters by using immobilon. As a result on the spot, human killings were checked and property was saved.

7) Many finer surgeries in big cats were successfully conducted at Nandankanan Zoological Park. For ex. Pneumothorax in a young tigress was corrected and Eye lid carcinoma of a male tiger was operated upon and excised successfully.

8) We have successfully reared the abandoned leopard cubs and elephant calves.

9) Anti-depredation squads have been formed in different zones of the state to deal with Animal depredation activities.

10) Monkey menace of the state has been significantly controlled.

11) Also elephant depredation has been markedly controlled.

12) Timely disease surveillance has been carried out collecting samples from wild migratory birds against bird flu.

13) Research activities have been fastened. For example Nandankanan Zoo in collaboration with CCMB, Hyderabad has conducted artificial insemination in big cats (leopards and lions).

14) Nandankanan officials have been trained to take up vulture conservation project shortly.

15) Defense Research Development Organization made extensive studies on vector control measures, which have been apparently successful, and the vector loads of Nandankanan have been significantly reduced.

16) Students, researchers, trainees from forestry college, environment college, veterinary cillege, Indian forestry services have been provided with on the spot practical training at different wildlife establishments. Many a scholars have successfully done their post graduation, and PhD under our guidance.

17) Eco-tourism has been geared up at Satkosia gorge sanctuary and Chandaka Sanctuary by successful translocation of captive elephants.

CONCLUSION

Dealing with wild animals is not an easy job. With many difficulties the forest cover of Orissa as of now has been substantially preserved to 31.06%. Amidst natural calamities, disease out-breaks, unforeseen events, the biologists, wildlife experts, Government and Non-Government officials have been constantly trying their best to preserve one of the richest bio-diversity spot of the globe. Given further planning, financial back up, training etc. we strongly believe, we would be able to preserve and conserve one of the very important component of the environment i.e. wildlife resources to a greater extent. With these steps and positive attitudes Orissa would certainly be way ahead in many ways towards conserving its rich wildlife resources.

SUCCESSFUL TREATMENT OF A SICK ELEPHANT (*Elephas maximus*) IN SATKOSIA GORGE SANCTUARY THROUGH CHEMICAL IMMOBILIZATION

Samantaray R.K.* and Mishra A.K. **

Introduction

Satkosia Gorge sanctuary boasts of 180 elephants and is considered as a biological stepping stone with its rich biodiversity. It is included in Mahanadi elephant reserve for long-term conservation of eastern elephant population. Satkosia Wildlife Division has initiated all out effort to increase the existing elephant population by substantially reducing poaching, improving habitat management, strengthening rescue and rehabilitation measure and treatment of wild elephants. When situation warrants expert help is usually taken from Zoo and Wildlife Veterinarians of Nandankanan Zoological Park. At times it is highly required to treat the pachyderm through tranquilization in its wild habitat by dart firing from long distance using a dart gun.

Many a time forest staffs and local inhabitants report the sighting of herds of small sized elephants (pigmy). Local people call this elephant as "Kairi" or "Gunthuni Hati". Herds of Dwarf Elephants (Gunthuni Hati) with maximum shoulder height of 195 cm-215 cm have been reported from Satkosia Wildlife Sanctuary. Further studies are required like genetic finger printing to establish if these can be given a sub-species status (Draft on Orissa State bio-diversity strategy and action plan (2002) prepared by Nature and Wildlife Conservation Society of Orissa). The reported sick elephant was suspected to be a pigmy elephant. On 05.03.2005 after getting information regarding sighting of a limping female elephant (pigmy), the Assistant Conservator of Forests with staff of Purunakote Wildlife Range and some APR force trekked inside Purunakote Reserve Forest at compartment No.15. In the process, the team sighted the aforesaid elephant at around 1.30 PM. This particular elephant had its left foreleg markedly swollen at the lower end and was limping. She had restricted movement and localized herself on lower slope with lot of Bambusa arunadinacea (Thorny bamboo) in and around. The nearest water point was about 400 meter away with a pool of water close to the forest road. From the staff reporting and local enquiry it was ascertained that she had restricted herself to 1 Km. range (length) and 400 meters at lower slopes from Purunakote-Chotkei-Tulka forest road and Chhotkei-Katrag forest road junction **(See Photo-1)**

Photo - 1 : The elephant with left foreleg markedly swollen strayed out

Director, Nandankanan was reported the matter with intimation to the Chief Wildlife Warden (CWLW), Orissa for immediate intervention. Later the expert team of Nandankanan was directed to take up the matter. Finally a team comprising of Veterinary Officer, Range Officer and one assistant to the doctor arrived at Purunakote range office on 12.3.2005 evening along with tranquilizing equipments and drugs. They were then appraised regarding the latest development. The forest staff of Purunakote range kept close watch on movement of the elephant and also was constantly reporting the sighting over VHF for proper planning and execution of next day's operation.

Material and methods

Since the pachyderm remained sick inside Satkosia Wildlife Division, Angul; the expert team of Nandankanan was entrusted to treat the animal. It was decided to treat the animal with parenteral administration of long acting

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antibiotics because of mainly 3 reasons i.e. (i) Frequent usage of tranquilizing drugs would be harmful since a substantial quantity of drugs would remain in the system even though large quantity would be excreted through different means (ii) To avoid much stress to the animal because the process of tranquilization in the jungle needs chasing, creating noise, using fire crackers if situation demands. (iii) Expert healthcare team may not be available in all the protected areas. Hence most often zoo & wildlife vets were requested to come from distant wildlife establishments. Therefore distance factor, availability of vehicle, road condition, assisting men, leaving aside the priority of job become important actors while a team comes from a long distance. Considering all angles three different dates of treatment were fixed i.e. 13.3.2005, 17.3.2005 & 22.3.2005. The date wise chemical immobilization and details of treatments are enumerated below.

13.03.2005: -

In order to carry out the job in the morning hours, most often the team from Nandankanan used to come one day ahead and make night halt somewhere nearer to Purunakote forest range where the elephant was strayed out. Accordingly on 12th March'2005, the expert team made night halt at Tikarapada Forest Rest House. On 13.3.2005 morning at about 0830 hrs., the expert team from Nandankanan reached the spot i.e. Purunakote Reserve forest compartment No.15 along with Assistant Conservator of Forests, Divisional Forest Officer and the Conservator of Forests of Angul Circle **(See Photo-2)**

Photo - 2 : The expert team from Nandankanan with the forest officers at the spot before the operation

After sighting the animal from close quarter the team assessed size of the elephant and revealed that it must have been a pigmy elephant.

Tranquilization: -

However on eye estimation the Veterinary Officer estimated the body weight and accordingly drug Xylazene Hydrochloride 300mg (3ml), TROY LAB PVT LTD, NSW 2164, Australia, Atropine sulphate 0.6 mg (1ml.) with 2 ml distilled water was loaded to a 5 ml. metal syringe barrel with the plunger and the 1- 5ml. cartouche (explosive charge) already put inside the plunger in correct place. After setting the needle and the stabilizer the complete dart was put into the Mod 60 N Dist. inject gun and the Veterinary Officer with the gun followed the elephant from down hill upwards keeping the team behind so that the elephant will move upward and come to a large plain area on the hill to avoid post tranquilization danger. The plan went correctly and the drive out action by all forest staff from down to up hill continued. After a brief chase the elephant running helter-skelter came to the plain and gave a stand still position with all confusions. Without wasting time visualizing safety treatment on the plain area, the doctor dart fired the animal at 0950 hrs. from 35 meter distance with eye sight of the gun keeping at '9' as per Dist inject recommended chart using the white cartridge. The dart hit at the rump portion correctly. Team members were then advised not to make noise. After about 20 minutes the animal was under standing sedation close to the bamboo clumps and nearer to a slightly muddy ground. After testing the state of sedation, the doctor moved nearer the animal, patted and gave the first injectable. Once the animal co-operated means there was proper sedation and hence all the team members were advised to come near and do their allotted jobs.

Disease status:-

Because the animal was supposed to be under fluid therapy, with the support of two timber poles in crossed manner, the trunk was blocked to avoid possible attack by the elephant. A member caught hold of the tail. Since the animal showed symptoms of falling down towards right side, two timber poles one each at elbow and inguinal region were supported to keep the animal standing. Sterilized swab was collected from a small sized open wound over the swelling portion. Blood was collected from ear vein aseptically for further studies to support diagnosis, which would facilitate the treatment later. These samples were then sent to Orissa Veterinary College, Bhubaneswar for required tests.

Morphological parameters: -

The following morphological parameters were recorded. Shoulder height- 194 cm. (Circumference of front foot- 97 cm, Hence height – 194 cm.) (ii) Tail length- 120 cm. (iii) Chest circumference- 338 cm (iv) Neck circumference- 132 cm. (v) Body weight [As per formulae W=12.8(g+ng)-4281]=1735 Kg where W=weight in Kg/ g-Chest girth/ ng-Neck girth. (Ref: Cheeran J.V./2000/Elephant Facts)

(i) Details of treatment on 13.3.2005: -

At 10.20 hrs. the following treatment was imparted during the state of standing sedation. Penidure LA-24 i.e. Benzathine penicillin G 2400,000 I/U per vial inj. (Wyeth Lederle) 8 vials, Optineuron i.e.Vit B-1,B-6, B-2 & B-12 (Lupin pharma) 24 ml., Dexona i.e. (Dexamethasone sodium 4mg/ml (Cadila-Hc)- 10 ml., Atropine sulphate(0.6 mg/ml)- 3ml. Neo-hepatex(Liver extract)- 20ml. and Esgipyrine-N Vety. (Sarabhai zydus)- 40ml. were injected intramuscularly. Ringers lactate 1 ltr , 10% Dextrose 1 ltr. and Dexamethasone sodium(4 mg/ml)- 10ml. were administered intravenously. Steroid Prednisolone (40 mg/ml.)20 ml was injected intra-jointly at the swelling part. Local area was applied with Iodex rub ointment. **(See Photo-3)**

Photo - 3 : The female elephant given treatment under standing sedation on 13.-03-2005

(ii) Reversal: -

Once the treatment was over at 1125 hrs. Romaverse i.e.Yuhimbine Hydrochloride 60 mg (Jurox, NSW2820, Australia)- 3ml. was given intravenously in the ear vein. Reversal time was 5 minutes in this case and by 1130 hrs. the animal came to normalcy and slowly walked into the jungle.

17.3.2005:-

The expert team including the forest officials halted at Forest Rest House on 16th night to have early treatment the next morning. On 17th the party entered the jungle and sighted the elephant in the near by zone of the plain area. Same dart and the cartridge were used and the animal was dart fired from 30 meter distance.Dosage of Xylazene HCl was also maintained in the same level for standing sedation taking experience from the earlier tranquilization programme.

(i) Tranquilization: -

3 ml. (300 mg) Xylazene HCl mixed with 2 ml. Distilled water was loaded to 5 ml. syringe barrel. Darting was carried out at 1140 hrs. and by 1155 hrs. its legs were fixed, vulva completely relaxed with interim snoring sound indicating the induction time to be 15 minutes. From 1200 hrs, treatment was carried out as follows.

(ii) Details of treatment: -

More or less same line of treatment was carried out maintaining the same drug dosage level. Only in this case Genticyne (Gentamycin 40mg/ml.)- 10 ml. was also given into the carpal joint for quick reduction of the inflammation. This decision was taken after getting the antibiogram report from Orissa Veterinary College, Bhubaneswar. Iodex rub was gently applied to the swelling area **(See Photo-4).**

Photo - 4 : Local application of liniment during course of treatment on 17.03.2005

The sterilized swab collected on 13.3.2005 from the site of inflammation after antibiogram revealed it was highly sensitive to Gentamycine.

(iii) Reversal :-

At 1310 hrs. Romaverse 3 ml. I.e.Yuhimbine Hydrochloride 60 mg. (Jurox, NSW 2820, Australia) was given intra-venously. The pachyderm recovered gracefully at 1315 hrs. Hence the reversal time was also the same as in the previous case.

22.3.2005-

As per planning the expert team from Nandankanan halted at Purunakote Public Works Department Inspection bungalow on 21.3.2005 night. The nearest stay was arranged to save time and to undertake early morning treatment. On 22nd morning at 0830 hrs. the team entered the jungle. It was reported that the animal had moved one kilometer from the earlier place. After half an hours walk in difficult terrain it was located near a huge teak tree.

(i) Tranquilization:-

Finally at 0930 hrs. 300 mg (3ml) Xylazene HCl mixed with 2 ml distilled water was dart fired from 35 meters by mod 60 N gun. The dart hit perfectly to the left gluteal zone. After 15 minutes the animal moved 15-20 ft and came from right side to the left side of the huge tree and rested its body (right side) to the huge size trunk of the teak tree. The doctor after gauzing its sedation status, proceeded nearer the animal and after necessary testing carried out the following treatment.

(ii) Details of treatment: -

Since in the second attempt drug dosage was rationalized, the third attempt was successful with requisite standing sedation to carry out the job smoothly. Analyzing the state of recovery viz. steady regression of swelling of the joint, acceptance of feed and better movement; the same line of treatment was extended as in the second attempt. Treatment started at 0945 hrs. and completed by 1145 hrs. In this case a steroid, Prednisolone (40 mg/ml)- 10 ml. and antibiotics Gentamycin (40 mg/ml)- 10 ml. injected into the joint cavity for faster recovery. **(See Photo-5)**

Photo - 5 : Administration of intrajoint injection of steroid and antibiotics on 22.03.2006

(iii) Reversal: -

At 1150 hrs. Yuhimbine HCl 60 mg. was given through slow 1/v route brought back the pachyderm to normalcy at 1155 hrs. Hence, in this case also the reversal time was 5 minutes.

Results and discussion

One should necessarily have a professional approach to face such an operation. Also to fast read the jungle terrain, water body, thickets, slopes, soil condition etc are important. Assistance of trained personnel is a must. One should have a check- list of items. Beforehand one should arrange materials like wooden logs, ropes, chains, specially made long stick for holding saline bottles, food like sugarcane, bamboo leaves etc. Doctor and staffs should take many precautions while dealing with a wild elephant like perfect darting, to escape from elephant chase, checking sedation, maintaining distance from trunk and legs, timely support of wooden poles to check the animal from falling down etc. The pachyderm responded nicely to Xylazine HCl for a better standing type sedation since all attempts were successful. Throwing a small stone to its body and striking its tail by a long stick may do testing of proper sedation. To check cardiac irregularity like bradycardia and reduction of heart block due to vagal activity, atropine sulphate (0.6 mg) worked well. Rise of temperature was reduced by sprinkle of water over head and body parts. Supportive therapy viz. neuro-tonics, liver supplements, steroids and intravenous administration of balanced fluid facilitated the process of recovery. Further intra-joint administration of steroids and antibiotics worked well to reduce the joint swelling. Yuhimbine Hydrochloride worked well as antidote to Xylazine Hydrochloride and there was proper and timely reversal in all occasions. There was slow and steady regression of the swelling and inflammation of the site and healing of small wounds over the swelling. Hence, the selected long acting antibiotics i.e. Penidure LA (Benzathine penicillin) worked well. Antibiogram and blood profile also gave better clue to support treatment The animal was reportedly moving freely in the vicinity of Purunakote Reserve Forests from 25.3.2005 onwards indicating that animal was recovered.

DATA SHEET FOR RECORDING & MONITORING TRANQUILIZATION ANTIBIOGRAM & BLOOD PROFILE OF SICK ELEPHANT

Species	:	*Elephas maximus*
Sex	:	Female
Age	:	Around 30 years.
Sub-species	:	Suspected to be Kairi/Gunthuni/Dwarf elephant
Captive/Wild	:	Wild
Purpose of capture	:	Treatment of swollen carpal joint.
Herd/lone	:	Loner
Morphological parameters	:	Front foot circumference- 97 cm. Shoulder height- 194 cm. Tail length- 120 cm. Chest circumference- 338 cm. Neck circumference- 132 cm. Body weight- 1735 Kg.
Condition of animal	:	Shinning coat, no ectoparasite, swollen carpal joint of left foreleg, appeared normal sluggish.

Sl. No.	Items	13.03.2005			17.03.2005			22.03.2005		
1.	Gun used for darting	Mod 60 N Dist.inj.			Mod 60 N Dist.inj.			Mod 60 N Dist. Inj.		
2.	Syringe barrel	5 ml.			5 ml.			5 ml.		
3.	Canula size	Elephant canula			Elephant canula			Elephant canula		
4.	Cartridge	White			White			White		
5.	Cartouche	1-5 ml.			1-5 ml.			1-5 ml.		
6.	Eye sight	9			9			9		
7.	Drug Xylazine HCl for sedation	300 mg.			300 mg.			300 mg.		
8.	Atropine sulphate	0.6 mg.			0.6 mg.			0.6 mg.		
9.	Time of darting	0950 hrs.			1140 hrs.			0930 hrs.		
10.	Induction time	1010 hrs. (20 min)			1155 hrs. (15 min)			0945 hrs. (15 min)		
11.	Behavioural changes out of drug effect	Relaxation of vulva, snoring, trunk movement ceased four legs fixed, ear flapping & Salivation								
12.	Physiological changes	1030hrs.	1045hrs.	1115hrs.	1200hrs.	1230hrs.	1300 hrs.	1000hrs.	1030hrs.	1100hrs.
	Temperature	98^0F	98.5^0F	97^0F	98.5^0F	97^0F	96^0F	98^0F	97^0F	96.5^0F
	Pulse	32/mt	30/mt	28/mt	33/mt	30/mt	27/mt	30/mt	28/mt	26/mt
	Respiration	7/mt	8/mt	8/mt	8/mt	8/mt	9/mt	7/mt	7/mt	8/mt
13.	Drug Yuhimbine HCl for recovery	60 mg.			60 mg.			60 mg.		
14.	Time of injecting antidote (1/v)	1125 hrs.			1310 hrs.			1150 hrs.		
15.	Reversal time	1130 hrs. (5 mts)			1315 hrs. (5 mts.)			1155 hrs. (5 mts.)		

- Antibiogram report against sterilized swab collected on 13.03.2005 revealed that it was highly sensitive to Gentamycine.
- Blood Haemoglobin was reduced to 10 gm. %.
- Blood differential count was reported to be – Neutrophil – 61%, Lymphocyte- 29%, Monocyte- 2%, Eosinophil- 8% and Basophil- Nil.

Conclusion

Since this particular elephant's height was short, body size was small having less body weight, it was thought to be a pigmy elephant. To add to it comparing the look, development of 1" ear fold, genital development, behaviour and attitude, the assessment is justified and after all many past sightings could draw a more conclusive analysis amongst the foresters, biologists and the wild lifers of the state. The whole episode of 13th March'2005 has been video graphed for further analysis by the wildlife biologists towards confirmation of presence of pigmy elephant herd at Satkosia Gorge Sanctuary. A wild lifer from Non Governmental Organization "Wild Orissa" had already published a first hand report recently in Sanctuary Magazine. Xylazine HCl worked well in Pachyderm towards standing type sedation. Generally in elephants the recommended dosage is 100 mg/ton. Here in case of Pigmy elephant the recommended dosage is 173 mg/ton (or say 175 mg/ton) i.e.1.75 times more than that of normal Asiatic/African elephant. Yuhimbine Hydrochloride as antidote of Xylazine Hydrochloride worked efficiently with the dosage level of 34.6 mg/ton (or say 35 mg/ton). The drug induction time ranged from 15-20 minutes. It was more so 15 minutes since the first attempt was 20 minutes but rest occasions it was 15 minutes. Temporary support of wooden poles to block the trunk is safe to carry out treatment. In jungle terrain leading the animal from slope to plain area saved the animal from falling down to the ground. Cautious approach of event management and presence of trained personnel worked well in this case. Proper feed back treatment of neuro-tonics, liver supplements, balanced fluid therapy, steroids, intra-joint infusion of both antibiotics and steroids facilitated fast recovery. Reversal with requisite dosage of Yuhimbine HCl (35mg/ton) has been henceforth recommended. Reversal time was invariably 5 minutes in all three occasions.

Acknowledgements

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Summary

This paper discusses the treatment of a limping female elephant with left foreleg swelling at carpal joint. This particular female elephant claimed to be a pigmy elephant of Satkosia Gorge Sanctuary, Angul District, Orissa. Because of its leg problem, its movement was restricted and it was strayed out from the herd. Specialized treatment was provided during state of standing sedation by tranquilzing through dart firing from a Mod 60-N Dart Gun from a distance of 30-35 meters, using the drug Xylazine Hydrochloride. Drugs like long acting antibiotics, analgesics, steroids, neurotonics, liver extract, fluid therapy and other life saving drugs were given on a definite interval i.e. 13.3.2005, 17.3.2005 and 22.3.2005. In each case after the treatment Yuhimbine Hydrochloride was administered intra-venously for a timely reversal. The swelling of leg was reduced and the mobility was restored. The animal recovered gracefully and as reported the animal was able to walk properly from 25.3.2005 onwards in the vicinity.

References

(1) Basappanavar C.H. (1998) Capture care and Training of Elephants; *'Elephant- Lady Boss'* Vanasuma Prakashana, A-605, Mittal Tower, and 6, M.G. Road, Bangalore-560001, India: PP.209-233.

(2) Cheeran J.V. (2000) Elephant Facts, *Elephant management resource material*: PP-3

(3) Choudhury S.R. (1982) Tranquilizing a wild tusker, Ganjam Experience; *'Hornbill'*: July-September : PP.25-39.

(4) Fowler, M.E. (1978) *Restraint and handling of wild and domestic animals*. The IOWA State University press: PP-231-239

(5) Jacob V. Cheeran. K. Chandrasekharan. K.N. Muraleedharan Nair. & K. Radhakrishnan (1991): Use of Xylazine as an anaesthetic for elephants in surgical conditions. *International seminar on Vet. Med. in wild and captive elephants.* Bangalore: 22c.

(6) Muraleedharan Nair K.N. K. Radhakrishnan.K.Chandrasekharan.Jacob V. Cheeran.S. Raveendran Nair & P.O. George (1992): Anaesthesia for surgical manipulations in the elephants. *The Asian Elephant-Ecology, biology, disease, conservation and management*-KAU: PP-156-158.

(7) Nair Muralidharan K.N. (2000) Anaesthesia for surgical manipulation of elephant, *Elephant management resource material*: PP-44.

(8) Namboodiri N. (1997) *Practical Elephant Management, A handbook for Mahouts*; Publisher Elephant Welfare Association & Zoo: PP.13-23.

(9) Nature & Wildlife Conservation Society of Orissa (2002*) Orissa State Bio-diversity strategy and action plan* : PP 10-10.

(10) Singh L.A.K., Nayak B.N. and Acharya S.K. (1996) Chemical capture of a problem elephant in Bolangir, Orissa; *'Indian Forester'*; 122(10) : 955-960.

(11) Srivastava S.S. and Singh L.A.K. (2001) *Elephants in Similipal*; History, status, issues, techniques and Biological notes on Elephants; (1) : 80-127.

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Blackbucks in Ganjam: Symbols of Prosperity

J. K. Panigrahi

INTRODUCTION

When the great apes - gorillas, chimpanzees, and baboons - are being hunted to extinction for commercial bushmeat in the equatorial forests of west and central Africa, when the density of the golden-cheeked warbler *(Dendroica chrysoparia)* - an endangered migratory species of bird that breeds only in central Texas - is radically declining, and when many such other species of wildlife are on the brink of being pushed into the threatened or endangered category, the Indian gazelle, blackbuck in the Ballipadar-Bhetnoi and adjacent areas of Ganjam district in Orissa must be heaving a sigh of relief for being protected passionately by the local communities, may be on religious grounds. As more and more natural ecosystems of the world are devastated sequel to an array of anthropogenic activities and as the pristine habitats are degraded, the wildlife species inhabiting them are now encountering severe threats and consequently, are disappearing at an alarming rate. Such being the overall global scenario, the blackbuck population in Ganjam exhibits a different statistics of increasing trend over the years that attracts the attention of the wildlife conservationists.

Fig. 1: A male blackbuck quenching its thirst

Taxonomic Position

The Indian blackbuck, *Antilope cervicapra* (Linnaeus, 1758), the most elegant among the antelopes, has the following systematic position in the Animal Kingdom.

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Superorder:	Cetartiodactyla
Order:	Artiodactyla
Family:	Bovidae
Subfamily:	Antilopinae
Genus:	Antilope
Species:	cervicapra

Some of the local names for the species include *ena* (male), *harina* (female) and *mriga* in Sanskrit; *hiran* (male), *hirni* (female) and *kalwit* (female) in Hindi, and *krushnasara* and *kala harina* in Oriya.

Distribution and Habitat

The blackbuck is a species of antelope distributed mainly in India, though is also found in some parts of Nepal and Pakistan. It has also been introduced into other parts of the world, including numerous ranches of Texas in the USA, where its populations are fluorishing. There are four subspecies or geographical races of blackbuck - *cervicapra* (Linnaeus), *rupicapra* Muller, *rajputanae* Zukowsky and *centealis* Zukowsky (Prater, 1971). Though the species was spread over large tracts of India in the past (except in north-east India), it is presently confined to parts of Rajasthan, Punjab, Haryana, Gujarat, and Orissa with a few small pockets in Central India (Madhya Pradesh). Some of the best places to observe blackbucks in the wild are Tal Chapar in Rajasthan and Velavadar in Gujarat, and the Jodhpur area (Ghosh and Singh, 1990). Many zoos of the country keep the species as one of the popular exhibits that enchants the tourists. They are essentially creatures of open plains covered with scrub or cultivation, but not averse to thin forests with wild expanses of grass.

Fig. 2: A male in the company of two female blackbucks

Orissa is the home to three species of antelopes – Blackbuck, Chowsingha (*Tetracerus quadricornis*) and Nilgai (*Boselaphus tragocamelus*) - all the three being even-towed (artiodactyle) bovids. Though in the past the blackbuck was distributed in the districts of Balasore and Puri, and to lesser extent in Bolangir and Kalahandi, and also in the sand dunes of Bhitarakanika and Kujanga regions, it is now occurring primarily in Ballipadar-Bhetnoi and adjacent areas of Ganjam district, and Balukhand-Konark Sanctuary of Puri district. The habitat of blackbuck primarily covers about

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60% cultivated lands/ cropped fields, 15% rocky elevations, 10% man-made houses and roads, 8% forest cover, 5% water bodies, and 2% horticulture farms and wastelands (GoO, 2004)

Distinguishing Features

Blackbucks exhibit distinct sexual dimorphic characters. The male possesses brown coat colour at its young stage with pure white underbellies and chest, and is without horns. However, as it matures to adulthood and grows older, it attains elegant black coat colour, a white patch around each eye, and an unbranched, long, ringed and spirally twisted or 'corkscrew' horn with three to four turns on each side of the head. The horns measuring up to 70 cm in length, add to the grandiose of the male and are never shed unlike the antlers of deer. The male may attain a maximum height of about 80 cm at the shoulder and a weight of about 40 kg. The female is smaller than the male in size and has a yellowish brown coat colour with white underbellies, and horns are lacking in it.

Blackbuck exhibits two outstanding characteristics: speed and vitality (Seshadri, 1995). It is considered as the fastest of the Indian antelopes progressing in a series of graceful bounds and the second fastest animal in the world being next to Cheetah, which was used by the Indian princes and their nobles to run down it in their hunting spree. It feeds on grass and various available cereal crops. Usually living in groups of 20-30, each blackbuck herd functions under the leadership of an old and vigilant female. Breeding occurs in all seasons of the year, but the main sexual excitement of the male (rut) takes place between February and March (Prater, 1971). The young ones, produced one or two at a time, gain strength quickly and join others in the herd.

Present Conservation Scenario

Wild animals all over the globe are woefully experiencing momentous decline in their population at the present juncture and there is very little place on earth where they can live in peace and contentment. Blackbuck is no exception to such trend as varied factors such as uncontrolled poaching, escalated habitat destruction and predation have contributed to its fast decline. Once living in enormous herds, with early nineteenth century accounts of congregations of 10,000 animals at places, the animal is presently confined mostly to the existing reserves. Considering this reality, the IUCN has designated it under the vulnerable category in the Red Data Book (1994). In blatant contravention of the laws, the blackbuck is hunted for its flesh, skin and sport purposes; the recent shooting of the animal by Bollywood stars has brought to the fore the overarching threats to the race. Of course, *in situ* conservation through protected areas of different categories, especially in Bishnoi areas around Jodhpur and Buguda areas of Ganjam under community protection, and *ex situ* conservation in the zoos have saved the antelope from its imminent extinction. The important national parks and sanctuaries protecting the antelope are Blackbuck National Park (Velavadar), Bandhavgarh National Park, Kanha National Park, Ranthambhore National Park, Corbett National Park, Bharatpur Bird Sanctuary, Gir National Park and Chhapar, Churu, Blackbuck Santuary.

Fig. 3 : 'Corkscrew' horns adding to the grandiose of male blackbuck

In Orissa, the blackbuck population during 1960s was reported to consist of 1200-1300 individuals, which in due coarse has reduced to about 800 to 900 at present. Earlier, the royal people of India were taking pride of hunting the blackbuck; the trend declined only after independence of the country. The enhanced demand for arable land and grazing ground for domesticated cattle has culminated in encroachment of the natural habitat of blackbuck. It is also exposed to bovine diseases on coming in contact with the domesticated cattle. The remaining population is under threat from inbreeding consequent to reduced population.

The Ganjam Illustration

The blackbucks in Ganjam district of Orissa are a fortunate lot, since they are regarded as the symbols of prosperity. They esteem the Hindu mythological belief that considers blackbuck or Krishna Jinka as the vehicle (vahana) of the Moon-god or *Chandrama.* The other belief is that blackbucks are devotees of Lord Rama and Lord Krishna. Thus, the villagers worship them and consider their killing as a sinful act, similar to the Bishnoi community in Rajasthan, who believe their ancestors' souls dwell in blackbucks. Even blackbucks occupy place in the sculptures of some temples. People consider the grazing

of the paddy fields by blackbuck as a boon, since the yield enhances consequently, and believe that their prosperity is linked with blackbuck's conservation. These religious beliefs have come as saviours for them.

The people have displayed their commitment for conservation of the species further by constituting a Blackbuck Protection Committee with the participation of two members from each family of the locality. Such rescue operations and custodianship on the part of the local communities have brought about exemplary increase in the population of this antelope in the Ballipadar-Bhetnoi area, declared as a game reserve in 1989 for providing protection to blackbucks and their habitat comprising 64.21 km^2, under Buguda range of Ganjam (Table 1). The population count of 2004 reveals a 42% increase in number of blackbucks over the census of 1998 (GoO, 2004). In recognition of the commendable work undertaken for conservation of the blackbucks, the first Biju Patnaik Award for Wildlife Conservation, worth Rs.50,000 and a citation, was conferred on the Blackbuck Management Committee of Buguda tehsil in Ganjam district, the place having the highest concentration of blackbucks in the state, on the occasion of the celebration of the 51st Wildlife Week in October 2005. The people of Buguda and the adjacent blocks of Aska, Jagannath Prasad, Polasara, Purushottampur and Khallikote have recently expressed their desire to have a notified Ghumusar blackbuck community reserve under the relevant provision of the Wildlife Protection (Amendment) Act, 2002. The Ganjam illustration elucidates how significant the contribution of local communities can be in transforming the conservation movements into reality.

Table 1: Population trend of blackbucks in Ballipadar-Bhetnoi area during 1973-2004 (GoO)

Year	Male (% out of total)	Female (% out of total)	Young (% out of total)	Total Number	Sex Ratio M/F
1973	152 (29.1)	302 (57.7)	69 (13.2)	523	1:2.0
1980	129 (26.6)	284 (58.7)	72 (14.8)	485	1:2.2
1998	94 (17.1)	376 (68.2)	81 (14.7)	551	1:4.0
2004	212 (27.0)	487 (62.0)	87 (11.0)	786	1:2.3

The Future Agenda

The blackbuck has been included in the Schedule-I of Wildlife (Protection) Act, 1972 and the laws provide ample protection to this rare antelope. However, despite being listed in the Schedule, there has been blatant violation of the law on many occasions. Consequently, the species once roaming freely in large herds in the plains of north India, has suffered heavy casualties and diminished in number drastically. However, at the present juncture, the survival of blackbuck seems assured with the creation of reserves for its protection such as Velavadar and Point Calimere, and also in Keoladeo, Ghana, Shivpuri, Bandhavgarh and Kanha (Seshadri, 1995). Notwithstanding the fact that protected areas work as conservation tools for wildlife and further creation of such areas would boost the survival security of blackbuck, the antelope needs to go back to the natural state of wilderness from the confines of the protected habitats such as zoos and reserves. The *Homo sapiens*, as a superior species, must be more radical in changing its attitude towards the environment and the ction plans for conservation vith the other species of flora leleterious effects on the ir biodiversity would be the nake to the Mother Nature. he habitats of not only the pecies, but also of diverse ould take them out of the long-run save everything – sitive wildlife. Let blackbuck all other species. We need m, conduct ourselves as conscientious stewards of Nature and have the responsibility of protecting and conserving all forms of life on Earth.

Fig. 4: Indian Blackbuck by Jean-Baptiste Oudry - an artistic creation

REFERENCES

Ghosh, N. and Singh, R. (!990) *Wildlife of India*, Tiger Books International, London.

GoO (2004) *Wild Orissa*, State Wildlife Organization, Forest Department, Government of Orissa, Bhubaneswar.

Prater, S.H. (1971) *The Book of Indian Animals*, Oxford University Press, Bombay Natural History Society, Bombay

Seshadri, B. (1995) *Call of the Wild : Survival in the Sun*, Sterling Paperbacks, New Delhi – 110016.

A LEAP TOWARDS BANDAGING THE WOUNDED LANDSCAPE: STRENGTHENING THE ELEPHANT CORRIDORS OF ORISSA

S. K. Tiwari

INTRODUCTION

Fragmentation and shrinkage of wildlife habitats is one of the major threats to the long-term conservation of species. Closely coupled with the issue of large-scale loss of natural habitats is the challenge of maintaining and conserving biodiversity in a landscape dominated by human beings. Strategies to reduce the adverse effect of habitat fragmentation have been widely discussed and one proposed method for moderating the negative effects of habitat fragmentation is the preservation and restoration of biological corridors thus making bandages for the wounded natural landscape (Soule and Gilpin, 1991). Wildlife habitats in India are no exception to the ubiquitous phenomenon of shrinkage, fragmentation and degradation. Large animals like elephants, which require extensive areas for survival, are the most affected ones leading to increased conflict between humans and elephants.

ELEPHANT HABITATS IN ORISSA

The elephant habitat in Orissa consists of about 11,000 km^2 forests forming about 24% of the forest cover of the State and supports approximately 1800 elephants. Although this number is only a little over 7.5% of the elephant population of India, the area has a comparatively high elephant-human conflict. Over 200 people have lost their life due to elephants in the last five years (2000-01 and 2004-05), an average of more than 40 human deaths per year. The elephant habitats north of the river Mahanadi is threatened by severe mining activities, where as the southern part (about 5030 km^2) suffers from shifting cultivation.

The elephant habitat of Orissa is broadly divided into four major populations ***Similipal-Kuldiha-Hadgarh*** and the adjoining population comprises of three Protected Areas *viz*. Similipal Tiger Reserve, Hadagarh and Kuldiha WLS and is in continuity with Noto RF, Sukinda RF and Badampahar RF and supports about 500 elephants. Initially Kuldiha WLS, Hadagarh WLS and Similipal NP were part of a larger continuous stretch of forest area but now Kuldiha has been separated from Similipal due to chromite mining at Baula RF and expansion of settlements and agricultural land. Similarly, elephant movements from Orissa to South Chaibasa (Jharkhand) takes through degraded forests patches of Badarampahar RF, Budhipat and Basila RF up to Mosabani Range (Jharkhand) through even more degraded forest patches of Badarampahar, Dhasra, Tungru and Sarali RF. Movement between north Similipal and Tapoban (Jhargram, West Bengal) area has also been severely threatened by mining and agricultural activities (Tiwari *et al*, 2005).

Satkosia-Baisipalli and adjacent areas of Athamalik division, Mahanadi WL division and Angul Forest Division includes two Protected areas- viz Satkosia George WLS and Baisipalli WLS forming part of the State Mahanadi Elephant Reserve (1023 km^2). Satkosia-Baisipalli forms a continuous habitat with the river Mahanadi bifurcating them. The construction of the Manjhor dam has obstructed the movement of elephants between Taleipathar RF and Baruni East and Baruni West RF, an important link between Satkosia and Khalasuni. Talcher-Sambalapur railway line, irrigational canals, mining and illegal felling of trees have also fragmented the habitat and increased man-elephant conflict.

South Keonjhar plateau and adjacent areas includes the Deogan, Ghatgaon and Telkoi Ranges of Keonjhar Forest Division and Kamakhyanagar East and West Ranges of Dhenkanal Forest division and adjacent areas spread over 2600 km^2 area. Considerable deterioration of elephant habitat has occurred in the Dhenkanal Forest Division due to the construction of Rengali irrigation canal at Samal and other medium sized irrigation canals. This, coupled with encroachment has severely fragmented the habitat. Habitat degradation and encroachment in and around Saptasajya RF in Dhenkanal Forest Division has also severely hindered the elephant movement between north–east Dhenkanal and south-west Dhenkanal. This, along with heavy mining in the neighboring Sukhinda Range of Atagarh Forest Division, has almost severed the elephant connectivity between Angul and Similipal (Sar and Lahiri-Choudhury,1999 and 2002 and Tiwari *et al*, 2005).

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Madanpur-Rampur-Kotgarh and Chandrapur is to the south of the river Mahanadi and covers the districts of Phulbani,(Kandhamal) Kalahandi and Ganjam. A major part of this area is under shifting cultivation and Kotgarh is the only PA in this area. Elephant movement between Kotgarh WLS and Kalahandi used to occur in the past but has now been discontinued due to shifting cultivation and encroachment. Elephant movement between Kotgarh WLS and Chandrapur RF takes place through degraded forest patches. The population of Lakhari valley WLS and Mahendragiri has been isolated from other elephant populations.

Wildlife Trust of India has identified nine elephants corridors in Orissa- six within the state and three are interstate corridors joining the elephant habitats of Orissa and Jharkhand (Tiwari *et al*, 2005). These include:

Similipal- Satkosia (Similipal- Hadagarh) corridor connects Similipal NP with Hadagarh WLS through Noto and Satkosia RF. The corridor is intact at present, but human settlement and anthropogenic pressure is slowly degrading the corridor and can fragment the elephant habitats.The corridor is regularly used by herds of 20-25 elephants.

Baula- Kuldiha (Hadgarh-Kuldiha) corridor connects Kuldiha WLS with Hadagarh WLS through small hillocks in Garsahi RF, Gaguapahar, Balihudi and Baula hills and is now confined only to these hills as villages have come up near the foothills. Blasting in the stone quarries and in Baula chromite mines and degradation of corridor forest due to expansion of settlements and agriculture are major threats. The corridor is mostly used by loners and small herds.

Kahneijena- Anantapur : Elephants from Satkosia WLS, Handapa RF and adjoining area of Athamalik Forest Division are connected by some degraded and discontinuous forest patches of Simulipathar RF, Durgapur RF, Nisha PF, Kuio PF, Kauchiakhol RF, Rakas RF and Kahneijena RF with Anantapur Reserve Forest of (Khamakhyanagar Range) Dhenkanal Forest Division covering a distance of about 40 kms. However, there is major discontinuity between Kahneijena RF and Anantapur RF. The elephants cross Brahmani River near Joka village. Due to construction of Rengali canal, the movement has been severely affected, but the elephants are reported crossing the canal near Joka village. Heavy traffic on NH-23, rail and expansion of settlements are other major threats. Used mostly by loners and small herds of three to five elephants during October-February.

Tal- Kholgarh corridor connects Tal RF with Kholgarh RF and Landakot RF thereby connecting the elephant population of Satkosia WLS with Khalasuni WLS though Baruni (East and West) RF and Raun RF. Heavy traffic on NH-42, the construction of a railway line (Sambalpur-Talcher) that passes through the corridor and degardation of forest have severly affected the movement of elephant. The elephant crosses the railway line near Podabarunda. The corridor is regularly used by herds of 10-12 elephants.

Nuagaon- Baruni corridor connects Satkosia WLS, Talaipathar and Nuagaon RF with East and West Baruni RF. The corridor has been threatened by the construction of Manjhor dam near Manabera village thereby reducing elephant movement between Angul and Rairakhol Forest Division through Athamalik Forest division. The dam will submerge about 442 ha of forest land and about 8 villages. The corridor is regularly used by herds of 8-12 elephants.

Kotgarh- Chandrapur: Kotgarh WLS (Balliguda FD) is connected with Chandrapur RF (Raygada FD) through this corridor. Elephants pass through Lassery, Belgarh and Baliguda forest block and some settlements to move from Kotgarh to Chandrapur. Degradation and fragmentation of habitat due to expansion of human settlement and shifting cultivation has affected the movement of elephants in this region. The corridor is regularly used mainly by bulls and small herds of five to nine elephants.

The Interstate corridors connecting elephant habitat of Orissa and Jharkhand includes:

Karo- Karampada: Karo and Sidhamat RF of Keonjhar Division (Orissa) is connected to Karampada RF of Saranda Division (Jharkhand) through this corridor. With marked reduction of elephant movement between Tholkobad

and Toda RF due to disturbance from settlements and developmental activities, this corridor is important for continuity between elephant populations of Jharkhand and North Keonjhar and further onwards to Bonai Forest area of Orissa. Major threat is from expansion of SAIL township - NMDC colony and nearby villages, mining and road and rail traffic. Used mostly by loners and small herds of three to five elephants during October-February.

Badampahar- Dhobadhobin corridor connects Badampahar RF (Orissa) with Dhobadhobin RF and Unduda PF leading to Haldipokhari RF of South Chaibasa (Jharkhand). The corridor maintains connectivity between Similpal and south Chaibasa. Major threat is from degradation and fragmentation of habitat due to expansion of settlements and agricultural activities. The corridor is seasonally used by bulls and herds of 6-10 elephants during October-February.

Badampahar- Karida East corridor connects Badampahar RF of Orissa with Karida RF of Jharkhand thereby maintaining contiguity between Similipal NP (Orissa) and Mosabani Range of Dhalbhum FD (Jharkhand). During movement, elephants from Similipal pass through Badampahar RF, Dhasra RF, Teltangia VF, Dhenkla PF, Tungru RF, Sarali RF (Orissa) to enter Karida East RF near Satbakra (Jharkhand). The corridor is very much fragmented and has narrow and degraded patch of forest. Settlements and agricultural activities in the area, high traffic on NH-6 and other developmental activities are major threat to elephant movement. The corridor is regularly used by both bulls and herds.

CONCLUSION

It is very important that the identified corridors is secured at the earliest and the first approach should be to declare them as state elephant corridor followed by legal protection under various laws appropriate for the area. Developmental policies in elephant habitat should be thoroughly discussed involving various stake holders to prevent further fragmentation and degradation. The overall policy in the state should be long-term conservation of wildlife by ensuring larger forest areas.

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REFERENCES

Soule M E and Gilpin M E (1991), The theory of wildlife corridor capabilities. In D.A.Saunders and R.J.Hobbs eds. Nature Conservation 2: the role of corridors, Surrey Beatty and Sons, Chipping Norton, Australia, Pp 3-8.

Tiwari Menon V , Easa S K, P.S. and Sukumar R (2005), *Right of Passage*: Elephant corridors of India. Conservation Reference Series 3.Wildlife Trust of India, New Delhi, 287pp.

Sar C K and Lahiri Choudhury D K (1999), Project Elephant-human conflict in Asia. Report on Orissa, India (Part-IIa). Atagarh Forest Division

Sar C K and Lahiri Choudhury D K (2002), Project Elephant- human conflict in Asia. Report on Orissa-India (Part-IIe). Keonjhar Forest Division

Tiwari S K, Singh A K, Singh R K and Swain D (2005), Elephant Corridors of Central India. In. Menon, V., Tiwari, S.K., Easa, P.S. and Sukumar, R. eds. Right of Passage: Elephant corridors of India. Conservation Reference Series 3. Wildlife Trust of India, New Delhi. Pp.70-119.

Map 1-3: showing the elephants corridors of Orissa and interstate corridor with Jharkhand

BIODIVERSITY RESOURCES OF BHITTARKANIKA MANGROVE ECOSYSTEM

V. P. Upadhyay*, P. K. Mishra and J. R. Sahu

INTRODUCTION

The state of Orissa has a geographical area of 1,55,707 sq. km., with an actual forest cover of 47,107 sq. km. (30.3 %). Out of this, mangrove forests constitute 195 sq. km. Thus, the percentage of mangrove forests to geographical and actual forest cover comes to 0.125 % and 0.414 %, respectively (Daniels & Acharjyo, 1997). The Bhitarkanika ecosystem is located at 20^0 4'- 20^0 8' N Latitude and 86^0 45'- 87^0 5' E Longitude, in the north-eastern coastal plain of Kendrapara district in Orissa, India. Total area of Bhitarkanika, notified as a wildlife sanctuary, is 672 Sq. km. out of which mangrove forests constitute approximately 130 sq. km. the remaining are water bodies, villages, uninhabited private land and other revenue land. Table 1 provides some of the features of the area (Chadha & Kar, 1999; Sarma *et al*., 1997). The area is situated in the combined delta of the rivers Mahanadi, Brahmani and Baitarani, which are interconnected. Distributaries of the Mahanadi and Brahmani join together near the coast and have a common estuarine region. Similarly, the Baitarani at its lower reaches drains into the river Brahmani and these two rivers have a common mouth near a place called Dhamra (Sinha, 1999). Bhitarkanika mangrove wetland, an important genetic resource of the world (Swaminathan, 1994), is located in the estuarine environment created by Brahmani and Baitarani. These forests are rich in species diversity and are dense, and the trees are tall like those of Sunderbans (Selvam, 2003).

Table1: Details of the Bhitarkanika mangrove forest

Sl. No.	Legal Status	Declared as a Wild Life Sanctuary in 1975. Declared national park in 1988. Declared Gahirmatha (marine) Wildlife Sanctuary
1.	Total Area	1,59.561 square kilometers
	Mangroves and	Total 71 species
2.	Associates	
	Sedimentary	60 genera and 64 species
3.	Macrofauna	
4	Sedimentary	15 families, 22 genera, and 25
5	Icthyofauna	species
6	Reptiles	22 families and 42 species
7	Birds	170 species
8	Mammals	7 orders, 18 families, 25 genera and 28 species

MANAGEMENT OF BHITARKANIKA MANGROVES IN THE PAST

This region was part of the erstwhile 'Kanika Zamindari', one of the most prominent private estates in the state. The forests were under the control of this zamindari till 26th November 1951. The forest blocks were classified as Atak jungle blocks (or Class I forests), Rakshit jungle blocks (or Class II forests), and Chhada jungle blocks (Class III forests). The entry of all humans was restricted in the class I forests and collection of all resources were also banned. Permits for collection of specific items were required in the class II forests and such permits were only for inhabitants of the zamindari. With the abolition of the zamindari system in 1952, the administrative control of these areas was vested with the revenue eepartment of the state government till 1957. The area was then transferred to the forest department on 15th November 1957 and administration was vested with the Athagarh forest division. government of Orissa declared all the forest areas including wastelands on 4th October 1961 as Kanika forests in Aul, Rajnagar, Pattamundei, and Mahakalpara areas of Kendrapara district, and Chandbali, Tihidi, Basudevpur, and Bansoda areas of Bhadrak district as protected forests under the Indian Forests Act, 1927 (Daniels & Acharjyo, 1997). Thus legal status of Bhitarkanika and adjoining forest areas of Mahanadi delta has been changing since 1957.

The former Cuttack district portion of Bhitarkanika was declared as a wildlife sanctuary on 22nd April 1975 (vide notification no. 6958- 4F (W)- 34/ 78- FFAH- dated the 22nd April 1975 published in the Orissa gazzettee dated the 30th May 1975). A part of this sanctuary was finally notified as 'Bhitarkanika National Park' wide notification no. 19686/

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F&E/ dated the 16th September 1998. The Gahirmatha area of Bhitarkanika along with two reserve forest blocks of the adjacent Mahanadi delta, Hukitola and Bhitarkharnasi is declared as the Gahirmatha (Marine) Wildlife Sanctuary vide notification no. 18805, F & E dated the 27th September 1997 published in the Orissa Gazette No. 1268 dated 17th October 1997 (Chadha & Kar, 1999). A separate wildlife division at Chandbali (Bhadrak district) was created during February 1980 for better management of the sanctuary, which was renamed as Mangrove forest division (Wildlife) with office at Rajnagar (Kendrapara district) since November 1990. This division also looks after the adjacent mangrove forests of Bhadrak and Jagatsinghpur districts including Mahanadi delta and is under the control of the Chief Wildlife Warden, Orissa. A network of wireless communication systems has been established connecting Rajnagar with the different areas of mangrove forests such as Dangmal, Ekakula, Chandbali, and Kendrapara etc.

Studies on anthropogenic pressures on the mangroves have been summarized extensively (FAO, 1994; Saengar *et. al*. 1983; Field, 1995; Groombridge, 1992; Marshall, 1995; Hatcher *et al*., 1989). However, these studies are little known or used by local land managers or regional policy makers (Farnsworth and Ellison, 1997). With the exception of projected climate change effects, the consequences to mangroves of anthropogenic stressors are amply documented and well appreciated by biologists, managers, and local communities using mangrove resources (Ellison and Farnsworth, 1996). Functioning of mangrove ecosystems is controlled by hydrology and soil factors, and given the appropriate physical conditions, restoration and recovery can proceed fairly rapidly (Ellison, 2000). According to Lugo (1980, 1998), although not all the desired uses of mangroves are compatible with the sustainability of the mangrove ecosystem, these ecosystems are resilient within a range of environmental conditions. Thus, the values that humans can derive from mangroves can be optimized if proper management techniques are used. Any conservation efforts for mangroves require community support. There is a need to ensure that the local communities are made part of the conservation initiatives.

THE PRESENT STUDY

Four forest blocks were surveyed through the present study. The mangrove areas of Mahanadi delta have greater diversity, structural characteristics and floristic composition representing 43 species from 32 genus and 26 families of angiosperms; the species were categorized on the basis of their ecological attributes (Rao, *et. al*., 1998). The study revealed that there is a need for monitoring species that are critically endangered (*A. alba*, *A. marina*, and *B. gymnorrhiza);* endangered (*A. ilicifolius, A. rotundifolia, A. corniculatum, A. cucullata, A. officinalis, B. tersa, C. manghas, C. decandra, H. fomes, K. candel, L. racemosa, M. wighitiana, P. paludosa, S. apetala, S. caeseolaris, T. troupii, X. granatum, X. mekongensis*, and *X. molluccensis); and* vulnerable (*E. agallocha, P. coarctata*, and *R. mucronata*) in the Bhitarkanika ecosystem. A case of *H. fomes* can be discussed here. *It* is considered to be the best commercial *Heritiera* species in India, and it has properties superior to teak. Difficulty in accessing it, which makes it uneconomical to exploit, may be an important factor in its conservation (Tomlinson, 1986). It was established through discussions with local villagers in the sanctuary area that they prefer the wood of *Heritiera* for its durability and strength. Observations in the forest blocks, especially in the Thakurdia and Kakranasi forest blocks, showed that individuals of *Heritiera fomes* in the girth class of 20-25 were selectively removed from the fringe areas, which could be accessed easily through the river. It is reported that several mangrove species are on the way to extinction from the west coast such as *Xylocarpus granatum, Bruguiera cylindrica, Sonneratia acida*, and *Cynometra ramiflora*. The species that are fast disappearing from the Sunderbans are *Heritiera fomes, H. minor* and *Nypa fruticans* (Upadhyay, *et al*. 2002). Lugo (2002) lists the following paradoxes as regards the mangroves:

i. Mangroves are simple ecosystems of great complexity.

ii. Mangrove forests are mature ecosystems with pioneer species.

iii. Mangroves are highly productive but they can die in a very short period.

iv. Mangroves are resilient and vulnerable.

v. Mangroves are vital to humans, but many times, they are not valued.

vi. Consulting local users of mangroves is useful for planning coastal development, but local perceptions may not match reality.

vii. As economic development progresses, humans discontinue direct uses of mangroves, but the value

of mangroves increases.

viii. In a modern context, the conservation of local mangrove stands requires attention to regional or global level processes.

These provide valuable insights into the nature of the ecosystems and therefore any management practice that is suggested for their conservation must take into account the challenges posed by such paradoxes. Ellison and Farnsworth (1996) observed that loss of a single tree species reverberates through the system. Exact nature of impacts it causes in the ecosystem are not known and therefore management implications are not realized. Lack of enough scientific information on the various factors that are operating in a mangrove forest is therefore a priority need.

Salinity level and availability of adequate freshwater flow into the mangrove ecosystems may change the structural and functional characteristics of mangroves of Bhittarkanika. Construction of bunds and diversion of freshwater for other uses in the upper catchments of the rivers (Mahanadi, Brahmani, Dhamra, Baitarani, Maipura etc) draining into the area would therefore prove fatal in the long run, and mangroves of Bhitarkanika may get affected as experienced in Pichavaram and Muthupet in Tamil Nadu and several mangrove pockets in the west coast of India. There is a need to closely monitor the salinity parameters in the area and factors (such as river run-off, lack of inundation in few areas, construction of bunds etc) that influence it.

Analyses of the reproductive status of the plants indicate that though the area has a stable population of trees that are mature/ reproducing, the population of juveniles is poor. Although regeneration of seedlings is seen in adequate number for most of the species, except for few species (*Pongamia pinnata, Intsia bijuga*, *Amoora cucullata*, *Avicennia alba*, *Tamarix troupii*, *Hibiscus tiliaceous* and *Xylocarpus molluccensis*), lack of similar representation in case of other tree species is of particular concern. This indicates very poor recruitment rate from seedlings to trees in the forest area. One of the strategies to manage this is to step up restoration attempts in the forest area. Restoration of various mangrove species needs to be undertaken and restoration sites should consist of different species, as seen naturally rather than creating monocultures of single/ few species. Plantation of mangroves (in revenue lands) should be encouraged in addition to forest areas. Tide dominated creeks and rivers in the area provide good opportunity for mangroves to be developed in the upper catchment areas. Monitoring of forest areas for seedling, tree mortalities, infestations, wave damages etc. should be done regularly.

NEEF FOR FURTHER INVESTIGATION

Site management and conservation plans should be developed for mangrove forests that incorporate conservation priorities, fisheries, tourism, and sustainable utilization of the resources. Development of such integrated plans requires a fundamental appreciation for the intrinsic value of a mangrove ecosystem and understanding of the links between the concerned ecosystem, adjacent ecosystems, and human habitations surrounding it. Participatory and multi-stakeholder approach to resource management in the mangrove forest areas is needed.

Bhitarkanika mangrove forest is most diverse in terms of floral species diversity, but have been poorly studied. Scientific information related to the ecosystem mainly the plant formations, biotic and abiotic factors that play a significant role, nutrient cycling etc. are mostly not available for this ecosystem. There is a priority need for collection of these information and use of the same in management planning and launching an integrated long term research programme with the help of a multi-disciplinary team, primarily to generate the information. This will help generating information regularly to know the 'trend' or patterns of processes that are at play in the area. Dynamics of the forest structure has to be monitored to know change in patterns of species domination and change in forest composition. The area has most of the trees that are less in diameter and height and care must be taken to monitor change in the structural composition over time. Study on impact of the projected global climatic change and sea level rise on the mangrove forests of Bhitarkanika may be initiated.

MANAGEMENT

Areas in the forest blocks, which do not need adequate inundation, require a different type of management through creation of channels to ensure tidal water flushing. Similar strategies have been found effective in case of Pichavaram and Muthupet mangroves of Tamil Nadu, and Coringa mangrove forests of Andhra Pradesh. Creating a network of mangrove sites (in the Subarnarekha river mouth in Balasore district; Devi river mouth in Jagatsinghpur district; Mahanadi river mouth in the Kendrapara district; and Bhitarkanika formed at the river mouths of Maipura,

Dhamra, Baitarani and Brahmani) to implement unified management system aided by a scientific approach for mangrove management may be the best management option. Ecosystem approach to management emphasizes on careful use of the resources. Livelihood needs of the local communities are safeguarded if the resource harvests are managed in a sustainable manner without overexploiting them. Fisheries in the waters surroundings and mangroves, harvest of forest resources like timber and honey need to be managed so as to make them sustainable. There is a need for creating public awareness on importance of the mangrove ecosystems and conservation priorities. This would help sensitizing the people and to ensure their cooperation for management. Involving school children and formation of eco-clubs could be taken up to encourage children adopt conservation roles in mangrove ecosystems. The mangrove forests are the areas of immense eco-tourism potential. Eco-tourism may be encouraged and made part of the management strategy to generate revenue and increase awareness among people.

REFERENCES

Chadha, S. & C. S. Kar, 1999. Bhitarkanika: Myth and Reality, Natraj Publishers, Dehradun, pp.368 pages.

Daniels, R. J. R. & L. N. Acharjyo, (1997), Rejuvenation of degraded mangroves and development of seed banks at Bhitarkanika, Final Technical Report submitted to NORAD by M. S. Swaminathan Research Foundation, Chennai.

Ellison. Aaron M. Elizabeth J. Farnsworth (1996), Anthropogenic disturbance of Caribbean mangrove ecosystems: Past impacts, present trends, and future predictions, Biotropica, 28 (4a), pp- 549- 565.

Ellison. Aaron M., (2000), Restoration of mangrove ecosystems, Restoration Ecology, Volume 8, No. 3, pp- 217- 218.

FAO, (1994), Mangrove Forest Management Guidelines, FAO Forestry Paper no 117, Food and Agriculture Organisation of the United Nations, Rome.

Farnsworth, Elizabeth J & Aaron M. Ellison, (1997) The Global conservation status of Mangroves, Ambio, 26(6) Pp- 328- 334.

Field, C., 1995b. Impact of expected climate change on mangroves, Hydrobiologia, 295, pp- 75- 81.

Field, C.D., (1995), Impact of expected climate change on mangroves, Hydrobiologia, 295, pp- 75- 81.

Groombridge, B. (ed), (1992) Global biodiversity: Status of the earth's living resources, Chapman & Hall, London, UK.

Hatcher, B. G., R. E. Johannes & A. I. Robertson, (1989), Review of research relevant to the conservation of shallow tropical marine ecosystems, Ocenogr. Mar. Biol. Ann. Rev., 27, pp- 337- 414.

Lugo, Ariel E., (1980) Mangrove ecosystems: successional or steady state?, Biotropica, 12, Pp- 65- 72.

Lugo, Ariel E., (1998), Mangrove ecosystem research with emphasis on nutrient cycling, (in: Ecology Today: An Anthology of contemporary ecological research, B. Gopal, P. S. Pathak and K. G. Saxena- Ed), International Scientific Publications, New Delhi, Pp- 279- 305.

Lugo, Ariel E., (2002), Conserving Latin American and Caribbean mangroves: issues and challenges, Madera Y Bosques Numero especial, Pp- 5- 25.

Marshall, N., (1995) Mangrove conservation in relation to overall environmental considerations, Hydrobiologia, 285, Pp- 303- 309.

Rao, T. A., S. Molur & S. Walker (Eds), (1998) Mangroves of India, Biodiversity Conservation Prioritisation Project (BCPP), India, Endangered species project, Conservation Assessment and Management Plan workshop, National Institute of Oceanography, Goa, India

Saengar, P, E. J. Hegerl & J. D. S. Davie, (1983), Global status of mangrove ecosystems, Environmentalist 3 (suppl.), Pp- 1- 88.

Sarma, A. L. N., D. G. Rao, U. K. Nanda & P. K. Pattanaik, (1997), Ecological status study and survey of benthic macro, meio, and icthyofauna of Bhitarkanika mangrove estuaries of Mahanadi river system, Final Project Report, Regional College of Education, Bhubaneswar, India, Pp- 258 .

Selvam, V., (2003), Environmental classification of mangrove wetlands of India, Current Science, Vol. 84, No. 6, March, pp- 757- 765.

Sinha, B. N., (1999), Geography of Orissa, National Book Trust, New Delhi.

Swaminathan, M. S., (1994) Conservation of mangrove genetic resources, M. S. Swaminathan Research Foundation, Chennai, Pp- 87- 95.

Tomlinson, P. B., (1986) The botany of mangroves, Cambridge Tropical Biology Series, Cambridge University Press, Pp 413.

Upadhyay, V. P., R. Ranjan & J. S. Singh, (2002), Human mangrove conflicts-the way out, Current Science, 83, (11) : Pp- 1328- 1336.

ECOSYSTEM APPROACH FOR MANAGEMENT OF *PROTECTED AREAS* AND THE "CONVENTION ON BIOLOGICAL DIVERSITY".

A. K. Pattnaik

INTRODUCTION

For more than a century, countries throughout the world have been setting aside areas for special protection because of their natural beauty and their repository status for important biodiversity. Protected areas are the cornerstones for *in situ* conservation of biological diversity. They have long been recognized as a key tool to counter the loss of the world's biodiversity. Over the last 40 years there has been a paradigm shift in the role of protected areas from 'national parks and reserves' to a broader conceptual and practical approach including sustainable use areas. Today, it is globally recognized that protected areas contribute, in addition to their conservation function, to human welfare, poverty alleviation and sustainable development. Their importance, ranging from conservation of biological diversity, storehouses of genetic materials, provision of essential ecosystem services for human welfare, and contribution to sustainable development, have been recognized at multiple levels, from international bodies to national governments, local groups, and communities. Globally, the number of protected areas has been increasing significantly over the last decade and there are now more than 100,000 protected sites worldwide covering about 12% of the earth's land surface, making them one of the earth's most significant land uses. However, while the number and size of protected areas have been increasing, biological diversity loss continues unabated. The existing global system of protected areas is inadequate in several ways: (i) they are incomplete and do not cover all biomes and critical species; (ii) they are not fulfilling their biodiversity conservation objectives; (iii) participation of local communities in establishment and management of protected areas is inadequate; and (iv) protected areas in developing countries are poorly funded.

ECOSYSTEM APPROACH

Ecosystems are complex entities and comprise of interdependent and interacting biotic and abiotic components, which are linked by the transfer of energy and materials. Sustainability of any ecosystem depends on maintained conditions or on the resilience of organisms within changing conditions. An ecosystem is an interconnected community of living things, including humans, and the physical environment with which they interact. Ecosystem management is an approach to restoring and sustaining healthy ecosystems and their functions and values. It is based on a collaboratively developed vision of desired future ecosystem conditions that integrates ecological, economic, and social factors affecting a management unit defined by ecological, not political boundaries. Ecosystem management is an approach of restoring and sustaining healthy ecosystems, and their functions and values. Human interaction, biodiversity, and ecosystem dynamics are highly integrated, with components of biodiversity making up the dynamic elements expressed through ecosystem processes. However, the present trends of economic development, supported by inappropriate financial incentives, typically under value the ecosystem processes and services leading to the over exploitation of valuable resources worldwide. Ecosystem-based management attempts to regulate our use of ecosystems so that we can benefit from them, while at the same time modifying our impacts on them so that basic ecosystem functions are preserved. The basic tenet is that conserving ecosystem functions and integrity will be, or should be, a fundamental vehicle for sustainable development. A central premise of ecosystem management is that the structural and functional integrity of the system should be maintained. The ecosystem-based management usually deals with sufficiently large spatial areas, whether they are regions, greater ecosystems or landscapes, that they are complex, interconnected and dynamic systems.

CONVENTION ON BIOLOGICAL DIVERSITY

The seventh meeting of the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) taking impetus provided by the Millennium Development Goals, the Plan of Implementation of the World Summit on Sustainable Development, the Durban Accord and the plan of action from the 5th World's Parks Congress, adopted a Programme of Work on protected areas.The programme of work represents the most comprehensive and specific protected area commitments ever made by the international

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community. The overall objective of the programme of work is to establish and maintain comprehensive, effectively managed and ecologically representative systems of protected areas that collectively, will reduce significantly the rate of loss of global biodiversity. This ultimate objective is to be achieved on land by 2010 and in marine areas by 2012. In the programme of work the COP set out detailed goals, targets and activities for meeting this ultimate objective. The COP made it clear that fully implementing the *Programme of Work* would require unprecedented international cooperation, including the provision of increased financial and technical resources to developing countries. An effective global protected area system is the best hope for conserving viable and representative areas of natural ecosystems, habitats and species, would and help to achieve the 2010 biodiversity target. In adopting the *Programme of Work*, the world community has agreed to work together at the national, regional and international level to meet clearly defined goals and time-bound targets for the world's protected areas.

PROGRAMME OF WORK

This Action Guide to the Programme of Work on Protected Areas describes the targets and time frame, and provides an overview of potential steps, case studies, tools and resources for implementation. It contains four programme elements, i) Direct actions for planning, selecting, establishing, strengthening, and managing protected area systems and sites, ii) Governance, Participation, Equity and Benefit Sharing, iii) Enabling Activities, and iv) Standards, Assessment and Monitoring.

The salient features of goals and the targets of the *Programme of Work* are as follows :

Goal 1.1 - To establish and strengthen national and regional systems of protected areas integrated into a global network as a contribution to globally agreed goals.

Target: By 2010 terrestrially and by 2012 in the marine area, a global network of comprehensive, representative and effectively managed national and regional protected area system is established as a contribution to (i) the goal of the Strategic Plan of the Convention and the World Summit on Sustainable Development of achieving a significant reduction in the rate of biodiversity loss by 2010, (ii) the Millennium Development Goals - particularly goal 7 on ensuring environmental sustainability, and (iii) the Global Strategy for Plant Conservation.

Goal 1.2 - To integrate protected areas into broader land- and seascapes, and sectors so as to maintain ecological structure and function

Target*:* By 2015, all protected areas and protected area systems are integrated into the wider land and seascape, and relevant sectors by applying the ecosystem approach and taking into account ecological connectivity and the concept, where appropriate, of ecological networks.

Goal 1.3 - To establish and strengthen regional networks, transboundary protected areas (TBPAs) and collaboration between neighbouring protected areas across national boundaries

Target: Establish and strengthen by 2010/ 2016 transboundary protected areas, other forms of collaboration between neighbouring protected areas across national boundaries and regional networks, to enhance the conservation and sustainable use of biological diversity, implementing the ecosystem approach, and improving international cooperation.

Goal 1.4 - To substantially improve site-based protected area planning and management

Target: All protected areas to have effective management in existence by 2012, using participatory and science-based site planning processes that incorporate clear biodiversity objectives, targets, management strategies and monitoring programmes, drawing upon existing methodologies and a long-term management plan with active stakeholder involvement.

Goal 1.5 - To prevent and mitigate the negative impacts of key threats to protected areas

Target: By 2008, effective mechanisms for identifying and preventing, and/or mitigating the negative impacts of key threats to protected areas are in place.

Goal 2.2 - To enhance and secure involvement of indigenous and local communities and relevant stakeholders

Target: Full and effective participation by 2008, of indigenous and local communities, in full respect of their rights and recognition of their responsibilities, consistent with national law and applicable international obligations, and the participation of relevant stakeholders, in the management of existing, and the establishment and management of new, protected areas *Programme of Work* on Protected Areas

Goal 3.1 - To provide an enabling policy, institutional and socio-economic environment for protected areas.

Target: By 2008, review and revise policies as appropriate, including use of social and economic valuation and incentives, to provide a supportive enabling environment for more effective establishment and management of protected areas and protected areas systems.

Goal 3.2 - To build capacity for the planning, establishment and management of protected areas

Target: By 2010 comprehensive capacity building programmes and initiatives are implemented to develop knowledge and skills at individual, community and institutional levels, and raise professional standards.

Goal 3.3 To develop, apply and transfer appropriate technologies for protected areas

Target: By 2010 the development, validation, and transfer of appropriate technologies and innovative approaches for the effective management of protected areas is substantially improved, taking into account decisions of the Conference of the Parties on technology transfer and cooperation.

Goal 3.4 To assess and monitor protected area status and trends

Target: By 2010, national and regional systems are established to enable effective monitoring of protected-area coverage, status and trends at national, regional and global scales, and to assist in evaluating progress in meeting global biodiversity targets.

THE CHALLENGES OF ECOSYSTEM APPROACH OF MANAGEMENT AND THE WAY AHEAD

The existence, variety and perhaps ubiquity of obstacles to ecosystem-based management and other integrative activities such as integrated resource management are well known. The following issues are pretty typical; many of these problems plague most efforts at integrated or ecosystem-based, environmental management. i) fragmentation and specialization in administration and research; ii.) competition within and between agencies and governments; iii.) arbitrary, politically defined management units; a structural and functional orientation; short-term, local and self-interested policies, and economic determinism; obscure terms and goals such as sustainability and integrity; top-down planning and management processes; and poor use of existing information.

A strong and effective protected areas system need to be supported by appropriate policies, legal instruments and institutions. The Programme of Work aims at sensitizing countries to understand the true value of protected areas and to provide more supportive policy environments. Many protected areas are yet to develop the associated human and material resources needed for effective management and therefore capacity building has been highlighted in the Programme of Work. Capacity building in form of formal training, informal exchanges and collaboration, and more general educational efforts need to be a priority.

Protected areas only work as conservation tools if they are managed effectively to maintain their values in perpetuity. Three important steps in addressing management effectiveness would be ; i) identifying an agreed set of standards for a protected area or a national protected areas system; ii) developing and applying systems for evaluating management effectiveness, thus helping to identify necessary changes (adaptive management); and iii) establishing systems to monitor the status and trends of protected areas and their biodiversity. Good protected area management needs a good basis of knowledge about biodiversity, environmental services, social issues and management strategies. Although protected areas are perhaps the world's most important resource in terms of building ecological knowledge, much of the current research that takes place in protected areas is not translated into information that is of use to managers. The *Programme of Work* suggests some steps to address these problems. It is difficult to sum up what is necessary to implement ecosystem-based management or, more importantly, what is necessary to make it work. On the one hand, it encompasses so many issues and components, and on the other, it varies so much from site to site.

WATER HYACINTH – FROM IRRITANT TO UTILITY

S. Dash

INTRODUCTION

Water bodies in stagnation as well as with very slow flow of water seldom remain uncovered. They get covered, naturally, with myriad water plants ranging from *phytoplanktons* to *macrophytes.* The colonization of water bodies with hydrophytes is the result of as well as the cause of gradual changes in the physico-chemical and biological properties of water bodies. These changes occuring cumulatively bring about as Eutrophication and spell havoc to limnologists , for these processes lead progressively to a gradual demise of the water bodies. One of the most common hydrophytes found profusely and contributing elaborately to this inevitable natural process is the Water hyacinth.

These plants growing in a closely packed manner form floating rafts, which can withstand the weight of a human being and keep a passerby oblivious to the enormous depth and mass of water they so humbly cover. This ostensibly innocuous- looking plant is a potential as well as proven ecological hazard and efforts to control it are being taken on an enormous scale. Yet, the silver lining shows up flashing myriad possibilities of effective utilization of this plant for the betterment of the ecosystem as well as of the mankind.

HABIT AND HABITAT – Water hyacinth is a floating, flowering and perennial plant. It forms rafts through linked plants. It occupies large expanses of water body surfaces. It is an aquatic weed found worldwide in tropical and subtropical areas, because its growth is limited by extremely low temperatures. It grows profusely in lakes, ponds, ditches, and slow moving rivers and streams. The optimum temperature for its growth is 33-35^{0}c and it cannot withstand temperatures below 12^{0}C.

BOTANICAL DESCRIPTION – Its botanical name is *Eichhornia crassipes* (Mart.) Solms. It belongs to Pontederiaceae (Pickerelweed family). The generic epithet *Eichhornia* has been retained after Johann Albrecht Friedrich Eichhorn (1779-1856), a Prussian Minister of education and public welfare, a court adviser and a politician, all in one. The specific epithet, *crassipes* means thick in Latin. It reflects the thick mass formed by its growth.

Fig. 1- Water hyacinth with lucrative flowers

Fig. 2- Luxuriantly grown Water hyacinth in full bloom

It is a monocot, perennial found freely floating or sometimes stranded in mud. The leaves form rosettes and rise up to three feet above the water. The leaves are entire, ovate, rounded and around six inches in diameter. They act as sails in enabling the transport of the thick mat due to winds. The petioles are bulbous and spongy, and due to this buoyancy the mat affords to stay afloat. The flowers are formed in conspicuous spikes with 8 to 15 flowers in each. The flowers are blue coloured with a yellow spot. The

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trimerous flowers have bilabiate corolla, 6 stamers and 3 stigmas. The roots are fibrous and remain submerged. The fruit is a three-celled capsule with many ribbed seeds. Fruits and seeds are rarely observed because they are formed in withered flowers after submergence. Seeds germinate under moderate conditions. The primary mode of propagation is vegetative and occurs by means of stolons.

ORIGIN AND PROLIFERATION

It is a native of Brazil. At its centre of origin, seven species of *Eichhornia* are found, *Eichhornia azurea* and *E. diversifolius* being the most prominent.

The colonization of water hyacinth is closely related to colonization of the world by the Europeans. The Europeans had colonies in both the New and the Old Worlds. Several sorts of intercourse occurred between the Old and the New Worlds and amongst the Old and New Worlds themselves. The introduction of water hyacinth is just one of them. It is a gift of the New World to the Old World.

Owing to its bush-green spread, but more for its lucrative flowers, Water Hyacinth found place in the human psyche as an ornamental. It is still being sold over the internet. The British brought the plant to India and first introduced it in Bengal and Orissa. This was obvious for it was here that they consolidated their position for the first time. From the limited confines, it gradually spread out to occur in uncontrollable proportions.

NEGATIVE IMPACT OF WATER HYACINTH

This hydrophyte has earned for itself the notoreity of being branded the world's worst weed. The thick mat formed clogs water ways, making boating, fishing and almost all water activities impossible. This is a common observation. The Kanjia lake in Nandan Kanan, Orissa is being regularly worked upon to keep the area reserved for recreational boating, free from the weed.

The barrage reservoir at the river Mahanadi is heavily infested with Water Hyacinth. Water flow through the mat is greatly diminished. Compounding the problem is the high growth rate of the plant with a size doubling time of as little as six days under optimal conditions.

Fig. 3 : Weed infested Water Hyacinth

The water quality of the weed-infested water bodies gets severely degraded because the air-water interface is blocked. The living roots consume a lot of oxygen from the water. The putrefying and decomposing bacteria, feeding on plant debris, decrease the dissolved oxygen (DO) and thereby increase the biochemical oxygen demand (BOD). This proves deleterious to the aquatic life which suffers from acute oxygen deficiency.

Water hyacinth also competitively eliminates several species from its vicinity. This is largely due to the absence of co-evolution of Water hyacinth with the other plants in India. In its native home in the Amazon basin, it is seldom construed as a weed for it has evolved to co-exist with its co-evolved species.

CONTROL MEASURES

The first step adopted for the solution of this problem was control by known methods. Herbicides like Diquat, Endothall dipotassium salt, Endothall dimethy alkylamine salts and Glycophosphate were being used. Although substantial control was possible, it led to ecological problems like the rendering of the water as unsuitable for human and animal consumption as well as for irrigation. The biocides got bioaccumulated and biomagnified in the food chains.

Biological control of hyacinth has been studied by employing viruses, bacteria, fungi, manatees, insects, herbivore fish like grass carp and tilapia, ducks, geese, turtles, snails etc. But all these agents have proved more or less futile owing to the defense mechanism of the plant. For every leaf lost, 2.5 leaves reappeared. The only viable option left was to mechanically destroy the plants. This is costly in time, money and energy.

Fig. 4 : A machine used to clear water hyacinth

UTILIZATION OF WATER HYACINTH

The negative features are only one aspect. There is another side to it. If one is to quench his aesthetic desires of growing the plant, he can grow it in a pot where it flourishes and flowers as well.

Fig. 5 : A water hyacinth plant grown in a pot under terrestrial conditions

There are novel uses of this plant. The leaf and petiole, after being pressed, dried, are transformed into a durable wood-like material. It is being used for preparing furniture and handicrafts.

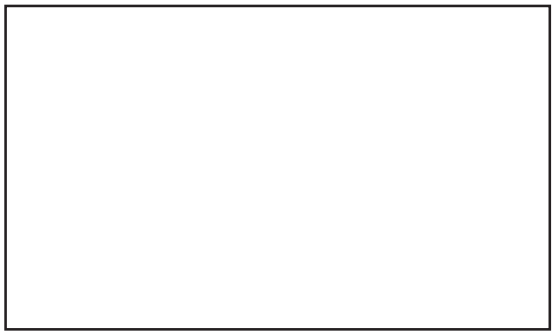
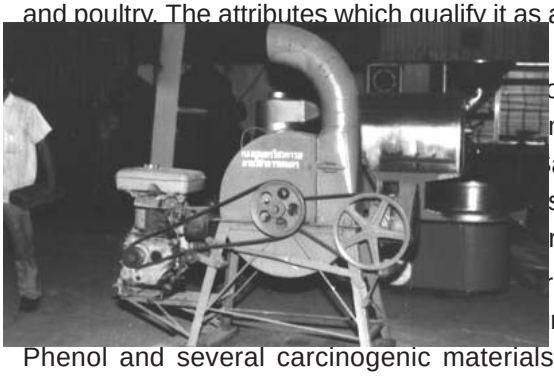


Fig. 6 : A water hyacinth chopping machine

Fig. 7 : A hand bag prepared from the dried petiole of water hyacinth

Efforts are on to harness distilled water by collecting the condensed water transpired from these high-transpiring plants. Water hyacinth is being used for procuring compost or organic fertilizer from its roots which accumulate nitrogen and phosphorus. The fibrous component is being used as a base for biogas production. One kilogram of dry water hyacinth yields 370 litres of biogas. Paper and pulp is also being prepared from it.

Animal feed (silage) is being prepared for sheep, cattle and poultry. The attributes which qualify it as an effective



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m, Mercury, Phenol and several carcinogenic materials are being effectively removed from polluted water bodies by this plant. It is also being used for treating sewage.

CONCLUSION

From the above discussion, it is worthwhile to infer that drawing a conclusion at face value could be prejudicious and precarious. The seeming beautiful plant can prove to be a problematic weed. And an established weed proved to be a store house of myriad utility. Water hyacinth needs to be used in a thoughtful manner. Its aesthetic and practical usefulness must be harnessed to the fullest but its growth and spread must also be kept under effective control. Water hyacinth can prove to be a servant and has already proved itself a bad master.

BIOTECHNOLOGY IN SHAPING FOREST & WILDLIFE OF ORISSA

A. Sasmal

INTRODUCTION

The state of orissa is bestowed with rich bio-resources especially with forests and wildlife which are complimentary to each other. The recorded forest area constitutes 36.73% of the geographical area of the state. The forest cover constitutes 30.21% as against the national forest cover of 19.29% (SFR1999).Forests continue to be a source of income and food for a majority of tribal population. Wildlife happens to be an important resource of the state which has attracted the attention of the world. There are two national parks and 18 wildlife sanctuaries covering 5.11% of the area of the state. The Similipal National Park, also a tiger reserve, has been declared as biosphere reserve. The Gahirmatha wildlife sanctuary, a mangrove ecosystem, is a famous nesting ground of the olive ridley sea turtle. The state has been facing challenges on account of rapid deforestation and loss of valuable wildlife. Making biotechnology as a premier tool we can shape our forest and wildlife resources ensuring social justice and inviting a healthy environment to live in.

FOREST AND WILD LIFE BIOTECHNOLOGY

Forests play an important role in meeting the economic needs of the people of the state.The tribals in the state depend mostly on forests for their sustenance. Decrease in forest area, apart from affecting the tribal population, also affects the environment. Forest biotechnology can play an important role in mitigating these problems.

Fig . 1 : Technique of plant tissue culture

There is a tremendous scope for application of wildlife biotechnology in the state. Certain species of forest plants and wildlife have declined due to several biotic and a-biotic factors which can be addressed using appropriate biotechnological tools. The techniques of plant tissue culture & development of genetic markers can be used in improvement in yield and quality, metabolic engineering of plants and restoration of forests.

PLANT TISSUE CULTURE

The plant micro-propagation technology allows production of a large number of plants in a relatively small growing area and in a short time with a high degree of clonal phenotypic uniformity and absence of disease. In Orissa, although the practice of using tissue culture derived plants in the farming process has just begun, it is a yet to be applied in forestry. By innovative implementation of this technology in forestry many endangered species can be restored. In order to make this possible, laboratories with skilled personnel should be established. Also research stations would come up for standardization of protocols of tissue culture samplings and also plants of different varieties so as to use them in the genetic transformation process. facilities should be created for better survival of tissue culture seedlings.

Restoration and improvements of forests:

There is an urgent need to develop biotechnological tools for forest restoration that can help to improve forest and forest products in following areas:

1. Genetic improvement of timber yielding crops like teak, sal, sisoo etc. and selection of desirable types and their molecular characterization.
2. Propagation of forest trees through macro- and micro-propagation methods particularly for the timber yielding species.
3. Yield improvement of non-timber species viz., oil-yielding trees like *Azadiracta indica* (need) and *Madhuca latifolia* (mahua) through gene transfer.
4. Mass propagation by tissue culture and molecular characterization and genetic improvement of different

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bamboo species. Tow main species of bamboo ie., *Dendrocalamus strictus* and *Bambosa arundinacea* are dominant in Orissa's forests. These species need immediate attention to their overexploitation. Hence, identification and selection of plus clumps, their conservation and mass propagation needs to be taken up on priority basis.

Biotechnological work in plant species can be taken up on the following lines:

i. Exploitation, collection, establishment and evaluation of tree germplasm of species like *Tectona grandis* (teak), *Santnum album* (sandalwood), Petrocarpus santilinus (red sanders), *Dalbergia sisoo* (sisoo), *M. Latifolia* (mahua), bamboo etc. with due emphasis on germplasm conservation.

ii. Selection of candidate plus tree in each case and conducting of provenance and progeny trial.

iii. Macro- and micro- propagation studies and standardization of propagation techniques and mass propagation plus and elite trees for operational planting.

iv. Field trial of plants raised by tissue culture.

v. Establishment of clonally seed orchard for mass production of improved seed.

vi. Data base storage and retrieval of tree germplasm.

vii. Exploration and collection of seeds of various provenance and plus trees of priority species from the areas of natural distribution. Selection based on fact growing nature, straight bole, resistance to diseases and pests, and good adaptability.

viii. Studies on the floral biology and breeding systems.

ix. Evolving vegetative propagation techniques including macro propagation methods and mass propagation by tissue culture.

x. Establishment of germplasm/gene banks for at least mid-term storage.

ENVIRONMENTAL BIOTECHNOLOGY

The environment includes various ecological sectors like forest, coastal and mining ecosystems.

Forest: The forest cover is declining; giving rice to deserted barren degraded waste-lands causing serious problems of soil erosion, soil nutrient loss and climatic imbalance. Deforestation also increases the threat to the survival of native and endemic vegetation. The State should take up the task of characterization and conservation (ex situ) of forest species, which include many endemic plant species which are almost in the verge of extinction due to excessive human interference.

Although in-situ conservation is the ideal approach, this needs further augmentation through ex situ measures. The conservation activity should also be further supplemented with molecular taxonomic approaches. In this context, steps need to be taken for:

i. Analysis and proper scientific investigation of forest health through appropriate technologies.

ii. Formulation of scientific procedure to conserve the forest species.

iii. Soil biotechnological strategy for forest cleared wastelands to develop into active forest.

Fig . 2 : Rehabilitation of mangrove forest

iv. Development of proper management strategies for the maintenance of existing undisturbed forest in its sound ecological state.

Mangrove vegetation embraces plants belonging to several unrelated families. These plants also exhibited different degree of salt tolerance. The mangrove species play a pivotal role in the coastal environment. The mangrove forest provides a good breeding ground and nursery for edible fish and prawns. The forest meadows and swampy habitats support a large number of resident and migratory birds.

Bioremediation :

Restoration of biota in mining areas is a major concern to the state of Orissa, since a huge land cover of the state has already been converted to wastelands due to mining activates. Phyto-and bio-remediation techniques need to be applied to such sites.The enormous amount of solid waste generated in the urban sites requires biological means to over come these

Fig . 3 : Turtles contributing to bio-remediation

problems. Biodegradation and vermin technology of solid wastes is to be given top priority in the State. Lactic acid from food wastes has a good scope.

Biodiversity Conservation :

The various geographical terrains in the State contain tremendous bio-diversity. The biosphere reserve of "Similipal" and forests like "Gandhamardhan" and "Harisankar" house rich biodiversity which needs to be preserved with suitable biotechnological interventions. There is need to explore the olive ridley turtles species which is to be genetically characterized and finger printed**.** The great diversity in the gene banks of mangrove species needs to be maintained. For examplei.

Fig . 4 : Black buck, part of biological diversity

Porteresia coarctata tateoka, belonging to family poaceae, is of high economic value for its sustainability in high salinity and submergence which is under the endangered list. Therefore, ex situ conservation of this plant is an urgent need. The Chilika lake which was quite productive until a few years ago, is now on the verge of a severe decline in its productivity. It needs biotechnological interventions in order to preserve this ecosystem particularly the plankton cycle.

WILDLIFE BIOTECHNOLOGY

Wildlife wealth of Orissa is very rich and varied. Be it princess Khairi of similipal or the white tigers of Nandankanan biological park or the olive ridley turtle of Gahirmatha these have attracted the attention of the world over. There is strong need to improve upon their habitat by restoring the lost species. Biotechnology can only provide the support to restore the species.Further molecular characterization of all the wildlife species can be taken up for their future safety.Besides, the habitat of the tiger and leopard in the wild (entire state) & Similipal

Fig . 5 : Salt water crocodileof Bhitarkanika

tiger reserve (Mayurbhanj), the elephant at Mayurbhanj, Mahanadi & Sambalpur elephant reserve, salt water crocodile in Bhitterkanika wild life sanctuary (Kendrapara), birds (both migratory & resident) in Nalaban of chilika lake & Bagagahan in Bhitarkanika sanctuary, olive ridley in Rusikulya river mouth & Gahirmatha marine sanctuary, dolphin in chilika lake, black buck in Balipadar wild life reserve, mugger & gharial in Satakosia george & Mahanadi river need special attention.

CONCLUSION

Biotechnology being the frontier area of modern biology has the potential to provide substantial benefits to society in such sectors of forestry, Environment & Wildlife. Commercialization of biotechnology in these fields require financial resources, infrastructure for basic and applied research and skilled qualified man power. Keeping a view to our economic conditions we must utilize the rapid advances being made in biotechnology with optimum use of financial resources and should evolve its own strategy for reaping benefits by utilizing our rich biodiversity.

REFERENCES

Vision statement and thrust areas,biotechnology-2006,Govt. of Orissa.

Rai AN (2006) Environ. Education, Goyal Brother Prakashan ;N.Delhi

BIODIVERSITY OF SATKOSIA GORGE SANCTUARY AND ITS ECO- TOURISM POTENTIAL

D. K. Sarangi

INTRODUCTION

Satkosia gorge sanctuary at Tikarapada was established in 1975 with a total area of 795.52 sqr. kms. It is situated between 20 31 37" N and 20 45 37" N. latitude and 84 43' E and 85 5' 17" E longitude. The northern portion of the sanctuary is managed by Satkosia Wildlife Division with headquarter at Angul; covering an area of 530.01km^2 and the southern portion of sanctuary is managed by Mahanadi Wildlife Division with head quarter at Nayagarh.

According to the bio-geographic classification the north of river Mahanadi is classified under the Chhotnagpur plateau and that of south under Eastern ghat biotic provinces. Satkosia contributes to the assemblage of flora and fauna extravaganza. Ecologically the vegetation of Satkosia largely confirms to northern tropical dry deciduous forest.

The Satkosia gorge is about 23kms, which extends from Sunkharia (Boudh) to Baramul (Dasapalla). The width of the gorge is 750 mt. to 800 mt. and the depth is about 90 to 100 feet during monsoon. River Mahanadi whose width is normally 3 kms. runs through this narrow point forming a furious gorge.

FAUNA AND FLORA

The wildlife of the sanctuary is quite interesting and varied. The gorge is the traditional home of highly endangered gharial, mugger, turtles and tarrapins. The forest is the stronghold of elephant, gaur, tiger, leopard, sambar, spotted deer etc. Other wild animals are barking deer, barasigha, mouse deer, rhesus macaque, langur, porcupine, hare, civet etc. The Satkosia has been included in Mahanadi Elephant Reserve with a variable population of 180 elephants , 11 tigers and 19 leopards.

The avian fauna of Satkosia comprises of both resident as well as migratory populationS. Among resident birds, golden oriole, hill myna, babbler, barbel, Indian pitta, grey strike, scarlet minivet, Indian pipit, golden fronted chloropsis, red jungle fowl, black patridoge, botton quail, crested hawk eagle, pea fowl, parakeet, dove and pigeon are noteworthy.

FLORA OF SATKOSIA

The main tree species are sal, piasal, simuli,sisoo, kusum, karada, arjuna,kochila, pani gambhiri, manakada, Kendu etc.found along Mahanadi river.

CROCODILE RESEARCH CENTRE

Gharial Research and Conservation Project at Tikarapada was set up in 1975. It is the first among 34 crocodile rearing centers in the whole counry.Pioneering research work is done here in nature- simulated incubation, hatching, growing, release and post- release monitoring of gharial and Mugger crocodiles in river Mahanadi.For the first time in the world, release of captive- reared young Gharial was taken up in this sanctuary in 1977. Since then over 600 gharial and over 100 mugger juveniles have been released to river Mahanadi at Satkosia gorge.

ECO-TOURISM ASPECT

Before 2000 AD, tourists used to visit the historic temples and monuments. Now the main attractions of foreign tourists are biodiversity of India. For this purpose Govt. of Orissa has taken necessary steps. Tourists are allowed in to the sanctuary from October to May Forest staffs on duty and some guides are available to help the tourists. Boating and angling facilities are available on payment. There is provision to see the animals in wild inside the sanctuary. Circuit house forest rest house and luxury hotels are available at Angul. There are 40 villages inside the sanctuary. One fourth of the local populations are tribals like kandha, Kolha and Munda. They are simple and hospitable. The tribal communities living around the sanctuary should be culturally and professionally involved in eco-tourism and trade by promoting local handicrafts and cottage industry.

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BHITARKANIKA- A CONCERN FOR CONSERVATION

M. Mohapatra

INTRODUCTION

Orissa is very rich natural resources . Champion and Seth had described 32 forest types in Orissa mangroves are unique forest types that evolve in littoral and tidal mud flats. The mangroves and their associates of Bhitarkanika constitute the second largest mangrove forest in the country being next to the Sundarbans of West Bangal.

Bhitarkanika was declared as a Wildlife Sanctuary in the year 1975 and later notified as a National Park in the year 1988. There are few endemic species of mangroves in the area such as *Manghas, Acanthus volubilis, Xylocarpus granatum normal* and *Heritiera Kanikensis.* These forests were managed by the erstwhile Kanika Zamindars, but since 1957 they are under the administrative control of the forest department. The core area of Bhitarkanika spreads over 115 km with mangrove vegetation

PHYSICAL PARAMETERS

The tidal movement of water in the rivers and creeks of Bhitarkanika is an interesting phenomenon. There is a definite cyclic semi-diurnal rise and fall of the sea level due to gravitational pull of the sun and the moon on the earth. Depending on the slope of the sea bed, radiant of the discharging rivers and beach topography, tides move inland and affect the coastal margin. The activity is most conspicuous in river mouth regions of Mahanadi, Brahmani and Baitarani . The tidal flow from the sea and fresh water discharge from the rivers provide a saline ingredient, which governs the species composition and distribution of mangroves.

The minimum temperature experienced in the area is 10 degree C In winter, while the maximum temperature can rise to 45 degree C in summer. The average rainfall is 1,700 mm per annum. The relative humidity is 75 %. The water salinity ranges between 20-28 ppt. The tidal height varies from 3.6m to 5.5m.

FAUNAL DIVERSITY

Considered as one of the best refuges of the reptilian fauna, Bhitarkanika is well known for its estuarine crocodiles. Incidentally the largest living specimen of the species today in the world is in Bhitarkanika, which is in the range of 20-22 ft. The conservation efforts through assisted breeding programme by rear and release, has change the status of this critically endangered species of less than 100 in 1975 to a viable population of more than a thousand in 2006. The population estimation of this species during winter has shown the existence of all size class and age class of the estuarine crocodile. Reptilian fauna is enriched with water monitor lizard, chameleon, skink, king cobra, Indian python, red snake, water snake and kraits. The gahirmatha coast on the eastern side, which extends over 11 kms of coast land, is the largest rookery for olive ridley sea turtles in world. It witnesses the mass nesting of the turtles each year, with few lakhs of gravid female turtles coming out of sea to lay eggs in the coast. In view of its global significance and area of 1435 square kilometers along with territorial sea water and coast has been notified as Gahirmatha (Marine) Wildlife sanctuary in 1997.

The water bodies are rich with commercially important fishes like Ilisha, Bhekti, kantia and Khainga. Varieties of crabs and prawns are very common too.

The avifauna is rich with 174 species of birds identified so far in the area. The heronary of Bhitarkanika ,known as Baga Ghana, witnesses breeding of resident birds in the Monsoon. It spreads over an area of 20 acres. Eleven species of birds, like storks, herons and egrets are found nesting here. The common species are open bill storks, little cormorant, egrets, purple herons, night herons, darter etc. It is interesting to know that 82 species of birds have shown signs of breeding in this area. The important ones among them are white bellied sea eagle, black necked

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stork, lesser adjutant stork and white backed Bengal vulture. The niche separation with regard to nesting helps in large scale colonial nesting. The highly productive eco system provides enough fish, prawns, frogs, snakes and molluscs as diet to the thousands of breeding birds and their chicks. The important migrant birds are ducks, geese, wigeons, sand pippers, showvellers, osprey and king fishers.

The mammalian biodiversity is important too. The existing chital and sambar have been introduced to the Bhitarkanika forest by the Zamindars of Kanika Raj in 1940. These deer species have adopted to and naturalized in the mangrove forests of Bhitarkanika. The other important mammals are fishing cat, wild boar, Indian porcupine, smooth Indian otter, civet cat, gray mongoose, stripped hyena, jackal and small populations of gangetic dolphin and black propoise as aquatic mammals. The feral population include cow and water buffalo which had arisen from domestic stocks in villages that were wiped out during the cyclones of 1971.

THREAT TO BIODIVERSITY

The conservation threat in the area are multiple. As in most of the protected areas in the country, the biotic pressure from human habitation is also critical threat for this sanctuary. The hostile attitude of the local people in the area had not allowed colonization by migrants till 1950. But later the influx of refugees from Bengal particularly from Midnapore areas, who are adapted to such environments, lead to large-scale encroachment of managrove forest areas. The productive ecosystem allowed good harvest of paddy and water bodies provided good fish catch in less effort. The once rich mangrove forests have been depleted and fragmented and got limited as thin lines along the water channels. The conversion of mangroves into paddy fields remain the major threat to the biodiversity of the area.

The other threat is the reduced fresh water influx to the estuary by the rivers of Brahmani and Baitarani. Since the river Brahmani has major irrigation dams in the upper catchment areas, the fresh water influx has reduced the mangroves substantially. The river Baitarani now stands as the major river that suspense fresh water discharge as there is no major irrigation dams. The diverse activities in the upper catchment areas influence water quality and quantity that in turn have impacts on mangrove vegetation by the way of changing the specis composition and distribution. The saline gradient is a function of fresh water influx in to the estuarine regions.

The beach erosion is a threat for the olive ridley turtles in the coast as it not only reduces the nesting areas but at times leads to destruction of eggs in the nests. In the recent past, olive redleys have developed new nesting sites in the river mouths of Devi and Rushikulya, but the mangrove forest which provide precious food chains for the young olive redleys is not available in these in these river mouths.

CONCLUSION

Jawaharlal Nehru had once said, " We must try to preserve whatever is left of our forests and the wildlife that inhabits them." This cannot be more appropriate to any other protected areas of the state other than Bhitarkanika.

MANAGING URBAN SNAKE MENACE : A RESCUE MODEL EMPLOYED IN BHUBANESWAR

P. P. Mohapatra[1] S. P. Parida[2]
S. Mishra[3] and S. Ranjanee[4]

INTRODUCTION

Snakes, as carnivores in our ecosystem, maintain the balance of nature by controlling a major portion of the rodent pests. They are associated with mythology and our culture as the symbol of love and fertility and are often linked with Gods and Goddess. The myths associated with snakes make them more dangerous and ferocious than any other creature. Snakes have fascinated human from time immemorial and are utilized by them in various ways. They may be the source of livelihood or the sources of life saving drugs; thus snakes have become parts of our life. They live with us, serve us and of course, sometimes harm us. They are very shy animals and often avoid human encounter. Snakes follow the three basic principles of animal behavior - flight, fright and fight. Whatever species of snake it may be, it tries to escape at the first sight, if cornered it tries to fright the adversary and if still disturbed it fights (bites). Therefore, it is necessary to know more about these reptiles to conserve them and to save them.

SARPA SURAKSHYA ABHIYAN

Bhubaneswar, nestled on the northern Eastern Ghat ranges, is the capital city of Orissa situated near the Chandaka Wildlife Sanctuary and is bestowed with dry deciduous forest patches, scrub forest, open fields, agricultural lands, human settlements, slums, drains, water bodies and hillocks. Though the snake-human conflict persists in every part of the state, we started a programme to minimize the conflict for the first time in Orissa. The snake rescue operation by our group is named as “Sarpa Surakshya Abhiyan”, started during August 2002 from the Utkal University campus and then gradually extended over the whole stretch of Bhubaneswar and near by areas by 2003. Though snake rescue (catching) in Bhubaneswar is not a new practice, which was initially carried out by the snake charmers of Padmakesharipur; the approach was modified. The Sarpa Surakshya Abhiyan was started with the broader objective of reducing snake-human conflict by snake rescue, relocation of the rescued snakes and public awareness.

PROTOCOL

Snake rescue

Snake rescue work is carried out by the team as per accessibility of the rescuers in addition to maximum care taken for quick move and safe handling of snakes. After getting a rescue call, the rescuer gets ready within no time and tries to arrive at the spot as soon as possible. The rescuer starts the operation after observing the snake and the circumstances. The snake is caught by its tail with the help of a stick after it starts moving and is brought near the opening of the specially designed snake bag so that it enters inside. Once more than half of the body enters into the snake bag, the opening of the bag is twisted slowly to prevent the escape of the snake from the bag and in the mean while the rescuer saves his hand from bite. Then the bag is tied nearly at one-third distance from the opening for handling. This method is one of the safest methods to handle the snakes as it causes minimum risk for the snake and the rescuer as well.

Relocation

Relocation of the rescued snakes is rather an important task than the snake rescue. Before the relocation of any snake the relocation site is studied. The study is done to assess the habitat suitability, prey abundance and diversity of the snake species in the area. Studies are made to ascertain the survival of the rescued animals. Though there is no provision for further study on the status of the animals after relocation, it is kept in mind to carry out the study in near future.

Public awareness

Snakes are always considered as dangerous and harmful animals because of their appearance and potential of some snakes to kill humans by the effect of their venom. They form a group that is associated with maximum number of myths than any other animals. The rescuer devotes some time after the snake rescue to explain the gathered public about the snakes and their role in the ecosystem. This awareness is called as “spot education” that provides the basic myth clearance of the public. Awareness campaigns are held on periodic basis in different villages and institutions with power point presentations and pictograms to aware

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the public about the snakes. It includes the identification of the snakes, their habitats, first-aid measures after snake bite and explanation of the myths associated with the snakes. These programs are aided with distribution of leaflets and special training to some volunteers of that area regarding the first-aid measures in case of snake bite. The group also takes initiative in counselling the snake bitten victims as and when required.

RESULTS AND DISCUSSION

During the last four years, the team has rescued more than 6,000 snakes (including more than 5,000 snakes rescued from Bhubaneswar) and conducted more than 100 awareness campaigns throughout the state. The snakes rescued from Bhubaneswar during the past four years of service are given in the following description.

From August 2002 (the month of foundation of Sarpa Surakshya Abhiyan) till December 2002, a total of 119 snakes were rescued. It includes 48 rat snakes followed by 31 spectacled cobras, eight wolf snakes, six checkered keel-backs, five striped keel-backs, five Russell's vipers, three kukri snakes and one Monocellate cobra. However, in the month of September a maximum of 36 snakes were rescued, which also shows highest species diversity among the rescued snakes. Minimum numbers of snakes were rescued in December.

In the second year (January 2003 to December 2003), 756 snakes were rescued encompassing 402 spectacled cobras, 267 rat snakes, 36 checkered keel blacks, 16 wolf snakes, 10 banded kukris, nine Russell's vipers, eight monocellate cobras, three striped keel backs and one cat snake. Rescue of spectacled cobras constituted highest population among rescued snakes, followed by the rat snakes. The maximum number of snakes (113 individuals) was rescued during September and the highest diversity (of six species of snakes) was observed in October. The minimum numbers of rescue calls were recorded in February.

During the third year (2004) a total of 1255 snakes were rescued. There were 582 spectacled cobras, 574 rat snakes, 47 checkered keel backs, 12 monocellate cobras, 9 Russell's vipers, 9 wolf snakes, 9 green vine snakes, 8 banded kukris, 3 common kraits, 1 checkered keel back and 1 cat snake. In this year maximum number of calls (152) and highest diversity among the species (individuals from 7 species) were recorded in the month of October. Minimum rescue calls were attended in January, consisting of 54 snakes.

Snake rescue in the fourth year (2005) includes 1733 individuals of different species. The number of snakes rescued includes 885 spectacled cobras, 761 rat snakes, 21 checkered keel backs, 22 wolf snakes, 18 monocellate cobras, 13 Russell's vipers, 6 striped keel backs, 5 banded kukris and one common krait. Interestingly, more numbers of snakes were rescued (203 individuals) in the month on June and highest diversity among the rescued snakes (seven species) was observed in the month of December.

From the above data it is clear that the number and diversity of snakes rescued are arbitrary as it depends on several factors like availability of the rescuers, presence and absence of the snake at the site, seasonal variation of snake encounter and patchy distribution of snakes. It is evident that the sighting frequencies of some species of snakes like spectacled cobra, rat snake, checkered keel back and striped keel back are higher from the pre monsoon (May) to early winter (October). Though during monsoon seasons snake encounters are more, but because of certain limitations on the part of rescuers and the informers there is maximum chances of escape of the snake. Rat snake being the most agile snake, is 'master in escaping'. Some snake species like Russell's viper and wolf snakes show higher occurrence in winter season. The occurrence of common krait is very rare in Bhubaneswar and is more evident in early winter. Rescue of spectacled cobras and rat snakes are in peak than the other snakes because of adaptation of these snakes near human habitation for easy prey hunt and religious beliefs associated with the species. It is also evident that more numbers of spectacled cobras are rescued during the early winter months, when the snake search for plenty of food and a safe place for hibernation.

DESCRIPTION OF SOME OF THE COMMON SNAKES FOUND IN BHUBANESWAR

Cobra (Venomous)

Cobras are easily identified from their hood and can be identified as two species namely spectacled cobra and monocellate cobra. Body colour varies from yellowish to reddish brown or dark brown with a spectacled mark on the backside of the hood of the spectacled cobra and an eye shaped mark in the monocellate cobra. Spectacled cobras are mostly seen near human habitation, in open fields, inside rat holes and granaries, whereas monocellate cobras are semi aquatic and found in low land paddy fields and water lodged areas.

Krait (Venomous)

There are two species of kraits found in Orissa, namely common krait and banded krait. They are slow moving nocturnal snakes of body colour black or bluish black, tinted with thin white cross bars with pointed tail in case of common krait and thick or broader white or yellow bands with blunt tail in case of banded krait. Common kraits are found in rat holes, termite mound, near human habitation or in gardens and farms near water bodies. Banded kraits prefer open plains and low lands near water bodies.

Viper (Venomous)

Viper is characterized by triangular head, short and stout body with highly keeled scales. Body colour is olive green or brown with dark brown or black oval blotches in three longitudinal series, nocturnal in habit and hiss like a pressure cooker. It is found in shrub areas, rocky hillocks and dense thorny hedgerows.

Rat snake (Harmless)

Rat snakes are one of the common non-venomous snakes of India, popularly known as 'friend of farmers' for their efficient rat hunting skill. Characterized by long slender body and small head; of body colour brown, yellowish brown or black with prominent dark cross bars in lip scales and hinder part of the body. Mostly found near human habitation inside rat holes, granaries, degraded termite mounds and paddy fields.

Wolf snake (Harmless)

It is often confused as krait and is one of the common snakes in Orissa. Body colour varies from brown or chocolate brown with distinct yellow bars starting behind the neck (not found in kraits) and are either faint or absent towards the hind body. Nocturnal in habit, it is mostly found in cracks and crevices in walls, roof and stone piles, and easily climbs rough vertical walls of the houses for hunting lizards.

Checkered keel back (Harmless)

It is the commonly found in and around the freshwater bodies, drains, and paddy fields. Colour varies from glossy olive green, olive brown, yellow, gray to black, usually with a checkered body pattern. It feeds on fishes, frogs, frog-eggs, tadpoles and occasionally scavenges on dead fishes.

Apart from these common snakes, there were also occasional rescue of pythons, sand boas, tree snakes, vine snakes, kukri snakes and king cobras rescued during the operation. Instance of rescue of black-headed snake from Sikharchandi area of Bhubaneswar was remarkable and added a new species to the checklist of snakes of Orissa. In another recent occasion, rescue of a king cobra from the Jaydev Vihar area of Bhubaneswar spell bounded the common people of the city. There were also reports of python sighting in the Regional Research Laboratory campus, Institute of Physics campus, Doordarsan Campus, and O.U.A.T. farm house ensuring its distribution inside the crowded city.

Table - 1 : Rescued Snakes from Bhubaneswar area

Sl No.	Snake species	Common English name	Oriya name	Area of rescue
1	*Python molurus molurus*	Indian Rock Python	Ajagara	Bharatpur Reserve Forest area, RRL campus, Institute of Physics and near by area
2	*Gongylophis conicus (Eryx conicus)*	Common Sand Boa	Domundia sapa	Utkal University campus, Khandagiri and RRl campus
3	*Eryx johnii*	Red Sand Boa	Domundia sapa	Observed with snake charmers and also confiscated from them
4	*Coelognathus helena helena*	Common trinket snake	Pahadia chiti	RRL campus, RMNH campus, Utkal University Campus and Doordarsan area
5	*Ptyas mucosa*	Indian Rat snake	Dhamana sapa	Through out Bhubaneswar
6	*Oligodon arnensis*	Common kukri snake	Pahadia chiti	Through out Bhubaneswar
7	*Dendrelaphis tristis*	Common bronze back tree snake	Kanal sapa	Through out Bhubaneswar
8	*Lycodon aulicus*	Common wolf snake	Kaudia chiti	Through out Bhubaneswar
9	*Sibynophis saggitarius*	Cantor's black headed snake	Sikhar chandi area	
10	*Xenocrophis piscator*	Checkered keel back	Pani dhanda	Through out Bhubaneswar
11	*Amphiestoma stolatum*	Striped keel back	Matibiradi sapa	Through out Bhubaneswar
12	*Boiga trigonata*	Common cat snake	Katakatia naga	Chandrasekhar pur, Rental colony near Bharatapur Reserve forest

13	*Ahaetulla nasuta*	Common vine snake	Laudankia sapa	Through out Bhubaneswar
14	*Enhydris enhydris*	Smooth scaled water snake	Dhanda sapa	Old town area, Kausalya gang
15	*Bungarus caeruleus*	Common krait	Chiti sapa	Through out Bhubaneswar
16	*Bungarus fasciatus*	Banded krait	Rana sapa	Kausalya gang, Patia and Old town
17	*Naja naja*	Spectacled cobra	Gokhar sapa	Through out Bhubaneswar
18	*Naja kaouthia*	Monosellate cobra	Tampa sapa	Mancheswar, Old town, Jagamara,
				Khandagiri and Patia
19	*Ophiophagus hannah*	King cobra	Ahiraj sapa	Rescued from Jayadev vihar
20	*Daboia russelii*	Russell's viper	Chandan boda	Through out Bhubaneswar

FUTURE OBJECTIVES

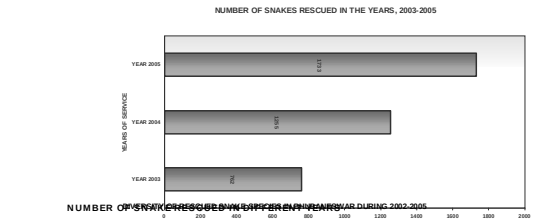
The snake rescue operation can be taken as a model for snake conservation by involving the snake charmer community. Snake charmers can better utilize the multidimensional aspect of the work for conservation of these reptiles as well as to solve a major part of their rehabilitation. For developing the idea of institutionalizing the work, the following recommendations are planned to be taken as the future objectives of the team.

1. Setting up of a rescue center: Rescue center is a temporary shelter for animals found in distressed condition. In Orissa, there is urgent need for a rescue center, which can be started with the snake rescue center as a first step.
2. Setting up of mini snake interpretation centers in village level : The team has already started operating in various parts of the State and aims at educating the public by providing basic knowledge about snakes through posters and leaflets to the village level clubs. In each club, volunteers are trained with the basic skill of snake rescue and are also provided with the literature to have additional knowledge about snakes.
3. Formation of a rapid action team for controlling snake menace during flood : It is observed that the snake bite casualty increases many folds during flood and monsoon seasons. So, the team plans to set up a group of volunteers to counteract the snake bite casualty in the flood affected areas.
4. Database management on availability of anti-snake venom in the hospitals of Orissa: After snake bite, the victim is often confused in getting proper medical treatment. The database will be prepared for directing the snake bitten victim to the nearest hospital having ASV for treatment after the advocacy of the first aid measures.

ACKNOWLEDGEMENT

At the outset, I would like to place on record my deep sense of gratitude to my esteemed guide Prof. Dr. S. K. Dutta, H.O.D., P.G. Department of Zoology, North Orissa University, Baripada, Orissa whose sincere guidance and supervision has enabled me to excel in my research work. My special to thank Dr Anup Nayak, conservator of forest, wildlife wing for their valuable advices and encouragement to work in this field. In the same spirit my heartfelt gratitude to deputy conservator of the forest, Sri S. K. Mohapatra I am also thankful to Mr. Subhendu Mallik and Mr. Saroj Kumar Behera for their assistance in collecting data. Lastly but not the least my thanks goes to the volunteers those put forth their helping hands to solicit the work.

Fig.1: Yearly snake rescue data



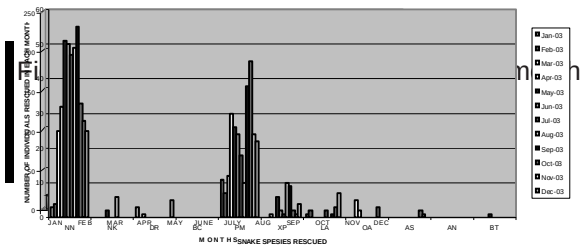
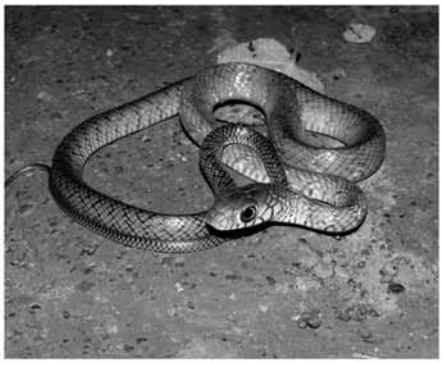


Fig. 3 : Diversity of snake species rescued in each month

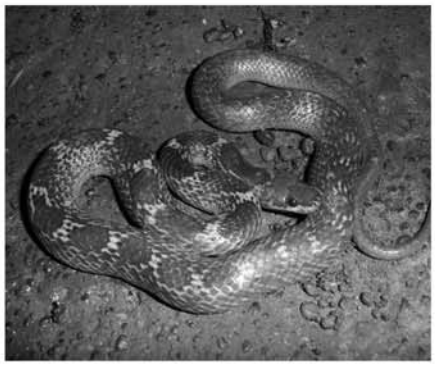
SNAP SHOTS OF SNAKE RESCUE

A Spectacled cobra rescued from a pipe

Russell's vi[per are mostly seen during clearance of weeds in winter months



Rat snakes are efficient rat killers and comsumes more than 200 rats per year



Wolf snakes are often confused as Common kraits and mostly seen in cracks and crevices of houses

Bagging of snakes as demonstrated by a rescuer

The King cobra rescued from Bhubaneswar

NIYAMGIRI : AN ECOLOGICAL, SOCIAL & CULTURAL HERITAGE OF ORISSA

B. Mohanty

INTRODUCTION

Niyamgiri is a hill range of Eastern ghats, about 250 sq. km. in area lying between 19.33° N latitude and 83. 25° E longitude. It forms the northernmost hill in the massif of the cluster of hills called the Niyamgiris or the Dongaria Kondh country. Also known as the Niyam Dongar, it runs in a southwest alignment with a maximum elevation of 1306 meters. From socio-cultural, anthropological as well as geographic point of view, this is a single hill-country; but from administrative point of view, the area comes three districts viz. Kalahandi, Rayagada and Koraput.

Both culturally and ecologically, the Niyamgiri hills are extremely rich and significant. Most importantly Niyamgiri Hills are the watershed of Vansadhara river as well as a major tributary of Nagavali river. It forms a distinct phytogeographical zone because of its height and its highly precipitous topography. It also has some of the most pristine forests in Orissa, and is home to a number of vulnerable wildlife species including tiger, leopards, sloth bear, pangolin, palm civet, giant squirrel, mouse deer, langur and sambhar, etc. It is also on the path of migration corridor of elephants, and comes within the territory of Royal Bengal Tiger. In view of its ecological importance, it was declared as nature conservation / game sanctuary and also was proposed as a Wild Life Sanctuary in the working plan of Kalahandi Forest Division. The State Wildlife organization has a proposal to declare this area as South Orissa Elephant Reserve as mentioned in the vide memo no. 4643/ 3WL(Cons) 34/04 dated 20.08.2004

SOCIO-CULTURAL IMPORTANCE OF NIYAMGIRI

Niyamgiri is better known as the 'Dongria Kondh country'. The Dongrias have derived their name from 'Dongar' meaning agricultural land on hill slopes. Dongaria Kondha is one of the primitive tribes of the State and enjoys a critical and symbiotic relation with the Niyamgiri forests. The census for 2001 reveals that the total population of this tribe is limited to only 7952 which includes 3458 males and 4529 females.

This rare indigenous tribes Dongarias believe that the hill country belongs to Niyam Raja Penu, a male deity represented by a sword and worshipped during Dussera and Jura parab. They claim themselves to be descendants of the Niyam Raja. The Dongrias have a distinguished heritage, because of their dress style, mode of living, indigenous skills, cultural pattern and social system interlinked with nature and forests.

The Dongaria Kondhas economy and its major sources of livelihood are directly related with Niyamgiri Forests. Around 40 to 50% of their annual income derived from by selling of forest products like siali leaves, myrobalans, amla and etc. They grow fruit crops like pineapple under the thick forests. Dongaria Kondhs are not at all known for hunting. No literature developed in vernacular or in english suggests that the Dongrias were hunters at any point of time in history.

ECOLOGICAL RICHNESS OF NIYAMGIRI

Streams and Rivers

The Niyamgiri hill range abounds with streams. More than 100 streams flows from the Niyamgiri hills and most of the streams are perennial. Niyamgiri hills have been receiving high rainfall since centuries and drought is unheard of in this area. Some of the major streams originated from Niyamgiri include Vamsadhara, Nagavali, Sakta nallha, Barha nalla and etc.

Table - 1 : Some of the major streams that originate from Niyamgiri hills

Sl. No	Local Name	Hill of Origin of the Stream	Nearby Village Settlement
1	Kadituni	Surgabata-Parapabata	Karjodi
2	Bamanadeu	Bata Karjodi	Karjodi
3	Mutkeni narengasus	Priskudi Horu	Priskudi
4	Latikanu	Lakdatarga	Khambesi
5	Dumberihua	Adanaka	Khambesi
6	Ambagorada	Purgi Dongar	Munduavali
7	Bijahua	Baplakata	Hundi Jhali
8	Kaman	Neba Horu	Arisakani
9	Baming jadi	Batigari	Thuaguda
10	Dindenihua	Tudangapadi	Dindeni

Secretary Wildlife Society of Orissa, Link Road, Cuttack, Orissa

11	Panche jadi	Sraledong	Ghartuli
12	Satahua	Kupdingapatra	Ghartuli
13	Jambusua	Papibangeni	Ghartuli
14	Banjipanche	Kajapadi	Khajuri
15	Latikanu	Mundepambu	Khajuri
16	Kdaninga pambu	Madangkala	Khajuri
17	Panchejadi	Bengdavali	Talaguma
18	Biamnghua	Parang Kuda	Uparaguma
19	Kayukakadi	Tudangpadi	Uparaguma
20	Kakadipau	Kdangar jala	Uparaguma
21	Takusua	Hergi Haru	Kadraguma
22	Derukuta	Sapta Amba	Kadraguma
23	Bamanadeu	Kumaravali	Kadraguma
24	Bijanghua	Madabasa	Khajuri
25	Taddali	Paklakaska	khajuri

FLORAL DIVERSITY OF NIYAMGIRI

The flora of the hill range exhibits a very rich and varied assemblage of plant species owing to its diversified topography with high mountain peaks and innumerable deep valleys and gorges, abundant springs and diverse vegetation resources. Taxonomists have reported the occurence of 602 plant species distributed over 114 families of angiosperms, gymnosperms and pteridophytes.

Rare/endangered/conservation dependent plant species :

1. *Bupleurum falcatum*
2. *Clematis gocuriana*
3. *Laggera alata*
4. *Themeda arundinacea*
5. *Tephrosia roxborghiana*
6. *Exacum perottetii*
7. *Vernonia divergens*
8. *Eusteralis stellata var. roxborghiana*
9. *Bidens pilosa*
10. *Uraria picta*
11. *Plectranthus nilgherricus*
12. *Scutellaria discolor*
13. *Stemona tuberosa*
14. *Asparagus gracilis*
15. *Spilanthes calva*

(Source: Forest Tribes of Orissa, Volume –1: The Dongaria Kondha)

High altitude plant species :

1. *Persea macrantha*
2. *Rauwolfia serpentina*
3. *Gnetum scandens*
4. *Homalium nepalense*
5. *Gloriosa superba*
6. *Clematis gouriana*
7. *Laggera alata*
8. *Tephrosia roxborghiana*
9. *Exacum perottetii*
10. *Stemona tuberosa*
11. *Rhaphidophora hookeri*
12. *Bulbophyllum polyrrhizum*
13. *Cycas circinalis var.orixensis*
14. *Psychotria adenophylla*
15. *Tylophora fasciculata*

Orchid flora of Niyamgiri :

The present orchid flora of Niyamgiri accounts for 31 species (19 epiphytic, 12 terrestrial).

1. *Acampe carinata* (Griff.) Panigr.
2. *Acampe ochracea* (Lindl.) Hochr.
3. *Acampe praemorsa* Blatt.& McCann
4. *Aerides multiflora* Roxb.
5. *Aerides odorata* Lour.
6. *Bulbophyllum polyrhizum* Lindl.
7. *Crepidium mackinnoni* (Duthie) Szlach.
8. *Cymbidium aloifolium* (L.) Sw.
9. *Dendrobium aphyllum* (Roxb.)Fisch.
10. *Dendrobium bicameratum* Lindl
11. *Dendrobium fimbriatum* W.J.Hook.
12. *Dendrobium herbaceum* Lindl
13. *Dendrobium macrostachum* Lindl.
14. *Dendrobium transparens* Lindl.

15. *Eulophia spectabilis* (Dennst.) Suresh
16. *Geodorum recurvum* (Roxb.) Alston
17. *Habenaria digitata* Lindl
18. *Habenaria diphylla* Dalz.
19. *Habenaria furcifera* Lindl.
20. *Habenaria panigrahiana* S. Misra
21. *Habenaria reniformis* (D.Don) J.D.Hook.
22. *Habenaria stenopetala* Lindl.
23. *Luisia zeylanica* Lindl.
24. *Oberonia falconeri* J.D.Hook.
25. *Pelatantheria insectifera* (Rchb.f.) Ridl.
26. *Peristylus constrictus* (Lindl.) Lindl.
27. *Peristylus goodyeroides* (D.Don) Lindl.
28. *Rhynchostylis retusa* (L.)Bl.
29. *Seidenfia rheedii* (Sw.) Szlach.
30. *Vanda tessellata* (Roxb.) Hook. ex G.Don
31. *Vanda testacea* (Lindl.) Rchb.f.

FAUNAL DIVERSITY OF NIYAMGIRI

Niyamgiri hills is the natural habitat for many endangered, threatened and conservation dependant fauna species because of its diversified topography with high mountain peaks, plain plateaus at hill tops, innumerable deep valleys and gorges, abundant springs, diverse vegetation resources and it's distance from so called mainstream development.

Large colonies of the Golden Gecko were found in Niyamgiri hills. Due to its extremely rare status, this lizard is classified in the Schedule I of the Wildlife Protection Act, 1972. This again is the first record from Orissa from this place.A new specimen of cat snake was noticed here.

Sl. No.	Name of the Animal	Scientific Name	Classification/ Categorization in WPA
1	Elephant	*Elephas maximus*	Schedule - 1
2	Tiger	*Panthera tigris*	Schedule - 1
3	Leopard	*Panthera pardus*	Schedule - 1
4	Pangolin	*Manis crassicaudata*	Schedule - 1
5	Palm civet	*Paradoxurus hermaphroditus*	Schedule - 1
6	Sloth Bear	*Melursus ursinus*	Schedule - 1
7	Mouse Deer	*Tragulus meminna*	Schedule - 1
8	Giant squirrel	*Ratufa macroura*	Schedule - 1
9	Bison	*Bos gaurus*	Schedule - 1
10	Four horned antelope	*Tetracerus quadricornis*	Schedule - 1
11	Leopard cat	*Felis bengalensis*	Schedule - 1
12	Indian Wolf	*Cansis lupas pallipes*	Schedule - 1
13	Rhesus Monkey	*Macaca mulatta*	Schedule - II
14	Wild Dog	*Cuon alpinus*	Schedule - II
15	Fox	*Vulpes bengalensis*	Schedule - II
16	Langur	*Presbytis entellus*	Schedule - II
17	Smooth Indian otter	*Lutra perspicillata*	Schedule - II
18	Mongoose	*Hypestus edwardsi*	Schedule - II
19	Sambar	*Cervus unicolor*	Schedule - III
20	Spotted Dear	*Axis axis*	Schedule - III
21	Hyena	*Hyaena hyaena*	Schedule - III
22	Barking Deer	*Muntiacus muntjack*	Schedule - III
23	Porcupine	*Hystrix indica*	Schedule - IV
24	Five Striped Palm squirrel	*Funambulus pennanti*	Schedule - IV
25	Rat	*Rattus rattus*	Schedule - V

Reptiles like monitor lizard is a common sight here.The Travancore wolf snake, which was last reported from Orissa by the British herpetologists in pre- independence era, has also been rediscovered from here recently.

ANTHRAX : ITS THREAT TO MANKIND AND THE PRECAUTIONARY MEASURES

A. K. Das[1], R. K. Samantray[2] and P. K. Roy[3]

INTRODUCTION

Anthrax is an acute, febrile disease of virtually all warm-blooded animals, including man. Birds are reasonably resistant to the disease. Most commonly, it is a septicaemic condition principally characterized by a rapidly occuring fatal course. It occurs worldwide. Above all, it is a dreadful disease in animal with prime zoonotic importance. In Orissa anthrax is generally reported in western and northern Orissa in district such as of Kalahandi, Sundargarh, Sambalpur, Angul including Keonjhar, Dhenkanal and Koraput.

CAUSATIVE ORGANISM

Anthrax is caused by the Bacillus anthracis bacterium.

Fig. 1: *Bacillus anthracis* in Gram stain

PROPERTY

It is a Gm (+) ve, aerobic, spore forming, non-motile, capsulated and roughly rectangular rods. It produces long chains and non-hemolytic irregular (Medusa head appearance) colonies in culture media.

SUSCEPTIBILITY

Cattle, sheep, goat, elephant, buffalo, rhinoceros and carnivores are highly susceptible to the disease.

ENVIRONMENT

Outbreak of anthrax is commonly associated with neutral, alkaline or calcareous soils. In these areas, the spores apparently revert to the vegetative form and multiply to infectious level when environmental condition of soil, moisture, temperature, pH, and nutrition are at the optimal level. Further, the presence/ absence of O_2 and CO_2 does play a significant role in the above process. Moisture and organic matter in soil also encourage germination of anthrax spore. The spores remain viable in the infected area for even 60 yrs as reported. Outbreak tends to occur in association with marked climatic or ecological change; heavy rain fall, flooding and drought.

INCUBATION PERIOD

3-7 days(1 to_>14 days) with clinical course of par acute to chronic form incase of animal. In human being it is 1-7 days, may be prolonged up to12 days for cutaneous anthrax and 60days for pulmonary form.

TRANSMISSION

Animals like cattle, horse, mule, sheep and goat may readily become infected when grazing on infected pasture. In fact, outbreak generally originates from soil borne infection. Even biting of insects and flies may mechanically transmit the disease from one animal to another. Consumption of contaminated foodstuffs like different crop and fodder when grown in contaminated soil also act as a very good source of infection. Of course consumption of infected meat and bone meal also acts as a potential source.

ANTHRAX IN MAN

Human anthrax can be principally of 3 forms i.e. Cutaneous ,Gastro-Intestinal and Pneumonic form.

Further, the first two above forms i.e. cutaneous form and gastro- Intestinal form are once again coming under another category called Non- Industrial form. The Pneumonic form is known as Industrial form of anthrax

Cutaneous form: About 95-99% of human anthrax occurs in cutaneous form. It occurs in truckers, farmers, pathologist, and veterinarian as a result of handling or close contact with infected animal. Insect

like Stomoxys spp. and Tabanide fly do transmit cutaneous form of anthrax. It is mainly characterized by formation of malignant carbuncle, which ultimately takes a septicaemic course. Another 5% cases of cutaneous form may develop meningitis called anthrax meningitis.

Gastro intestinal form: - It is resulting form consumption of infected meat. Recently in Orissa, human casualties were reported among the tribals of Kalahandi and Koraput districts due to handling and consumption of infected meat.

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2. Veterinary Assistant Surgeon, Nandankanan Zoological Park, Bhubaneswar, Orissa,India, e-mail : rtndrrranjit@yahoo.com
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Pneumonic form: It occurs through inhalation of spore, mostly through industrial exposure. It becomes a potent occupational hazard for those employed in the processing of wool, hair, hide, bones and other animal product that prompted inhalation of spore-laden dust during processing.

ANTHRAX MENINGITIS

It may occur as a result of bacteraemia developed after inhalation (pneumonic) anthrax and is less common in comparison to other forms of anthrax. The cerebro-spinal fluid is hemorrhagic. In most instances, numerous large, encapsulated, gram-positive bacilli are found to be present in the cerebro-spinal fluid. Mortality approaches 100 percent, but occasionally, patients treated with antibiotics have survived.

IMMUNIZATION

Sterne's strain vaccine, popularly called as Anthrax Spore Vaccine (living), for animals is available in Orissa as well as in different parts of India. Full immunity takes 10 to 14 days to develop. Human vaccine was developed in the erstwhile Soviet Union from 1940 and in U.S.A. and Great Britain from 1950 from the cell-free culture filtrate of an attenuated strain of B. anthracis.

BIOLOGICAL WARFARE

Anthrax has acquired some degree of notoriety as a potential agent of biological warfare. After September 11,2001 terrorist attack on World Trade Center, New York, U.S.A., many a terrorist outfit threatened to launch biological warfare against U.S.A. through anthrax spore by disseminating powder samples in postage envelopes. That really created a panic among the common citizens and the U.S. administration as well. However, the development of safer and more potent vaccine has received maximum attention due to fear of such biological warfare using inhalant anthrax spores. The possibility of creating aerosols containing anthrax spores has made B. anthracis a chosen weapon of bio-terrorism. Iraq, Russia, Korea and many other nations have the capability to load spores of *B. anthracis* into weapons. In Indian context, terrorists may develop means to distribute spores via mass attacks or small-scale attacks at a local level. As an agent of biological warfare it is expected that a cloud of anthrax spores would be released at a strategic location to be inhaled by the individuals under attack. Spores of B. anthracis can be produced and stored in a dry form and remain viable for decades in storage or after release. In this case the anthrax vaccine protects against anthrax that is acquired through the skin and it is believed that it would also be effective against inhaled spores in a bio-warfare situation.

TREATMENT

Penicillin has been the drug of choice for decades. Amoxycillin, doxycycline and oxytetracycline are also common anti-microbial drugs. In vitro, B. anthracis is also susceptible to most other commonly used anti-microbial drugs, such as ciprofloxacin, ofloxacin, levofloxacin, tetracycline, chloramphenicol, macrolides, amino-glycosides, clindamycin, rifampicin, vancomycin, cefazolin, and other first-generation cephalosporins. It is resistant to cefuroxime, extended-spectrum cephalosporins such as cefotaxime and ceftazidime, aztreonam, trimethoprim, and sulfamethoxazole.

VACCINATION GUIDELINES

(i) The vaccines, which consist of living attenuated strains of the organism with low virulence, can be capable of forming spores. Disadvantage is that anthrax may result in some cases from vaccination. This type of Sterne's strain live spore vaccine is considered unsuitable for human use. In fact, human vaccine available in 1960s containing cell free filtrate of sterne strain culture, alum precipitated in U.K or $AlOH_2$ gel adsorbed in USA.

(ii) In enzootic area, annual revaccination of all stocks is necessary.

(iii) Vaccination should start 2-4 weeks before the season when outbreak may be expected.

(iv) Animal should not be vaccinated within two months of anticipated slaughter.

(v) Antibiotics must not be used at the same time as vaccines are given, since they interfere with the development of immunity. Moreover, as anthrax spore vaccine is a live vaccine, antibiotics should not be even administered within one week of vaccination.

(vi) Milk from vaccinated cows is usually discarded for 72 hours approximately.

CONTROL MEASURES

i) Rigid enforcement of quarantine is essential ?

ii) Infected carcass should not be opened but immediately burnt or buried together with bedding and soil contaminated by discharges. Burial with sufficient quick lime is recommended.

iii) Annual vaccination of survivors should be under taken.

iv) All suspected and in-contact animals should be segregated.

v) Hygiene is the biggest single factor in prevention of spread of the disease. Disinfection of premises, hides, bone meal, wool and furniture are desired.

vi) Destruction of discharges and cadavers with careful disposal of infected materials is desired.

vii) Prohibition of milk and meat from farm during quarantine period should be administered.

viii) During outbreak the placing of animals in quarantine is desired.

ix) In cases of spore formation, strong disinfectants such as 5% lysol is required to be in contact with spores for two days. Strong solution of formalin or NaoH (5-10%) is also most effective.

X) Disinfection can be carried out immediately before spore formation occurs. Ordinary disinfectants or heating with 60^0 c / 140^0 F can be sufficient to kill vegetative forms.

XI) Control of scavengers that feed on animals died of anthrax should be given priority.

XII) Observation of general sanitary procedures by people who handle diseased animals is need,as it is a potential zoonotic disease.

CONCLUSION

Anthrax is one of the oldest bacterial diseases known to mankind with prime zoonotic importance. In view of its ubiquitous presence in nature, associated with characteristically long survivility, it continues to be a constant threat to the livestock and human population. However adequate awareness regarding the disease along with salient precautionary measures including ever-effective routine vaccination can ensure a safer world to live in.

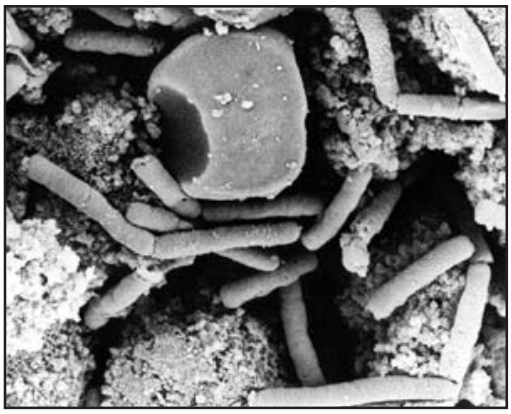

Fig. 2 : Characteristic anthrax bacteria

Fig. 3 : Bleeding of tarry coloured blood from natural orifice of infected animal.

Fig. 4 : Colin Powell holding a model vial of anthrax while giving a presentation to the United Nations Security Council.

REFERENCES

Chakraborty A (1993) A text book of preventive veterinary medicine : Pp- 201.

Fowler E M (2nd Ed.) Zoo and wild Animal Medicine.

Packer M (1983 Ed.) Veterinary Bacteriology and Virology

Blood, Radostitis (7th Edn) Veterinary Medicine.

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ROYAL BENGAL INDIAN TIGER : PAST, PRESENT AND FURURE – AN ANALYSIS IN ORISSA CONTEXT

S. K. Palita

INTRODUCTION

The most magnificent of all the cats, the tiger down the ages had been an object of awe, reverence and fear (Kurup,1986). Few mammals have become creatures of myth in the minds of man as great an extent as has the tiger (Schaller, 1967). The tiger is the spirit of the Indian jungle. Acute sensitivity, secretiveness and the ability to surprise, untiring perseverance, agility to attack, tenacity to follow and hold and strength to over power are the qualities necessary in a successful predator. The tigers possess them all in extraordinary measure (Sankhala, 1978).

In the present paper an analysis has been made to analyse the past and present status of tigers and its future in the India's wild habitats as well as in Orissa vis-a-vis causes for its decimation.

Tiger – An Endangered Species :

In 1972, an All-India Tiger Operation was launched under the direction of Late, Saroj Raj Choudhury, a reputed Forest Officer from Orissa and through a through a instrument invented by him known as "Tiger-tracer". The census of tiger revealed that there were only 1827 tigers left in India. These figures were close to that of Sankhala's figures of 2,500. Thus, a major information was gathered for the formulation of the conservation plan to save the tiger.

Task Force on Tiger

Late Prime Minister Mrs Indira Gandhi, appointed an 11 Member Task Force Committee in 1972, to go into details of the problem and prepare plan to preserve the wild tigers in India. Thus, on the basis of recommendations of Task Force Committee, the Project Tiger was launched on April 1, 1973 with the following objectives :

Project Tiger

Initially, the Project started with 9 tiger reserves, covering an area of 16,339 sq.km., with a population of 268 tigers . At present there are 27 tiger reserves covering an area of 37761 sq.km., with a population of 1498 tigers (Table-1) . This amounts to almost 1.14% of the total geographical area of the country. The selection of reserves was guided by representation of ecotypical wilderness areas across the biogeographic ranges of tiger distribution in the country.

The main achievements of this project are excellent recovery of the tiger habitat and consequent increase in the tiger population in the reserve areas, from a mere 268 in 9 reserves in 1972 to 1576 in 27 reserves in 2001 (Figure-1). Tiger, being at the apex of the food chain, can be considered as the indicator of the stability of the eco-system. For a viable tiger population, a habitat should possess a good prey base, which in turn will depend on an undisturbed forest cover. Thus, 'Project Tiger', is basically the conservation of the entire eco-system and Apart from tigers, all other wild animals also have increased in number in the project areas. In the subsequent 'Five Year Plans', the main thrust was given to enlarge the core and buffer zones in certain reserves, strengthening of protection and ecodevelopment measures in the buffer zones of existing tiger reserves, creation of additional tiger reserves and stepping up of the research activities.

Present Status of Tiger – Speedily Dwindling Population

The euphoria over success of Project Tiger was short-lived. Within 30yrs of implementation of the Project Tiger, rampant poaching and trade on tiger bones,the tiger population in India was found have dwindled. Today, due to intense poaching, Sariska Tiger reserve has lost all its tiger population. The high numbers of seizures of tiger parts from Uttar Pradesh, Madhya Pradesh, West Bengal, Maharastra, Uttaranchal, and Andra Pradesh suggest increased level of poaching of tiger in India which indicate a potential market thriving. This year alone, Nepal has been able to confiscate 8 tiger skins and more than 130 kg of tiger bones which were heading for Lhasa, Tibet and seized by security forces (IUCN, 2005).

Ten tiger reserves — including Simplipal, Indrawati and Dudhwa — have reported little drop in tiger count in the latest census, highlighting a new crisis in India's efforts to preserve its tigers (Dutta, 2006). The detailed tiger population in India states by census years has been given in Table - 2.

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Similarly the detailed tiger population in project tiger reserves by census team has been given in Table -3

The Government of India has pointed out that the porous borders with Nepal, Bangladesh and Myanmar may have facilitated illegal trans-border movement of tiger skins and bones. With such rise in tiger trade and bleak prospect for tiger population in India, the Indo-China protocol on the tiger is being reactivated that was signed in 1995. This will allow high level Chinese delegation to visit Indian tiger reserves and then the Indian counterpart will seek Chinese cooperation in stopping trade in tiger products in China and Tibet. (IUCN, 2005)

Future of Tigers in Orissa ?

Tigers are facing an increasing threat from poachers due to their high value in the Asian markets. The poverty of the people who live in and around tiger habitats and the high price paid for tiger parts continue to pose an increasing threat to the tiger population and with major developmental activities work being undertaken in some National Parks.

Tiger Conservation - Orissa Scenario

Information available from Table-2 and Table-3 indicate that the number of tigers in Orissa as well as in Similipal Tiger reserve is in rise, which speaks high in favour of conservation measures.

According to the 2004 tiger census on the basis of pugmarks, the state has a total of 192 against 173 in 2002. The largest number of the big cats, 101 in all, is found in Simlipal, followed by 32 in Sunabeda wildlife sanctuary and 18 in Satkosia Gorge sanctuary. Ghumsur area (both north and south divisions) has 10 tigers. Similarly, 4 have been reported from Khariar reserve forerst, 3 each from Rayagada and Boudh reserve forest, 6 from Baliguda reserve forests under Kotagada sanctuary and 5 from Hirakud wildlife sanctuary.

The 2004 tiger census report says 57 of the 192 tigers in Orissa's forests are males, 75 are females and 60 are cubs.

The report of the Govt. that the number of tigers has increased in Orissa, particularly in Simlipal has been greeted with skepticism by wildlife experts.

While Forest Department Authorities at Similipal discard all allegations on poaching in Similipal, the former chief wildlife warden Saroj Patnaik expressed concern over tigers in various forests of the state. Barring Simlipal, tigers in other forests are exposed to poaching, as there are not enough forest guards to look after their security, Patnaik said. Though there has been no incident of tiger poaching in Orissa since 1996, sources said all forests, including Simlipal remain understaffed. Nearly 40% baselevel posts, including that of forest guards, have been lying vacant for years (Times of India, 27.03.2005).

What threatens the tiger in Orissa ?

The tiger in Orissa is threatened by a combination of many factors. This include habitat destruction, loss of corridor poaching for commercial gains and the conflicts arising from the management of protected areas and the problem concerning enforcement of law.

Loss of Habitat

The most formidable threat to the tiger continues to be the fragmentation and loss of prime tiger habitat. Increasing demand of forest areas for agriculture, industry, developmental projects and the need of rapidly expanding human and cattle populations are chiefly responsible for this. Developmental projects like dams, roads and mining have decimated forests more than any other single cause. Even after passing of the Forest (Conservation) Act. in 1980, forest lands were diverted for non forest purposes.

Tigers roam in territories ranging over several sq. kilometres which need to be relatively undisturbed and supported by an adequate prey base. Currently, this ideal situation may only be found in a limited number of protected areas of the state. Unless, its habitat is preserved, the tiger can not be saved.

Poaching

While tiger hunting was banned from 1970 onwards, tigers continue to be shot illegally. With the tiger population down to marginal levels in most of other countries of its former range, the attention of the illegal trade mafia turn to India, which still has a substantial number of tigers. Profit margins from illegal trade are exceptionally high, making tiger poaching a lucrative & thriving business.

In India alone, about 115 Bengal tigers were killed in known poaching incidents from 1995. The Wildlife Protection Society of India warned that this figure probably represented the tip of an iceberg, since most of tiger poachings are done clandestinely and hence are difficult to detect. Twelve tiger skins, 6 skeletons and 86.5kg of bones were seized by the Indian authorities between November 1998 and May

1999. By October 1999 an additional 12 tiger skins were seized. In January 2000, India reported major wildlife seizures in one month between mid-December 1999 and mid January 2000. The seizures included 7 tiger skins, 120 leopard skins, 312 tiger claws (representing 18 dead tigers), and 18,000 leopard claws (representing a staggering 1,000 dead leopards).

The recent incidents in Sariska and arrest of Sansar Chand, the kingpin of tiger bone trade has proved that there is a well organised illegal trade network running in India since last decade, and is now threatening our tigers.

Consumption of tiger parts

While there is some use of tiger products in virtually all tiger range countries in the last decade there has been a rise in commercial demand for tiger parts for use in Traditional Chinese Medicine (TCM) and other derivatives in South-East Asia. Mills and Jackson (1994) have identified 15 tiger parts that are used in TCM. These include hair, whiskers, testes, penis, brain, eyeballs, blood, bile, bones, etc. Moreover, the demand for tiger based products is no longer limited to South and South-East Asia. It is reported that some 116 factories are engaged in producing medicinal liquor in China.

The major suppliers of tiger parts and processed derivatives are China, Hong Kong, Indonesia, Singapore and Thailand. Mills and Jackson also point out that although available trade data does not indicate India as a supplier, by virtue of the number of tigers here and extent to which poaching appears to be taking place, it could be a major country of supply. The apparent major importers are South Korea, Japan, Taiwan, USA and Singapore. Between 1970 and 1993 these countries alone accounted for at least 10, 881 kg. of tiger bone, 12, 139 tiger or bear bones, and 27 million tiger derivatives in various units of measure. Their conclusion is a grim one : "The only certainty is that wild tiger populations can not sustain even limited trade on their parts. Given fragmented habitats and small isolated populations, many of the remaining wild tiger populations will require rigorous protection and management just to survive the continuing loss of habitat and the deleterious effect of genetic isolation, much less the presence of poaching to supply the international market with tiger bones and tiger derivatives." (Mills and Jackson, 1994).

Management of Protected Areas

The other major threat to the tigers in Orissa is due to increasing conflicts arising from the management of protected areas. These conflicts mostly revolve around the use and control of resources. People living in and around the forests were using the natural resources freely prior to the declaration of these forests as protected areas. The conflicts over the use and control of natural resources become law and order problems and result in physical clashes between the people and authorities. In the case of national parks where control measures are stringent, clashes are more common. Injury and death of human beings and crop damage caused by wild animals further aggravate the conflict.

Available information suggests that the threats to protected areas and wildlife have substantially increased. In a country such as India the human dimension of wildlife conservation can not be ignored in any strategy. More recently, the concept of'eco-developments' around protected areas have been adopted, leading to new ideas and strategies to involve local communities in wildlife conservation while also meeting their livelihood needs (WWF, 1996).

Lack of Political Support

There has never been any broad based political support for tiger conservation in the country. The only exceptions were the late Prime Minister Indira Gandhi and to a lesser extent, the late Prime Minister Rajiv Gandhi. It was Indira Gandhi's extra ordinary zeal for conservation that led to the enactment of the Wildlife (Protection) Act, 1972. Over the next 10 years or so the cause of wildlife received strong support from the highest level creating the momentum for the initial success of Project Tiger. This strong political support, however, was not backed by the larger body of political representatives of the states including Orissa followed by lack of interest on the part of politicians in matters related to wildlife conservation.

Absence of grassroots support

There is also an absence of interest and support for the cause of tiger conservation among the people, both rural and urban.Tiger conservation has been rarely supported by the local communities living in and around the tiger areas. With the declaration of protected areas most of them have

had to face restrictions on access and use of resources such as fuelwood, fodder, small timber, grazing areas and non timer forest produces. In addition, they have had to face physical displacement, damage to livestock and crops, as well as cattle lifting and human killing.

The alienation of the local people, and the fact that they do not receive any direct benefits from wildlife conservation has also bred an atmosphere of antagonism.

Lake of infrastracture support & training

Support structures like training of the forest department staff (espacially at lower levels for management of protected areas,) and the material support required by them for effective management are lacking.

Therefore , there exists an urgent need to strengthen the support structure for effective tiger conservation in the country.

CONCLUSION

The survival of the tigers in the wild is inextricably dependant on the survival of the ecosystem in which it lives in. Looking at the situation from purely an economic standpoint, the inhabitants of most tiger populated regions stand to gain subsistence from exploiting the forests. The Government's conservation policy is overwhelmed by the economic needs of the people who live in and around the tiger's habitat and cannot save the wild tiger from extinction by merely putting guards in place. Added to this is the economic incentive offered by poaching.

The current policy of putting in place guns and guards cannot protect the ecosystem. Local communities need to be involved in the conservation effort on a sustained basis. The conservation policy should mitigate the economic forces at play against the tiger and the forests at their causality rather than suppressing their manifestation (Khandelwal, 2005).

In the beginning of 21st Century "biodiversity conservation" is a priority before all nations. Biodiversity conservation can only be successful in India, when the flagship species 'Tiger', the majestic mammal and top most carnivore atop ecological pyramid is protected and conserved.

Table -1 : Name of the Tiger Reserves in Tiger range states with year of creation and area

SNo.	Name of Tiger Reserve	State	Year of Creation	Total area (In Sq. Kms.) 1
1	Bandipur - Nagarhole (extension)	Karnataka	1999-2000	642
2	Corbett	Uttaranchal	1973-74	1316
3	Kanha	Madhya Pradesh	1973-74	1945
4	Manas	Assam	1973-74	2840
5	Melghat	Maharashtra	1973-74	1677
6	Palamau	Jharkhand	1973-74	1026
7	Ranthambhore	Rajasthan	1973-74	1334
8	Similipal	Orissa	1973-74	2750
9	Sunderbans	West Bengal	1973-74	2585
10	Periyar	Kerala	1978-79	777
11	Sariska	Rajasthan	1978-79	866
12	Buxa	West Bengal	1982-83	759
13	Indravati	Chattisgarh	1982-83	2799
14	Nagarjunsagar	Andhra Pradesh	1982-83	3568
15	Namdapha	Arunachal Pradesh	1982-83	1985
16	Dudhwa - Katerniaghat (extension)	Uttar Pradesh 1999-2000	1987-88 551	811

17	Kalakad-Mundanthurai	Tamil Nadu	1988-89	800
18	Valmiki	Bihar	1989-90	840
19	Pench	Madhya Pradesh	1992-93	758
20	Tadoba-Andhari	Maharashtra	1993-94	620
21	Bandhavgarh	Madhya Pradesh	1993-94	1162
22	Panna	Madhya Pradesh	1994-95	542
23	Dampha	Mizoram	1994-95	500
24	Bhadra	Karnataka	1998-99	492
25	Pench	Maharashtra	1998-99	257
26	Pakhui-Nameri	Arunachal Pradesh-Assam	1999-2000	1206
27	Bori, Satpura, Pachmari	Madhya Pradesh	1999-2000	1486
		Total		**37761**

Source : www.progecttiger.org as viewed on 11.01.2006

Table 2. Tiger population in Indian states by census years

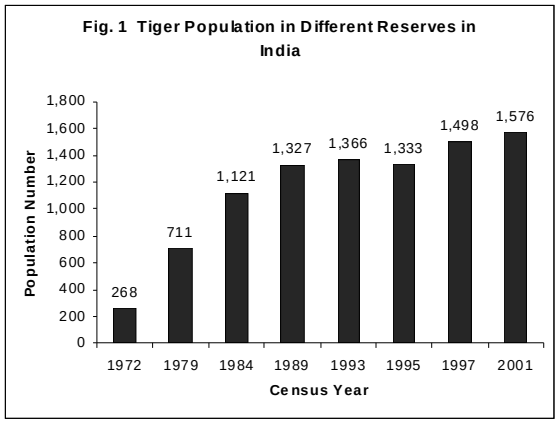
State	**1972**	**1979**	**1984**	**1989**	**1993**
1. Andhra Pradesh	35	148	164	235	197
2. Goa				2	3
3. Bihar*	85	110	138	157	137
4. Mizoram		65	33	18	28
5. Orissa*	142	173	202	243	226
6. Rajasthan*	74	79	96	99	64
7. Gujrat	8	7	9	9	5
8. Maharashtra*	160	174	301	417	276
9. Karnataka*	102	156	202	257	305
10. Meghalaya	32	35	125	34	53
11. Uttar Pradesh*	262	487	698	735	465
12. Arunachal Pradesh*	69	139	176	135	180
13. Madhya Pradesh*	457	529	786	985	912
14. Kerala	60	134	89	45	57
15. Tamil Nadu*	33	65	97	95	97
16. West Bengal*	73	296	352	353	335
17. Assam*	147	300	376	376#	325
18. Tripura	7	6	5	5#	NA
19. Nagaland	80	104	102	102#	83
20. Sikkim	-	-	2	4	2
21. Manipur	1	10	6	31	NA
Total	**1,827**	**4,005**	**3,015**	**4,334**	**3,750**

Information not available NA. Tiger census undertaken, but figures not yet available # Tiger census could not be undertaken during 1989, Assam, Tripura and Nagaland. Hence figures for 1984 have been used * States together having about 93% of the total tiger population of the country. Source: WWF (1996)

Table 3. Tiger population in project tiger reserves by census years

Project tiger Reserve	Year	1972	1997	1984	1989	1993	1995
1. Bandipur (Karnataka)	1973	10	39	53	50	66	74
2. Corbett (UP)	1973	44	84	90	90	123	128
3. Kanha (MP)	1973	43	71	109	97	100	97
4. Manas (Assam)	1973	31	69	123	92	81	94
5. Melghat (Mah.)	1973	27	63	80	77	72	71
6. Palamau (Bihar)	1973	22	37	62	55	44	47
7. Ranthambhore(Raj)	1973	14	25	38	44	36	38
8. Similipal (Orissa)	1973	17	65	71	93	95	97
9. Sunderban (WB)	1973	60	205	264	269	251	NA
10. Periyar (Kerala)	1978-79	-	34	44	45	30	39
11. Sarika (Raj.)	1978-79	-	19	26	19	24	25
12. Buxa (WB)	1982-83	-	-	15	38	29	31
13. Indravati (MP)	1982-83	-	-	38	28	18	15
14. Nagarjunasagar (AP)	1982-83	-	-	65	94	44	34
15. Namdapha (AP)	1982-83	-	-	43	47	47	52
16. Dudhwa (UP)	1988	-	-	-	90	94	98
17. Kalakad-Mundathurai (TN)	1988	-	-	-	22	17	NA
18. Valmiki (Bihar)	1990	-	-	-	81	49	NA
19. Peneh (MP)	1992	-	-	-	-	39	27
20. Tadoba-Andhari (Mah.	1994-95	-	-	-	-	34	36
21. Bandhavgarh (MP)	1994-95	-	-	-	-	41	46
22. Panna (MP)	1994-95	-	-	-	-	-	26
23. Dampa (Mizoram)	1994-95	-	-	-	-	7	4
Total		**268**	**711**	**1,121**	**1,258**	**1,178**	**1,079**

Was declared a Tiger Reserve subsequently. NA Tiger census undertaken, but figures not yet available. Source : WWF (1996)



REFERENCES

Anonymous (2005) Disbelief over Orissa tiger count. Times of India, Bhubaneswar Edition, 27.03.2005

Dutta, B. (2006) Tiger census in India drops from 3000 to 1500 in 4 years. May 15, 2006. http://bigcatrescue.blogspot.com/

IUCN (2005) Newsletter, IUCN World Commission on Protected Areas (WCPA) for South Asia, http://www.iucn/themes/wcpa

Khandelwal, V. (2005) Conservation Economics: The case of the Indian tiger. www.ccsindia.org

Kurup, G.U. (1986). The treasured tiger. In : *Wildlife Wealth of India* (Resources and Management). (Ed. by T.C. Majpuria), pp. 412-431. Tekpress Service, L.P. 487/42 Soi Wattan Slip. Pratanam, Bankok, Thailand.

Mills, J.A. and Jackson, P. 1994. *Killed for a Cure: A review of the worldwide trade in tiger bone*. TRAFFIC International: Cambridge, UK.

Sankhala , K.S. (1978). *Tiger: The story of the Indian Tiger.* Collins : London. 220 pp.

Schaller, G.B. (1967). *The Deer and the Tiger.* University of Chicago Press : Chicago.

Sharma, Devinder (2000) New Trend in Wildlife Crime: Poachers Target Indian Leopards, *Environment News Service*, New Delhi, India, January 28 .

WWF (2006) Tiger Conservation Strategy and Action Plan. World Wide Fund for Nature-India. July Issue. 35p.

SEASONAL MIGRATION OF BIRDS IN CHILIKA

A. Behera

INTRODUCTION

Chilika, the largest brakish water lagoon is situated on east coast of India between latitude 19^0-28' to 19^0-54' north & longitude 85^0-05' to 85^0-38' East covers parts of Puri, Khurda & Ganjam district of Orissa state. Chilika is rich in biodiversity and supports varied forms of life. About 234 species of migratory & resident birds find their abode in this wetland. Chilika is famous for its migratory birds which are the climax species of wetland ecosystem. Concentration of migratory birds are seen from October to mid March every year. At least 107 migratory bird (last census an 12th Jan 2007) visit chilika which is considered as birds paradise. Birds from as far as the Caspian Sea, Baikal lake, Arabian sea & other remote parts of Siberia, Kirghiz steppes of Mangolia, central & southeast Asia, Ladakh & Himalayas etc. used to visit Chilika. Chilika lake was designated as a Ramsar site during 1981 by Ramsar Bureau. The Nalaban island situated inside Chilika was notified as a sanctuary during 1987 considering its unique feature as a habitat for avifauna. Around 2,00,000 of migratory birds congregate in Nalaban (15.53 sq. km.) for foraging.

MIGRATION

Migration of birds from different parts of the globe takes place during winter mainly for foraging & change of climates. It is mysterious to say that these birds repeat their sojourn to Chilika from remote places of Saiberia, Arctic 3 zone, central & south east Asia. Normally they come through western side of Himalayan mountain range & when they depart during March, they follow eastern side of Himalayan range through Mongolia avoiding main Himalaya. Probable route followed by these birds in Himalayan routes are through mountain passes where as others route through Pakistan-Afghanistan finally leading to central Asia. These migratory birds return back to their respective breeding grounds after wintering in Chilika. The phenomenon of migratory involves amajor shift of the majority population from a well defined breeding area to a reasonably well defined non-breeding area & back again. Each migration takes place once in a year. Migration happens when breeding ground donot provide them favourable habitat condition during a particular period i.e. winter . A combination of environmental, climatic conditions & internal physiological conditions trigger to change in their behaviour.

A number of resident birds staying close to general area of their nesting ground of Chilika & its environment have some significance. Resident birds like tern, black winged stilt, little egret, cattle egret, pond herons, ringed plover, white bellied sea eagle, lesser whistling teals, kites etc.mostly nest in Chilika area. Some of the transient migrants or disperser birds move far, hundreds of kilometers in all directions from their nesting ground after breeding season depending upon weather & availability of food supply.

In termes of relative abundance six major bird concentrations are noticed viz. Nalaban, Gerasara, Bhusandpur, Mangalajodi, Kalupadaghat and Soran side of Chilika the areas near Parikuda islands. The major eye catching bird concentration is found in Nalaban island because of favourable habitat condition, feeding & roosting ground. This island remains under water during monsoon & thereafter dries up slowly providing habitat condition for different species of birds. There is abundant availability of aquatic flora & fauna, micro & macro life forms on the island which are preferred food materials for the visiting waterfowl. Although large flocks of birds scatter in other places of Chilika lagoon major congregation of diversified species found in Nalaban island.

SPECIES DYNAMICS

The migratory birds wintering in the lake include mostly shovellers, pintails, tufted poachard, brahminy duck, bar headed geese, lesser and large flamingoes, pelicans, red crested poachards, common pochards, wigeons, gadwalls, painted storks, spoon bills etc. The lake supports other aquatic birds such as egrets, herons, eagles, kites & a great diversity of waders. Census of birds are carried out during mid January every year to ascertain the species composition of waterfowl & wetland dependent birds in different sector of Chilika lagoon, their relationship with habitat factor & to study the population dynamics of migratory birds.

METHODS FOR COUNTING OF WATERFOWL

1. Total counting method is used primarily to count waterfowl/aquatic birds.
2. sample count : This method is followed for both water birds/waterfowl & land birds. A sample can be a large or small portion of the area & are extrapolated to the whole area of interst.

D.F.O. , Chilika. Wildlife Division

Total Count: Total count method is widely used for total count of all individual birds in any area/water bodies. In case of Chilika, the water spread area is devided into a number of segments (15 to 17) & each segments/unit entrusted to a group consisting of ornithology experts, a forest officer and local volunteer. The bird estimation is made by counting all birds one by one covering the segment bit by bit.

Analysis

The following result have seen recorded after conducting census of birds in Chilika over the year.

Year	Bird population inside sanctuary (Nalaban)	Total bird population in Chilika including Nalaban
2002-2003	2,03,202	4,54,895
2003-2004	181,268	8,66,817
2004-2005	2,37,236	9,58,681
2005-2006	257,936	6,79,183
2006-2007	1,98,546	8,39,529

From the study it is revealed that there is population fluctuation of different species on Nalaban island & other parts of Chilika.

The individual population of species (water fowl) in Chilika lake is more than 1%thresh hold of the bio-geographical population of atleast 30 species. The number of large whistiling duck and godwall recorded at Chilika are 70% and 50% respectively of their biogeographical population.

The species like godwall *(Anas strepera*), Northern pintail (*Anas acuta)*, northern shoveller (Anas clypeata), large whistling teal (*Dedrocygna bicolor*), garganey *(Anas querquedula*), black tailed godwit (*Limosa limosa*), Lesser sand plover (*Charadrius mongolus),* curlew sandpiper (*Calidris ferruginea)*, little stint *(Calidris minuta)*, spotted redshank (*Tringa erythropus)*, common coot *(Fulica atra)* occupy Chilika than 5% of the geographical population.

During 2005, 97 species of birds found among which 1043 Greater Flamingoes (*Phoenicopterus Ruber*) was counted in Nalaban. The number of individuals counted has exceeded over one lakh in the following three duck species namely northern pintail, northern shoveller and godwall *(Anas strepera*), Nearly one thousand pied avocets *(Recurvirostra avosetta*) were counted during the last four migration seasons. Two threatened species namely pallas fish-eagle (*Haliaeetus leucogaster*) and grey pelican (*Pelecanus philippensis*) were also recorded(42).

During 2006, 1092 species of water fowl were counted. Although godwall (*Anas strepera*) contributed the largest population of the birds counted, still their numbers are slightly lesser to previous year. The most abundant species of the previous year count, the northern pintail (*Anas acuta*) was 70,000 less than the previous year. The large congregation of northern pintail and black tailed godwit (*Limosa limosa*) noticed in Mangalajodi area till first week of January had moved out of the area, However there is not much change in number noticed for these species in other areas after they left Mangalajodi. Among the long distance migratory ducks over 50% decline was recorded in eurasian wigeon (*Anas penelope*) and common poachard *(Aythya ferina*) followed by northern shoveller *(Anas clypeata*) 40%.

The lesser flamingo (phoenicopterus minor) counted at Nalaban was the highest among the last five years.

During 2007, 10% waterbirds species was counted. The number of birds counted in Nalaban island was 1,97,925 (Water birds). However the total population of Nalaban was approximately one lakh less than the population observed during 1st week of December 2006. The number counted was nearly 2,00,000 each for northern pintail (Anas acuta) and godwall (*Anas stepera).* The population exceeds 50,000 in eurasian wigeon (*Anas Penelope*) & northern shoveller (*Anas clypeata).* The population of tufted pochards (*Aythya fuligula*) has gone down below 50,000 for the first time during last five years. Occurance of baillons crake *(Porgana Pusilla*) was documented this year also. A total of 14,615 land birds of 64 species (Water depandent) were also counted.

CONCLUSION

The population of migratory birds depends on environmental condition of breeding ground as well as roosting ground where the birds visit. It needs further comprehensive ecological study.

REFERENCE

Habital evaluation of Chilika lake with special refers to birds as bio-indicates, BNHS

Sanctuary Asia Vol-XII, No-4 192

Habital evaluation of Chilika (Annual Report 2002-2003)BNHS

Chilika a living lagoon – By Chilika Development Authority.

Report of census (2006) Chilika Wildlife Division.

Your Chilika (2006) Chilika Wildlife Division.

THE STUDY OF THE ABIOTIC AND BIOTIC FACTORS OF AGANASI ISLAND, A ROOKERY FOR OLIVE RIDLEY *SEA TURTLE (Lepidochelys olivacea)*

S.P. Mohanty and P. K. Das

ABSTRACT

Aganasi island is a part of the Gahirmatha marine sanctuary which is the largest rookery in the world for Olive Ridley turtle. This island is an ideal location for mass nesting of Olive Ridley. Abiotic and biotic parameters of the island and its coastal water have been studied. Soil condition of the land, soil temperature, air temperature, dissolved oxygen content, dissolved carbon-dioxide content, dissolved chloride content, available fish and invertebrate fauna have been recorded during two consecutive nesting seasons, i.e., during 2003 & 2004. These parameters are considered most important for Olive Ridley, as it spends about 6 months in this location for breeding and nesting. The study is aimed at ascertaining the reasons for which this island is preferred by the turtle for mass nesting.

Keywords : Aganasi island, sensor, nesting site.carbondioxide content, high attitude, egg clutch.

INTRODUCTION

Olive Ridley sea turtles *(Lepidochelys olivacea)* being a migratory species shuttles several times during its life-time between the feeding ground in the deep seas and the nesting ground on the beach. Olive Ridley spends about six months in coastal waters for breeding and nesting. Although sporadic nesting is common to all marine turtles, Olive Ridley is well known for mass nesting during which they congregate in thousands at one place, for this frenetic annual event. This is popularly known as *arribada*, a phenomenon demonstrating synchronised breeding. For the purpose of nesting, Olive Ridley travels long distance in search of a calm, sandy, coastal beach free from interference by other animals. Not withstanding the low-density nesting of Olive Ridley along the entire coast of Indian peninsula, the fertile estuarine habitat of the Orissa coastline is probably most conducive for mass nesting of the turtle. Though Orissa is endowed with 480 km of coastline bordering the Bay of Bengal, three locations along the coast of Orissa have been identified as the mass nesting ground for Olive Ridley.

These three locations are the Rushikulya river mouth in Ganjam district, Devi river mouth in Cuttack district and Gahirmatha near Dhamra river mouth in the adjoining districts of Cuttack and Bhadrak (*Pandav, Choudhury and Kar 1994 b*). It has been estimated that a sizable portion (about 30 to 40 per cent) of the world's Olive Ridley population is believed to nest in the above three rookeries along the Orissa coast.

The potentiality of Gahirmatha coast as a rookery for Olive Ridley was first explored in the early 1970's (FAO, 1974; Bustard, 1976). Soon after, it was recognised as the largest rookery in the world for Olive Ridley (Bustard, 1976). Gahirmatha, declared as a marine sanctuary on the 27th September 1997, constitutes a part of the Bhitarkanika National Park. It extends from the Dhamra river mouth in the north to the Mahanadi river mouth in the south. Mass nesting has been reported from its coastal locations like Barunei, Pentha, Habilikhati and Ekakula. Besides these coastal locations, four islands under this sanctuary namely Nasi-I, Nasi-II, Babubali and Aganasi have been identified as the common mass nesting sites Nasi-I, Nasi-II and Aganasi islands are of enough ecological interest because of their recent formation following their separation from the main land. Nasi -I and Nasi - II got separated from the main land in the year 1997 and Aganasi was cut off from the Hukitola island following the 1999 supercyclone. Aganasi island is still fascinating for its peculiar location, i.e., one side facing the Hansua river mouth and the other side facing the Bay of Bengal. It is located between the latitudes 20^0 4' - 20^0 8' North and longitude 87^0 4' East. The total area measures about four square kilometer. The peculiar location of this newly formed oceanic island has a marked influence on its topography, flora, fauna and physico-chemical conditions.

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Voluminous data on the nesting and biology of Olive Ridley have been collected by a galaxy of workers. Notable among them are: Bustard and Kar (1981); Kar and Padhy (1982); Dash and Kar (1984); Kar and Satpathy (1996); Mohanty-Hejmadi (1993, 1996, 1999); Dani and Kar (1999); and Pandav *et al*., (1994, 1995, 1996, 1997). So far adequate information on the impact of biotic and abiotic parameters on the mass nesting of Olive Ridley is not available from the above reports. Hence, the present study is aimed at exploring the relationship, if any, between the biotic and abiotic parameters of Aganasi island vis-a-vis its suitability for 'arribada' of Olive Ridley sea turtles.

OBSERVATION

The beach of Aganasi Island is one of the nesting beaches of Gahirmatha Marine Sanctuary. For the study of physical parameters two trips were made; first in February 16-21, 2004, and the second was from March 18-25, 2004. For the study of temperature, a digital thermometer was used (CE 305 of Taiwan make). Within the study period, beach temperature, soil temperature, air temperature, nest structure, nest depth, wind direction, beach erosion, and flora and fauna were recorded.

Table-1 : Soil temperature of Aganasi island measured at morning hours during March-April 2003 and February/March 2004

Date	Riverside Temp. (^{0}C)	Seaside (^{0}C) temp. in ^{0}C
28.02.03	27.8	27.0
01.03.03	26.8	26.3
02.03.03	22.4	22.2
03.03.03	25.6	24.8
04.03.03	26.7	26.0
05.04.03	26.5	23.3
06.04.03	26.3	27.9
07.02.03	24.6	26.3
08.04.03	26.1	26.1
16.02.04	20.4	18.5
17.02.04	19.8	19.9
18.02.04	19.0	18.2
19.02.04	19.2	18.9
20.02.04	20.2	19.2

Mean Soil temperature : 23.7^{0}C 23.1^{0}C

Soil temperature at morning on Riverside :23.7$\pm$3.19^{0}C

Soil temperature at morning on Seaside : 23.1$\pm$3.39^{0}C

ABIOTIC PARAMETERS OF AGANASI ISLAND

During breeding season the physical and chemical conditions of the air, soil, the chloride content of sea water, BOD, COD and a variety of other factors influence mating, nesting and hatching. The hatching success depends upon the interaction of a number of factors such as salinity, humidity, temperature, gas flow, rain fall, tidal inundation, erosion and predation.

PHYSICAL FACTORS

The direction of wind together with the sky condition, has been observed to be co-related with nesting of Olive Ridley. It also helps the hatchlings to find their way to go in seaward direction. After the month of April, the wind direction gradually changed from south-north to south-west. The sky during that period remained more or less cloudy and foggy. On the days when the sky was clear, no mass nesting was reported.

Table -2 : Soil temperature of Aganasi island measured at noon hour during March-April 2003 and February-March - 2004

Date	Riverside Temp. (^{0}C)	Sea side ^{0}C temp. (^{0}C)
28.02.03	29.6	27.9
01.03.03	26.8	27.5
02.03.03	26.3	29.2
03.03.03	26.7	31.3
04.03.03	23.1	38.5
05.04.03	37.1	36.2
06.04.03	38.2	38.0
07.02.03	33.2	32.9
08.04.03	33.2	37.2
16.02.04	25.0	24.5
17.02.04	24.5	27.0
18.02.04	25.3	25.6
19.02.04	24.9	24.0
20.02.04	25.7	25.1

Mean Soil temperature : 28.66^{0}C 30.45^{0}C

Soil temperature at noon on Riverside : 28.66$\pm$4.56^{0}C

Soil temperature at noon on Seaside : 30.45$\pm$5.24^{0}C

Table -3 : Soil temperature of Aganasi island at evening hours during March/April 2003 and February - March - 2004

Date	Riverside temp. (^{0}C)	Seaside ^{0}C temp. (^{0}C)
28.02.03	33.5	35.8
01.03.03	33.7	32.3
02.03.03	34.6	32.9
03.03.03	36.0	37.2
04.03.03	25.2	27.1
05.04.03	25.1	29.8
06.04.03	25.1	27.0
07.02.03	27.8	29.8
08.04.03	26.1	27.1
16.02.04	26.1	26.1
17.02.04	25.5	27.0
18.02.04	26.2	25.5
19.02.04	25.7	25.9
20.02.04	25.6	25.1

Mean Soil temperature : 28.2^{0}C 29.1^{0}C

Soil temperature at evening on Riverside : 28.2$\pm$3.97^{0}C

Soil temperature at evening on Sea side : 29.1$\pm$4.1^{0}C

Table - 4: Air temperature of Aganasi island at morning hours during March-April 2003 and February/March 2004

Date	Riverside temp. (^{0}C)	Seaside ^{0}C temp. (^{0}C)
28.02.03	22.9	22.9
01.03.03	22.7	22.7
02.03.03	22.8	21.1
03.03.03	21.3	22.2
04.03.03	22.0	22.4
05.04.03	21.1	21.9
06.04.03	23.4	27.3
07.02.03	22.4	26.9
08.04.03	23.4	27.8
16.02.04	18.6	17.6
17.02.04	19.8	20.5
18.02.04	17.3	17.3
19.02.04	18.2	19.2
20.02.04	19.2	20.1

Mean Air temperature : 21.0^{0}C 22.1^{0}C

Air temperature at morning on Riverside :21.0$\pm$2.01^{0}C

Air temperature at morning on Seaside : 22.1$\pm$3.30^{0}C

TABLE-5 :Air temperature of Aganasi island at noon hours during March-April 2003 and February - March 2004

Date	River side temp. (^{0}C)	Sea side ^{0}C temp. (^{0}C)
28.02.03	27.7	28.3
01.03.03	32.3	27.9
02.03.03	29.3	28.0
03.03.03	25.5	31.9
04.03.03	30.0	28.0
05.04.03	34.0	32.1
06.04.03	29.1	34.2
07.02.03	29.1	36.2
08.04.03	32.3	35.2
16.02.04	25.7	22.9
17.02.04	25.8	24.4
18.02.04	24.1	21.1
19.02.04	24.5	22.1
20.02.04	25.2	24.0

Mean Air temperature : 28.2^{0}C 28.3^{0}C

Air temperature at noon on Riverside :28.2$\pm$2.84^{0}C

Air temperature at noon on Sea side : 28.3$\pm$4.74^{0}C

Table - 6: Air temperature of aganasi island at evening hours during March-April 2003 and February-March 2004

Date	Riverside temp. (^{0}C)	Sea side ^{0}C temp. (^{0}C)
28.02.03	21.3	23.1
01.03.03	25.8	22.9
02.03.03	24.1	24.9
03.03.03	20.1	25.9
04.03.03	22.1	23.9
05.04.03	25.4	27.3
06.04.03	26.3	27.3
07.02.03	24.6	24.9
08.04.03	25.8	23.7
16.02.04	23.0	21.2
17.02.04	20.4	22.0
18.02.04	22.0	21.5
19.02.04	21.2	20.3
20.02.04	22.0	21.6

Mean Air temperature : 23.1^{0}C 23.6^{0}C

Air temperature at evening on Riverside :23.1$\pm$2.36^{0}C Air temperature at evening on Seaside : 23.6$\pm$3.2^{0}C

Table -7: Beach temperature of Aganasi island at morning, noon and & evening hours during March-April 2003 and February - March 2004

Date	Temperature (^{0}C) (Morning)	Temperature (^{0}C) (Noon)	Temperature in (^{0}C) (Evening)
16.02.04	18.5	33.3	25.2
17.02.04	18.2	29.8	24.8
18.02.04	18.7	30.1	24.8
19.02.04	17.9	29.3	26.0
20.02.04	19.8	30.8	25.5
21.02.04	21.8	30.9	24.7
22.02.04	20.2	32.3	25.1
23.02.04	21.0	33.2	26.2

Mean Beach Temperature
at Morning : 189.05^{0}C
at Noon : 31.21^{0}C
at Evening : 25.2^{0}C

CHEMICAL FACTORS

Some chemical parameters in the sea water around Aganasi Island have been investigated. There was regular monitoring of the dissolved oxygen and carbondioxide content of water which were found to be conducive for the arrival of Olive Ridley turtles at Aganasi Island.

The data was collected between 25th February and 5th March, 2003; 4th April 2003 and 11th April 2003; 16th February 2004 and 19th February 2004, and 21st March 2004 to 23rd March 2004. The data was analysed with descriptive statistical methods. The arithmetic mean and standard deviation were calculated. The descriptive statistical method employed in the present investigation has taken into account [(Mean $\pm$ S.D.)]

Dissolved oxygen content of water

The analysis of dissolved oxygen level of sea side water analysis shows the ability of sea and river to purify itself through biochemical process. Winkler's method was employed to determine the dissolved oxygen content of water. Dissolved oxygen is the quantity of molecular oxygen present in water to be availed by the aquatic organisms for respiration. After water analysis it was found dissolved oxygen content of coastal water showed diurnal variation.

The dissolved oxygen content of water on the river side was determined to be [(23.3$\pm$3.47)] parts per million (ppm). The mean dissolved oxygen contents at morning, noon and evening was 7.2 ppm 8.8 ppm, and 7.7 ppm respectively (Table 9). From the above observation, it is concluded that dissolved oxygen content at noon is higher than that of the water collected in the morning and in the evening.

Table - 8 : Sky condition and wind direction during nesting

Date	Direction of Wind	Condition of Sky	Nesting/ No nesting
16.02.04	South-North	Dense fog, Little cloudy	Nesting
17.02.04	South-North	No fog, Clear sky	No nesting
18.02.04	South-North	Dense fog, Cloudy	Nesting
19.02.04	South-North	Little fog, Little cloudy	Nesting
20.02.04	South-North	Clear sky, Fog	Nesting
21.02.04	South-North	No fog, Clear sky	No nesting
21.03.04	South-West	Little fog, Clear sky	No nesting
22.03.04	South-West	No fog, Clear sky	Nesting
23.03.04	South-West	Dense fog, Little cloudy	Nesting

The dissolved oxygen content on the seaside at morning, noon and evening was found to be 6.3ppm, 7.7 ppm and 7.2 ppm respectively (Table 10). The dissolved oxygen content of water on the seaside was determined to be [(21.3$\pm$3.47)] ppm.

Dissolved carbon dioxide content of water

Dissolved carbon dioxide content of water varied in accordance with the water temperature and the aquatic organisms present in it. The carbon dioxide content is maximum at 4^{0}C and it gradually decreased with the rise in temperature. For estimation, water samples were collected at a distance of about 5 meter from the coast line in conical flask at morning (6 a.m.) noon and evening (6 p.m.)

On computing the data by statistical methods, the carbon dioxide content of water on river side was estimated to be [(27.7$\pm$17.60)] ppm. (Table - 11) The carbon dioxide content at morning, noon and evening were 35.1 ppm, 27.1 ppm and 34.4 ppm respectively. From the recorded data it is concluded that carbon dioxide content at noon is lower than that in the morning or evening.

The carbon dioxide content of seaside was determined to be [(31.4$\pm$17.29)] ppm. The mean carbon dioxide content at morning, noon and evening were 35.8 ppm, 24.6 ppm and 32.25 ppm respectively. (Table- 12)

From this observations, it is concluded that at noon the carbon dioxide content of water also remains lower than that at morning or evening.

Table -9 : Dissolved Oxygen Content of water around aganasi Island at morning, noon and Evening (Riverside)

Date	Time	Tide	DO (ppm)
05.04.03	6 a.m.	H.T.	2.8
	12 Noon	L.T.	4.8
	6 p.m.	H.T.	4.0
06.04.03	6 A.M.	H.T.	4.4
	12 Noon	L.T.	5.2
	6 p.m.	H.T.	4.8
07.04.03	6 a.m.	H.T.	2.8
	12 Noon	L.T.	4.4
	6 p.m.	H.T.	4.0
08.04.2003	6 a.m.	H.T.	4.8
	12 Noon	L.T.	5.2
	6 p.m.	H.T.	5.2
09.04.2003	6 a.m.	H.T.	2.8
	12 Noon	L.T.	3.6
	6 p.m.	H.T.	5.6
16.02.2004	6 a.m.	H.T.	4.0
	12 Noon	L.T.	8.0
	6 p.m.	H.T.	5.6
17.02.2004	6 a.m.	H.T.	6.4
	12 Noon	L.T.	10.4
	6 p.m.	H.T.	8.0
18.02.2004	6 a.m.	H.T.	8.4
	12 Noon	L.T.	10.4
	6 p.m.	H.T.	8.8
19.02.2004	6 a.m.	H.T.	8.4
	12 Noon	L.T.	6.8
	6 p.m.	H.T.	7.6
20.02.2004	6 a.m.	H.T.	9.6
	12 Noon	L.T.	12.4
	6 p.m.	H.T.	10.0
21.03.2004	6 a.m.	H.T.	12.8
	12 Noon	L.T.	16.0
	6 p.m.	H.T.	14.0
22.03.2004	6 a.m.	H.T.	12.0
	12 Noon	L.T.	14.0
	6 p.m.	H.T.	12.4
23.03.2004	6 a.m.	H.T.	10.0
	12 Noon	L.T.	12.4
	6 p.m.	H.T.	11.6

The dissolved oxygen content of water on the riverside was found to be [(23.3±3.47)] ppm. H.T. : High Tide L.T. : Low Tide

Table - 10: Dissolved Oxygen content of water around Aganasi Island at morning, noon and evening (Seaside)

Date	Time	Tide	DO in ppm
05.04.03	6 a.m.	H.T.	3.2
	12 Noon	L.T.	4.4
	6 p.m.	H.T.	5.2
06.04.03	6 Aa.m.	H.T.	2.6
	12 Noon	L.T.	4.4
	6 p.m.	H.T.	3.2
07.04.03	6 a.m.	H.T.	3.6
	12 Noon	L.T.	3.6
	6 p.m.	H.T.	4.8
08.04.03	6 a.m.	H.T.	4.0
	12 Noon	L.T.	4.8
	6 p.m.	H.T.	4.0
09.04.03	6 a.m.	H.T.	3.6
	12 Noon	L.T.	2.8
	6 p.m.	H.T.	4.4
16.02.04	6 a.m.	H.T.	4.8
	12 Noon	L.T.	7.2
	6 p.m.	H.T.	5.6
17.02.04	6 a.m.	H.T.	6.8
	12 Noon	L.T.	8.0
	6 p.m.	H.T.	7.6
18.02.04	6 a.m.	H.T.	5.622
	12 Noon	L.T.	8.00
	6 p.m.	H.T.	6.8
19.02.04	6 a.m.	H.T.	8.4
	12 Noon	L.T.	10.8
	6 p.m.	H.T.	9.2
20.02.04	6 a.m.	H.T.	6.0
	12 Noon	L.T.	7.6
	6 p.m.	H.T.	6.4
21.03.04	6 a.m.	H.T.	7.6
	12 Noon	L.T.	10.0
	6 p.m.	H.T.	8.4
22.03.04	6 a.m.	H.T.	12.8
	12 Noon	L.T.	15.2
	6 p.m.	H.T.	14.8
23.03.04	6 a.m.	H.T.	12.8
	12 Noon	L.T.	14.0
	6 p.m.	H.T.	13.2

The dissolve oxygen content of water on the seaside was found to be [(21.3+3.74)] ppm H.T. : High Tide L.T. : Low Tide

Table - 11: Dissolved carbon Dioxide content of water around Aganasi Island at morning, noon and Evening (Riverside)

Date	Time	Tide	DO in ppm
05.04.03	6 a.m.	H.T.	22
	12 Noon	L.T.	12
	6 p.m.	H.T.	14
06.04.03	6 a.m.	H.T.	14
	12 Noon	L.T.	10
	6 p.m.	H.T.	14
07.04.03	6 a.m.	H.T.	16
	12 Noon	L.T.	8
	6 p.m.	H.T.	8
08.04.03	6 a.m.	H.T.	18
	12 Noon	L.T.	18
	6 p.m.	H.T.	6
09.04.03	6 a.m.	H.T.	18
	12 Noon	L.T.	12
	6 p.m.	H.T.	10
16.02.04	6 a.m.	H.T.	32
	12 Noon	L.T.	28
	6 p.m.	H.T.	34
17.02.04	6 a.m.	H.T.	38
	12 Noon	L.T.	20
	6 p.m.	H.T.	42
18.02.04	6 a.m.	H.T.	50
	12 Noon	L.T.	36
	6 p.m.	H.T.	46
19.02.04	6 a.m.	H.T.	44
	12 Noon	L.T.	38
	6 p.m.	H.T.	48
20.02.04	6 a.m.	H.T.	40
	12 Noon	L.T.	34
	6 p.m.	H.T.	50
21.03.04	6 a.m.	H.T.	52
	12 Noon	L.T.	48
	6 p.m.	H.T.	62
22.02.04	6 a.m.	H.T.	62
	12 Noon	L.T.	46
	6 p.m.	H.T.	58
23.02.04	6 a.m.	H.T.	68
	12 Noon	L.T.	42
	6 p.m.	H.T.	54

The dissolve Carbon dioxide content of water on the riverside was found to be [(27.7±17.60)] ppm

Table - 12 :Carbon dioxide Content of water around Aganasi Island at morning, noon & evening (Seaside)

Date	Time	Tide	DO in ppm
05.04.03	6 a.m.	H.T.	18
	12 Noon	L.T.	16
	6 p.m.	H.T.	12
06.04.03	6 a.m.	H.T.	22
	12 Noon	L.T.	8
	6 p.m.	H.T.	12
07.04.03	6 a.m.	H.T.	14
	12 Noon	L.T.	26
	6 p.m.	H.T.	12
08.04.03	6 a.m.	H.T.	12
	12 Noon	L.T.	14
	6 p.m.	H.T.	8
09.04.03	6 a.m.	H.T.	20
	12 Noon	L.T.	24
	6 p.m.	H.T.	8
16.02.04	6 a.m.	H.T.	44
	12 Noon	L.T.	38
	6 p.m.	H.T.	50
17.02.04	6 a.m.	H.T.	54
	12 Noon	L.T.	34
	6 p.m.	H.T.	46
18.02.04	6 a.m.	H.T.	50
	12 Noon	L.T.	20
	6 p.m.	H.T.	44
19.02.04	6 a.m.	H.T.	44
	12 Noon	L.T.	40
	6 p.m.	H.T.	48
20.02.04	6 a.m.	H.T.	46
	12 Noon	L.T.	38
	6 p.m.	H.T.	40
21.03.04	6 a.m.	H.T.	56
	12 Noon	L.T.	52
	6 p.m.	H.T.	42
22.02.04	6 a.m.	H.T.	60
	12 Noon	L.T.	38
	6 p.m.	H.T.	56
23.02.04	6 a.m.	H.T.	58
	12 Noon	L.T.	44
	6 p.m.	H.T.	48

The dissolve Carbon dioxide content of water on the Seaside was found to be [(31.4+17.29)] ppm

BIOTIC COMPONENTS OF AGANASI ISLAND

Flora

The plants were collected and properly dried in the sunlight for preservation and identification of the flora. The identification of flora was done after Choudhury and Pattanaik (1993), It has been reported earlier that the total island is devoid of true forest; the both ends (North and South parts) have no trees. It is under the early stage of succession, where few species of grasses and creepers have been observed towards the southern part whereas the northern part is totally lacking succession and it is barren. The central part of the island is having the casuarina plants and no other tree. On the whole, the flora of this island comprises of small areas of grasslands and casuarina trees.

Fauna

Aganasi island is totally devoid of human population and wild animals. Very few jackals and wild rats inhabit this island. Jackals are believed to have migrated from the nearby landmass, crossing the isthmus. The avian fauna of this island consists of migratory birds coming from nearby mainland during mid-day and evening. But there are many varieties of marine species, ranging from coelenterates to fishes found in the coastal water.

Collection of fishes around Aganasi Island

During our trip in the previous years, we came across a large variety of fishes in the coastal water of Aganasi island. Therefore, during our subsequent trip we collected several varieties of fishes and molluscs. Our trip began from 16th February 2004 to 21st February 2004 and again from 18th March 2004 to 25th March 2004.

Methods of fish collection

- For the collection of fishes around Aganasi Island, the fishermen used dead baits and several other lures. Occasionally live bait was also used by fihsermen while drift fishing.
- Mosses were used as baits to capture vegetarian fishes.
- Different fishnets were used to capture fishes.
- For capturing large fishes, bhekti nets were used by trawlers. But this method of fishing has been banned by the Government, as it is the cause of death of many Olive Ridley turtles.
- Some fishes were caught from the newly formed stream in the island during off tide.
- Large nets were also used by some fishermen around the beach. These nets were set before high tide. When the water level inceases, fishes came towards the beach and were caught in the nets. When the water level came down, the fishes remained trapped in the nets. In this manner about 20 varieties of fishes were collected.
- Fishes were collected from the seaside as well as from the riverside of the island.

Preservation

The specimens were collected and numbering was done for the convenience of identification. The preservation was done in 8% formalin solution and kept in separate air-tight jars for identification in the laboratory.

Identification procedure

A fish can be identified by :

(i) Body shape (ii) Colouration and markings (iii) Number of spines and soft rays in the fins Quite often (i) & (ii) are the only requirement for a positive identification. However, where there were several similar fishes, all from the same family, it was then necessary to count the spinal rays of the fins. It is quite difficult to identify a fish from just a line drawing or sketch. A photograph is obviously a much better guide. However, dimensional line drawings are quite acceptable provided detailed information with relation to the fins of the fish, particularly the dorsal and the anal, is available. Each collected prawn and fish was photographed.

Table -13 : Identified Prawns and fishes from Aganasi island

S.I. No.	Family	Species
1.	Penaeidae	Penaeus monodon (Fab.)
2.	Penaeidae	Fenneropenaeus indicus (H. Milne-Edwards)
3.	Penaeidae	Metapenaeus monoaros
4.	Cynoglossidae	Cynoglossus macrolepidotus (Bleeker)

5.	Cynoglossidae	Cynoglossus kopsi (Bleeker)
6.	Sciaenidae	Nibea albida (cuv.)
7.	Sciaenidae	Johnius (Johnius) amblycephalus (Bleeker)
8.	Sciaenidae	Johnius (Johnius) belangirii (Cuv.)
9.	Sparidae	Rhabdosargus sarba (Forskal)
10.	Sparidae	Acanthopagrus berda (Forskal)
11.	Sparidae	Acanthopagrus latus (Houttuyn)
Fig. No.	Family	Species
12.	Plotosidae	Plotosus limbatus valenciennes
13.	Plotosidae	Plotosus lineatus (Thumberg)
14.	Sillaginidae	Sillago sihama (Forskal)
15.	Stromatoidae	Pampus chinensis (Euphrasen)
16.	Trichiuridae	Trichiurus lepturus (Linn.)
17.	Trichiuridae	Eupleurogrammus muticus (Gray)
18.	Mugilidae	Valamugil buchanani (Bleeker)
19.	Pristigasteridae	Ilisha metastroma (Schneider)
20.	Pristigasteridae	Opisthopterus taradoore (Cuv.)
21.	Ariidae	Arius platystomus (Day)
22.	Lutjanidae	Lutjanus johnii (Bloch)
23.	Tricanthidae	Tricanthus biaculeatus (Bloch)
24.	Scatophagidae	Scatophagus argus (Bloch)
25.	Polinemidae	Eleutheronema tetradactylus (Shaw)
26.	Dasyatididae	Himantura imbricatus (Bloch & Schneider)
27.	Ephippidae	Ephippus orbis (Bloch)
28.	Terapontidae	Terapon jarbua (Forskal)
29.	Engraulididae	Setipina faisa
30.	Engraulididae	Coilia dussumieri (Val.)
31.	lupeidae	Escualosa thoracata (Val.)
32.	Clupeidae	Sardinella longicepus (Val.)
33.	Belonidae	Strongylura leiura (Bleeker)
34.	Serranidae	Epinephelus diacanthus (Val.)
35.	Hemiramphidae	Rhynchorhamphus malabaricus collette
36.	Carangidae	Carangoides talamparoides (Bleeker)
37.	Leiognathidae	Secutor insidiator (Bloch)
38.	Scopilidae	Harpodon nehereus (Hamilton-Buchanan)
39.	Scopilidae	Saurida tumbil (Bloch)
40.	Platycephalidae	Platycephalus sp.

Plate - I :

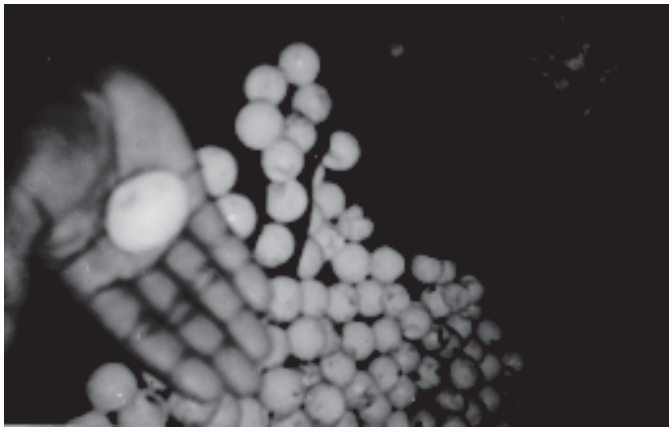

Fig. 1 - Abnormal eggs with an oval shape

Fig. 2 - Abnormal egg with (two yolks), double the size of normal egg.

Fig. 3 - Female Olive Ridley selecting a suitable location for egg laying.

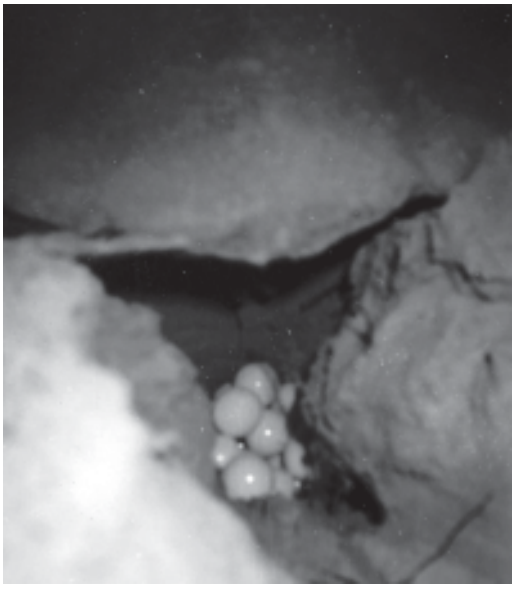

Fig. 4 - Female depositing eggs in the nest.

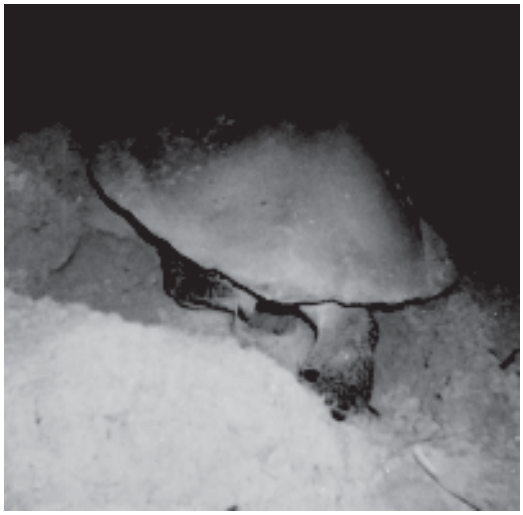

Fig. 5- Covering of the egg-nest with sand by the female.

Plate - II :

Fig. 46 - Seaward journey of an Olive Ridley after laying eggs.

Fig. 47 - Food print of an adult Olive Ridley turtle on the sandy beach of Aganasi.

Fig. 48 - Eroded beach with sea weeds.

Fig. 49 - Muddy, silty and barren shore.

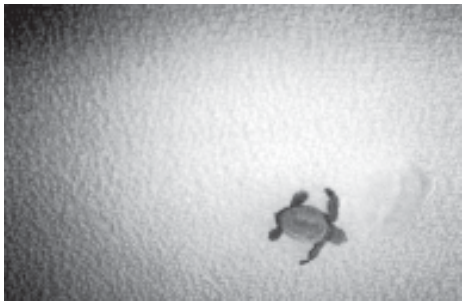

Fig. 50 - Seaward journey of a hatchling.

Fig.51 - Staff of forest department releasing hatchlings into the sea water.

DISCUSSION

The physico-chemical factors like soil temperature, water temperature, chloride content and pH of sea water, BOD, COD, sandy beach and the biological factors like flora and fauna greatly affect the nesting of Olive Ridley turtles. The prevailing environmental conditions around Aganasi island are favourable for courtship, mating and subsequent nesting of Olive Ridleys. The sea weeds, fish, fauna and molluscan species available in the coastal water around the island provide ample food which the turtles need before mass nesting. Out of thousands of sea beaches scattered along the coasts of the major oceans and seas of the world, the turtles prefer very few coastal waters for courtship, mating and their beaches for mass nesting. Further, the sand grain size also determines the exact locations on the beach for digging and egg laying. The sand grain samples collected from the nesting sites were found to be smaller/ in comparison to the sand collected from non-nesting sites. Probably the size of the sand grains and its loose nature in Aganasi island makes it a suitable nesting ground for Olive Ridleys. The conducive conditions of the beach attracts Olive Ridley turtle thousands of miles away. The loose sand facilitates digging and egg lying. The chemical parameters like pH of water and chloride content of water during nesting season is also favourable for breeding.

The physical and chemical factors have been recorded/ by several worker viz. Behera, (2003); Naik (2004) and Routray (2004). Although many wildlife specialists like Kar (1982); Dash (1982); Pandav *et al*. (1994); Shankar (1995); Choudhury (1994)and Mohanty-Hejmadi (1993) carried out extensive work, most of their work has been restricted to the ecology and conservation of the Olive Ridley turtles on the coast of Orissa. The present investigation has focussed

in deep study on the abiotic and biotic factors that facilitate mass nesting of Olive Ridley turtles in Aganasi island.

CONCLUSION

The physical, chemical and biological parameters for nesting of Olive Ridley turtles in Aganasi island are changing on a regular basis (Naik, 1994). In addition, many geomorphological changes and anthropogenic activities are adversely affecting the arrival of Olive Ridely turtles. The beach has been eroded by tidal waves and the growth of poisonous weeds have an adverse impact on mass nesting. The accumulation of waste materials, casuarina logs and invasion of the island by canine species like dogs and jackls are putting obstacles on the way of turtles to the seabeach. That may be the reason of decline in mass nesting recorded by Behera in (2003) but sporadic nesting observed by Naik in 2004. Inspite of the protective measures undertaken by NGOs and the Forest Department, Govt. of Orissa, the nesting of Olive Ridley turtles continues to fluctuate along the Gahirmatha coast. As Aganasi is an emerging mass nesting ground for this highly endangered species, all possible protective measures need be undertaken to minimise the anthropogenic activities which would facilitate "arribada" on a still larger scale.

AKNOWLEDGEMENT

The financial assistance received from the Wildlife Department, Govt. of Orissa for preparation of the "Olive Ridley database is thankfully acknowledged.

REFERENCES

Bustard, H.R. (1976) : World's largest sea turtle rookery. Tiger Paper, pp.3.

Choudhury, B. P (1986): Nomenclature and distribution of some mangrove elements in the Bhitarkanika Wildlife Sanctuary. News Letter- Nature and Wildlife conservation society of Orissa, 4 (1&2): Pp58-60.

Dani, C.C. and Kar, C.S. (1999) : Conservation of sea turtles and environmental relationship of arribadas of Olive Ridley, Lepidochelys olivacea (Eschsholtz, 1829) in relation to Bhitarkanika Mangrove ecosystem of Orissa coast. In : Bhitarkanika - The Wonderland of Orissa (N.W.C.S.O. Publ. Bhubaneswar), PP : 98-120.

F.A.O., (1974) : India : A Preliminary survey of the prospects for crocodile farming (Based on the works of Dr. H.R. Bustard, F.A.O., Rome, PP. 1-50.

Kar, S.K. (1982): Gahirmatha Kainchha. (Seaturtles of Gahirmatha). Paurusha. 115(12) : 28-32.

Kar, C.S. And Dash, M.C. (1984 b): Conservation and status of sea turtles in Orissa. In : CMFRI Special publication No. 18; PP 93-107 (Proc. Workshop on sea turtle conservation held at Madras 27-29, February, 1984).

Kar, C.S. and Padhi, G.S. (1992) : Biology, Life History and Conservation Strategy of the Olive Ridley sea turtles in Orissa, ORIFOREST Vol.1(2), October - Dec. 1992, PP : 36-40.

Kar C.S. and Satpathy, G.R. (1996): Mangrove ecosystem and its biodiversity in Orissa with special reference to Bhitarkanika. In : ADVANCES IN ECOLOGY AND ENVIRONMENTAL SCIENCES, Chapter 23, Ashish Publ. New Delhi, PP : 419-438.

Kar, S.K., Kar, C.S. and Patnaik, S.K. (1998) : Biodiversity Conservation in Bhitarkanika Mangrove Ecosystem of Orissa, India : Problems and Prospects. In (Patra, A.K. Eds.) : BIODIVERSITY CONSERVATION : Problems and Prospects.(Orissa Environmental Soc. Publ. Bhubaneswar), 1988, PP: 68-74.(ISBN: 81-00256-6-X).

Mohanty-Hejmadi, P. (1993) : A study of ecology, breeding patterns, development and Karyotype patterns of the Olive Ridely, Lepidochelys olivacea, Pranikee. Vol. IX, Xoological Society of Orissa (Monograph).

Mohanty-Hejmadi, P. (1996) : Sea turtles. In: Integrating Marine Conservation in the Indian Ocean : 1996 and beyond. New England Aquarium (USA), Mombasa, Kenya.

Mohanty-Hejmadi, P. (1999): Agonies and ecstacies of 25 years of sea turtle research and conservation in India. Proceedings of the 19th Annual Symposium on Sea Turtle Conservation and Biology, South Padre Island, Texas, USA (In press).

Naik. B.K. (2004): Physico-chemical Parameters of Aganasi Island: A case Study;M.Phil Thesis.

Packard, G. C. and Packard, M. J. (1988). The physical ecology of reptilian eggs and embryos. Biology of Reptilia:523.

Pandav, B., Choudhury, B.C. and Kar, C.S. (1994 a): Discovery of a new sea turtle rookery in Orissa IUCN/SSC Marine Turtle News letter No.67, October 1994, PP:15-16.

Pandav, B., Choudhury, B.C. and Kar, C.S. (1994 b): A status survey of Olive Ridley sea turtle (Lepidochelys olivacea) and its nesting habitats along the Orissa coast, India. Wildlife Institute of India, July 1994(Revised Edition: January 1997, PP: 1-48.

Pandav, B., Choudhury, B.C. And Kar, C.S. (1995): Occurrence of Juvenile Olive Ridley sea turtles along the Gahirmatha coast, Orissa, India. IUCN/SSC/Marine Turtle Newsletter, 71 : 15-17

Pandav, B., Choudhury, B.C. and Kar, C.S. (1996 b): Inter-nesting interval of Olive Ridley sea turtle (Lepidochelys olivacea) at the Rushikulya sea turtle rookery along the Orissa Coast, India, IUCN/SSC Marine Turtle News Letter.

Pandav, B., Choudhury, B.C. and Kar, C.S. (1997): Mortality of Olive Ridley turtles (Lepidochelys olivacea) due to incidental capture in fishing nets along the Orissa coast, India. ORYX Vol.31, No.1 January, 1997: PP32-36.

Routray. R.K. (2004): Ecology and Fish fauna of Aganasi Island: M. Phil Thesis.

Shanker, Kartik (1999) : Birth and Death - The Olive Ridley of Orissa, Sanctuary Asia. Vol.XiX(3) June, 1999 PP: 8-14.

STATUS AND CONSERVATION OF OLIVE RIDLEY SEA TURTLE (*Lepidochelys olivacea*) AT THE DEVI ROOKERY OF ORISSA COAST, INDIA

B. Tripathy[1] and A. K. Mishra[2]

ABSTRACT

The status of olive ridley turtles along the Devi rookery is meagerly known due to mere negligence of the area over the period of time since its discover in 1980. Although the Wildlife Institute of India has been documenting the nesting process at this rookery since 1998, there is no information available on the other aspects of olive ridleys at this important nesting ground. This paper highlights some of the interesting findings of the short time survey conducted at this rookery during the 2004-2005 nesting season.

Key words : Arribda, rookery, nesting, mortality, offsore, carapace, filippens, anterior, muchal scute, posterior, supracaudal, Beach monitoring, false crawl, stranding, predation, sporadic, inter-tidal, clutch size, carasses, management instructions.

INTRODUCTION

Of the world's seven species of sea turtles, five are known to inhabit Indian coastal waters and its bay islands including Lakshadweep (Kar and Bhaskar, 1982). All these five species are legally protected under the Indian Wild Life (Protection) Act, 1972, and are included in the Appendix I of the CITES. Barring the loggerhead turtle (*Caretta caretta*), the other four species - the leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green turtle (*Chelonia mydas*) and the olive ridley sea turtle (*Lepidochelys olivacea*) - are known to nest along the mainland and bay islands of India. The olive ridley sea turtle species is most numerous species along the mainland coast and nests sporadically along the east and west coast of India. However, mass nesting takes place only along the Orissa coast. This species is well known for its synchronous nesting behaviour also known as '*arribada*' (Spanish for "arrival") in which several hundred thousands of female olive ridleys nest enmasse. The major nesting aggregations for olive ridley occur in few beaches of Costa Rica and Mexico in the east Pacific (Pritchard, 1997), and in Orissa on the east coast of India (Bustard, 1974; Pandav *et al,* 1994a). The 480 km coastline of Orissa harbours three mass nesting grounds namely the Gahirmatha rookery along the northern Orissa coast, the Devi rookery located 100 km south of Gahirmatha, and the Rushikulya rookery near the mouth of river Rushikulya in the southern Orissa coast. Between January and May every year, more than half a million olive ridley turtles have been counted nesting enmasse at these three rookeries (Das and Kar, 1990; Pandav *et al.*, 1994a).

The mass nesting of olive ridleys near the mouth of river Devi was first reported in 1981 (Kar, 1981). However, after 1981 the nesting population at this rookery remained unmonitored for more than a decade.

Pandav *et al*. (1994) reported continuance of mass nesting at this rookery. Pandav and Choudhury (2000) during their six years of monitoring have recorded mass nesting only once during 1997, when nearly 25,000 turtles nested there in a newly created sandbar (Robert island). However, information on nesting by turtles on the mainland coast of Devi rookery is not known adequately. Rampant mechanised fishing takes place in the nearshore waters of Devi rookery. However, the impact of mechanised fishing on the turtle mortality at Devi is not known sufficiently. Also the sea turtle mortality along the 30 km stretch of Devi rookery has not been estimated properly. This paper summarizes the nesting and mortality of olive ridleys at the Devi rookery of Orissa coast of India.

STUDY AREA

The Devi sea turtle rookery along the Orissa coast is situated near the River Devi (Latitude $19^0$98'-$20^0$01' N and longitude $86^0$4'4'-$86^0$45'; (E Fig. 1). The mass nesting at this rookery takes place on an island located between the river Devi and Petaphutei. While this island subjected to

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submergence, the sand barrier remains throughout the year and during most part of the nesting season, the island remains intact where turtles prefer to nest. However, the present study monitored the turtle nesting and mortality between Devi and Kadua on the mainland coast, which extends upto nearly 10 km south of the River Devi. The average width of the beach is 300 m and has scattered sand dunes with 2-3 m in height. Beach vegetation includes *Ipomea pescaprae and Spinifex littoreus*, backed by dense Casuarina all along the coast. There are two fishing harbours (Nuagarh and Paradeep) situated north of Devi river mouth. Mechanised fishing remain rampant in the offshore waters of Devi, mostly between December and April every year.

MATERIALS AND METHODS

Nesting beach monitoring: Patrolling of the beach between Devi river mouth and Kadua river mouth was done by foot between 17.00 hr and 7.00 hr from December 2004 to May 2005. Turtle crawls on the beach were classified into nesting and non-nesting types. When a nesting turtle was not seen on the beach, a nesting crawl was characterized by the presence of a nest pit. In contrast, the non-nesting crawls lacked a nest pit and the turtle had gone back to sea without nesting. Upon sighting a female turtle laying eggs on the beach, the straight-line distance of that nest from the highest tide level on the surf zone was measured with a flexible fibre glass measuring tap with an accuracy of + 1 cm. A total of 2,485 nests were measured and all units were taken in meters. Once nesting was over, and the mother turtle moved away from the nest and started crawling towards the sea,curved carapace length measurement of the turtle was taken (CCL) and then the nest was excavated carefully and all eggs were counted from the nest. The excavations were done immediately and the procedure was made quickly, cleanly and carefully to keep exposure of eggs to minimum. A total of 350 nests were enumerated.

Dead turtle monitoring: The entire ~20 km coastline of Devi (from Devi to Kadua river mouth) was monitored by foot once in a fortnight throughout the breeding season from December to May. Dead turtles washed ashore were marked on their carapace with synthetic paint to avoid duplication during subsequent counts. These stranded turtles were sexed, using external characteristics. Males were characterized by the presence of a long tail, which extended much beyond the posterior end of carapace, and the strongly curved claws on the fore flippers. Females had a shorter tail with small and pointed claws. Putrefied specimens were classified as turtles of unknown sex. Curved carapace length (CCL) (anterior point at midline/ nuchal scute to the posterior tip of the supracaudal) and Curved carapace width (CCW) in centimetres were measured from all dead turtles. On the shore, the number of mechanised vessels fishing in the nearshore waters of Devi were counted daily in morning hours.

RESULTS

Nesting:

Beach monitoring was done from February to April 2005 in which a total of 91 nights were spent on the beach for encountering nesting activities. Of these in 55 days there was nesting or false crawl and in remaining nights there were no nesting or false nesting crawls by turtles. The highest nesting activities were recorded during March 2005 (22 days out of 31 days) and lowest during February (7 days our of 28 days). However, in terms of nesting aggregation, maximum numbers of turtles were encountered on the beach during April 2005 (Table 1). The distance of nest from high tide line was recorded between 3^{m} to 97m, x = 38.19^{m}) where as the distance of nest from vegetation was found to range between 1^{m} to 139 m x = 46.18^{m}). Maximum numbers of nests were recorded between 20-60 m from HTL and 20-30 m from vegetation level (Fig. 2 a and b).

Stranding of turtles and non human predation of nests

A total of 2,514 dead olive ridley turtles were counted along the 30 km stretch of Devi coast between December 2004 and April 2005. Upto the end of November 2004, only seven dead turtles were counted along the coast. However, after December the mortality increased (Fig. 3). Out of the total dead turtles sexed, 403 (16.03%) were male and 2,009 (79.91%) were female. A total of 103 were unidentified sex. The data on non-human predation of nests at the Devi rookery is presented in Fig. 4.

DISCUSSION

Solitary nesting emergences of olive ridleys at Gahirmatha is known to take place almost every month and also similarly along rest of the Orissa coast. However, solitary nesting turtles were found in more numbers during February to April indicating that this is the main nesting season of the species (Dash and Kar, 1990). Although year round sporadic nesting is not known from the Devi rookery, this study confirms sporadic nesting of olive ridleys from February to April. Temperature, weather conditions,

physiography of nesting beaches and its adjacent sea, conditions of tide, and surface current circulation play an important role to induce the females for selection of the site (Dash and Kar, 1990). These factors probably also stimulate the olive ridleys for selecting the Devi and other areas along the Orissa coast to deposit their eggs. Sporadic nesting was recorded almost continuously for the entire season (> 10 turtles/night) and during second half of March to first fortnight of April, there was intermediate level of nesting, although no arribada was recorded during this study. However, it is likely that the females emerging in nights with intermediate level of nesting may be responding to arribada and are truly arribada was nesters. The evidence of intermediate nesting and non-occurrence of arribada at the Devi rookery during this study attributed to the high level of disturbances to the breeding turtles in the offshore waters due to fishing related activities in the coastal waters of Devi rookery. On the beach predation, pressure was recorded to be high due to human settlements close to the rookery.

When turtles emerge during low tides, they usually cover 15-35 m to reach the high water mark depending on the tide conditions, length and slope of the inter-tidal region (Dash and Kar, 1990). The result of the present study shows that olive ridleys at the Devi rookery covered an average of ~ 40 m from the high water mark. The areas where sporadic nesting takes place in this rookery are wide, sandy and open beach backed by low dunes and flat sandy approach from the sea. This facilitates the females to approach suitable places to choose for digging a nest. However, there is invasion of casuarina plantations into these areas and as a consequence of that the turtles are forced to nest close to these plantations. This study shows that atleast 20% of the nests are located within 10 m from the vegetation. Casuarina plantation is known to be harmful to sea turtle nests (Pandav, 2000), and particularly in beaches like Devi, where there is high sporadic nesting, the impact of casuarinas plantation on sea turtle nests could be severe. Information is lacking regarding trends in clutch sizes over the course of a nesting season for olive ridleys. There are some reports available on the size of the olive ridley turtle eggs from Indian coastline. The clutch size observed during the present study is within the range observed else where for this species.

The Orissa olive ridley population has also been subjected to high mortality in recent years; with over 10,000 turtles counted dead on the coast each year due to fishery related incidental mortality (Pandav and Choudhury, 2000). The present study documented a high amount of mortality of olive ridleys along the Devi coast. This is a conservative number as the entire coast was not surveyed due to inaccessibility of the islands and the northern bank of Devi river. Studies in North Carolina found that many turtle carcasses did not strand on the coast (only 7 – 14%; Epperly et al., 1996). So the actual number of turtles killed during fishing operations is not known, but likely to be much higher than recorded on the beach. Gahirmatha and its adjacent areas are subjected to high mortality during the breeding season, and there is also intense shrimp trawling in these areas. Such trawling is common in the coastal waters off Devi rookery and its adjacent areas and hence results in high mortality of turtles along the coast.

RECOMMENDATIONS

Olive ridley sea turtles in Orissa are known to use multiple beaches for nesting during the same as well as in subsequent breeding seasons (Pandav, 2000). Along with this, the genetic studies (Shanker et al., 2004) substantiated the results of tagging and showed that one population uses all mass nesting beaches of Orissa. More significantly, the genetic studies also revealed the distinctiveness of the population on the east coast of India and suggested that they may be ancestral to populations in the Atlantic and Pacific oceans. The above studies indicate that significant reductions in the population of the olive ridleys at any of the arribada sites may affect the species as a whole. Despite being listed in Schedule I of the Indian Wild Life (Protection) Act (1972) and Appendix I & II of CITES, olive ridleys have suffered heavy casualties in the recent past. Undoubtedly, uncontrolled and illegal mechanized fishing is the major cause of turtle deaths in the high seas. The conservation approach for protection of olive ridleys at the Devi rookery will have to be distinctive from that required for Gahirmatha, since the former is not a Protected Area (PA) by law unlike the latter. The following are some of the useful management interventions required for the protection of olive ridleys at the Devi rookery of Orissa.

1. Strict implementation of the Orissa Marine Fishries Regulation Act, 1981 and the recommendations of the Central Empowered Committee of the Supreme Court of India will enhance the protection status of olive ridleys at the Devi rookery.

2. Continuous monitoring of the nesting stretch between Jatadhara river mouth (including Robert island near Devi mouth) to Keluni river mouth beach should be done for annual assessment of sporadic nesting and arribada of olive ridleys along the coast.
3. Dead turtle enumeration along the coast on a monthly basis should be done to assess the sea turtle mortality along Devi coast over time and space.
4. Involvement of local people in sea turtle conservation at the rookery need to be given top priority. Involving them in various eco-tourism promotion programmes at the Devi river mouth would also supplement their.

ACKNOWLEDGEMENT

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Fig. - 1. Map of Devi rookery, Orissa coast

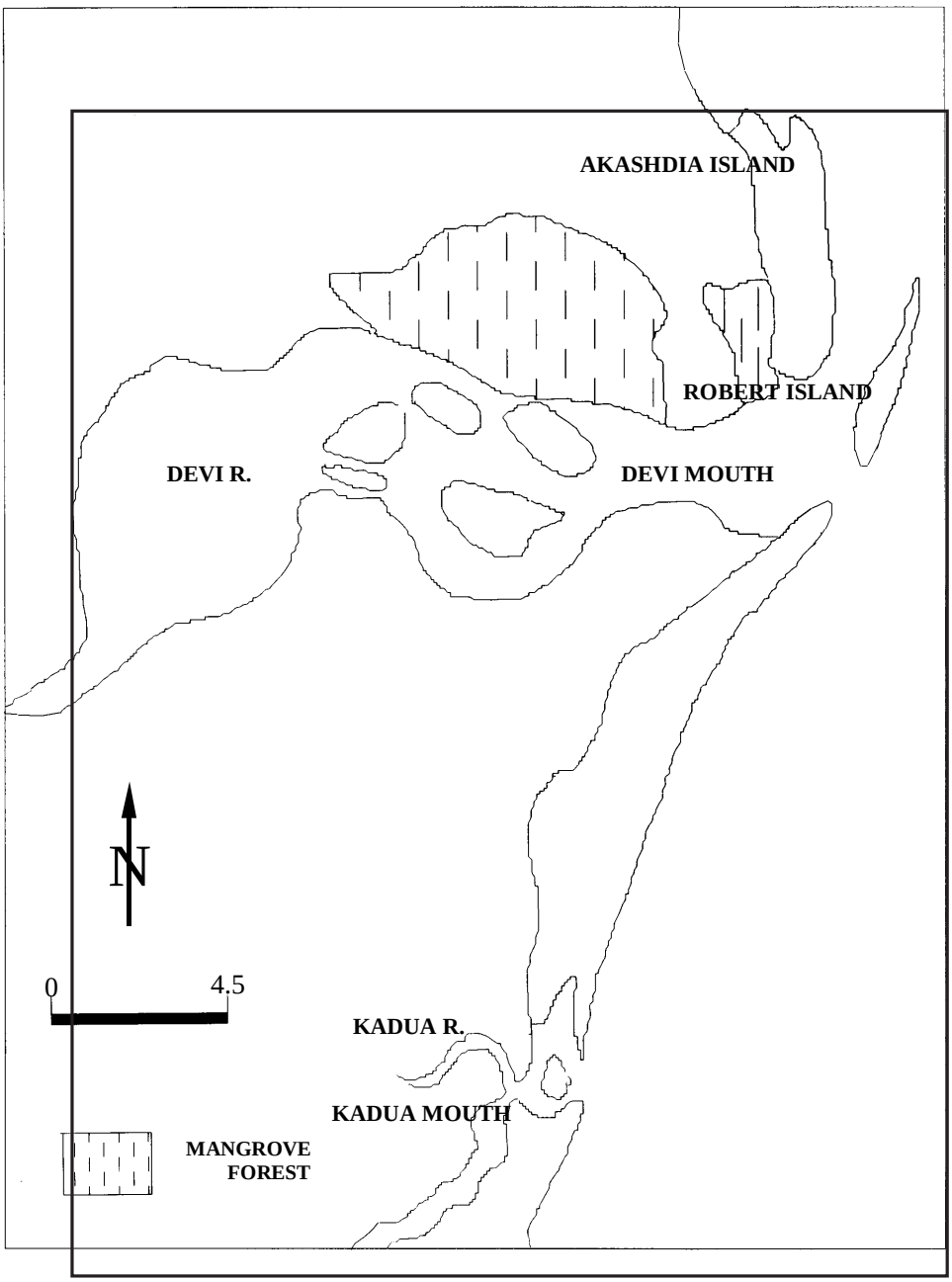
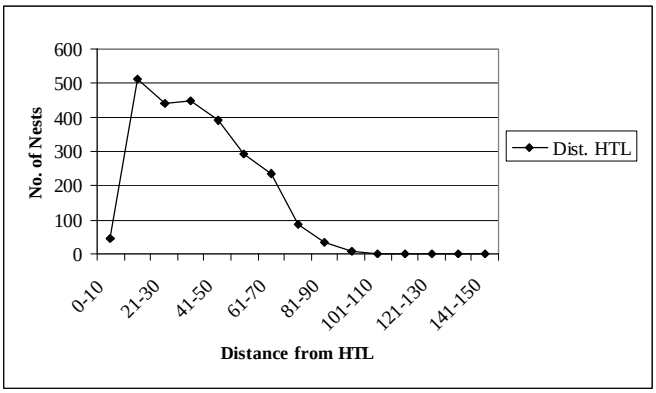


Fig. - 2 a & b : Nest location in relation to distance from high tide level and vegetation



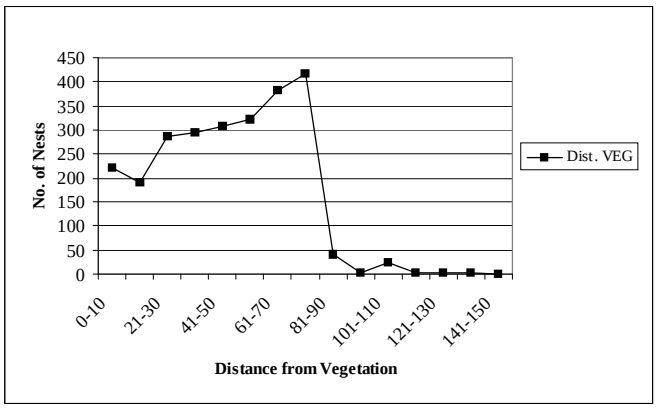


Table 1. Number of nesting and false crawls of olive ridleys encountered at the Devi rookery of Orissa during 2004-2005 season

Month	No. of nesting recorded nights	Total number of emergence	Number of false crawls
December	4	6	8
January	6	139	17
February	7	467	58
March	22	966	52
April	16	940	2

Fig.- 3. Dead turtles washed ashore along the coast of Devi

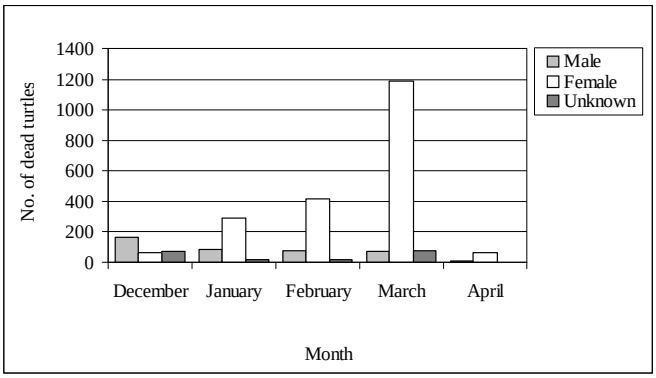
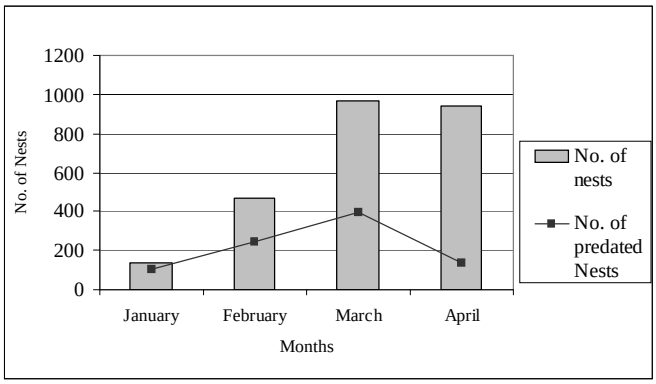


Fig. - 4 : Non-human predation of olive ridley sea turtle nests at Devi rookery



REFERENCES

BUSTARD H R (1976), World's largest sea turtle rookery ? Tiger paper 3: 3.

DASH M C AND C. S. KAR. (1990), The turtle paradise: Gahirmatha. Interprint, New Delhi. 295.

EPPERLY S P J BRAUN, A J CHESTER, F A CROSS, J V MERRINER, P A TESTER AND J H CHURCHILL. (1996), Beach stranding as an indicator of at-sea mortality of sea turtles. Bulletin of Marine Science Vol. 59(2): 289-297.

KAR C S AND S BHASKAR (1982), The status of sea turtle in the eastern Indian Ocean. Pp. 365-372. In: K. A. Bjorndal (Ed.), Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D. C. 615 p.

KAR C S (1982), Discovery of second mass nesting ground for Pacific ridley sea turtles in Orissa, India Marine Turtle Newsletter 23:3.

PANDAV B AND B C CHOUDHURY (2000), Conservation and management of olive ridley sea turtle (Lepidochelys olivacea) in Orissa. Project Final Report, Wildlife Institute of India. 77 .

PANDAV B B C CHOUDHURY AND C S KAR (1994a), A status survey of olive ridley sea turtle (Lepidochelys olivacea) and its nesting habitats along the Orissa coast, India. Wildlife Institute of India. 48 .

PANDAV B B C CHOUDHURY AND C S KAR, (1994b), Discovery of a new sea turtle rookery in Orissa. Marine Turtle Newsletter 67: 15-16 .

PANDAV B (2000), Conservation and management of olive ridley sea turtle (Lepidochelys olivacea) along the Orissa coast. Unpublished PhD Thesis, Utkal University, Orissa.

PRITCHARD P C H (1997), Evolution, phylogeny and current status. Pp. 1- 28. In: P.L. Lutz and J. A. Musick (Eds.). The Biology of Sea Turtles. Boca Raton, Florida, CRC Press, 432 .

SHANKER K, B PANDAV AND B C CHOUDHURY (2004), An assessment of the olive ridley turtle (Lepidochelys olivacea) nesting population in Orissa, India. Biological Conservation 115: 149 – 160.

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AN OVERVIEW OF WILD FLORAL AND FAUNAL BIO-DIVERSITY STATUS OF ORISSA

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ABSTRACT

Orissa has rich wild floral & faunal biodiversity. Due to its strategic location in Indian subcontinent it is considered as a stepping-stone for having floral & faunal elements of Northern & Southern India. The state has some ecoregions and biological hot spots viz. Similipal massif, Gandhamardhan, Deomali, Pradhanpat, Mahendragiri, Malyagiri etc. It has some excellent wet lands viz. Bhitarkanika & Chilika. The state has a good network of protected areas having many threatened & endangered species. The ecological profile shows that Orissa forms part of the oriental zoo-geographic realm with faunal diversity belonging to mostly Deccan peninsular Biogeographic zone.

Key words - Biodiversity, biological hot spot, stepping stone, endemic, biogeographic zone, eco-regions, ethno-medicines, wetland, corridor, floristic wealth.

INTRODUCTION

Orissa is endowed with rich biodiversity due to its strategic location in the east coast of India. It is located between 17^{0}50'-22^{0}30' North latitude and 81^{0}24'-87^{0}28' east longitude. The total geographical area of the state comes to 1,55,707 sq. km comprising 4.74% of India's landmass. This is a potential region contributing diverse floral & faunal elements of Coastal & Deccan peninsula biogeographic zones. It is the centre of diversity for many crop plants, agri-horticultural plants, primitive & nature cultivars. It becomes imperative on our part to conserve our diverse genetic resources and we must take adequate steps to protect and conserve the fragile ecosystems of our state's terrestrial, aquatic and coastal zone from sustained use and survival of diversity of plants and animals, which they support. We must formulate state biodiversity strategy and action plan to address the issues that are posing hindrance in our endeavor.

ECOLOGICAL PROFILE

Orissa has been divided into four district physiographic regions viz. Northern plateau, Eastern ghat Central table land and Coastal plains. Further it has been divided into ten Agro-climatic zones viz-Northwestern plateau, North central plateau, and Northeastern coastal plains. East & south eastern plain, North eastern ghat, Eastern ghat high land, South eastern ghat, Western undulating, West central table land & Mid central table land. According to Rodger & Panwar – Biogeographic classification, 1998, the state of Orissa has been divided in to the following provinces & zones.

BIOGEOGRAPHIC CLASSIFICATION OF ORISSA

Most of the state is included in two provinces of zone 6, the Deccan peninsula

These are Province 6B : Chotanagpur (50,943 km^2) with a single sub division.

1. Garhjat Hills

Province 6C : Eastern High lands (85,355^2) with two sub divisions

1. The Eastern ghats (with a northern boundary on the Brahmani river)
2. Chatisgarh – Dandakaranys

Province 7B-Gangetic plain forms a narrow coastal plain

(9131 km^2) recognized as a distinct land region, the Orissa plain.

BIOLOGICAL VALUES

The moist forests of the Eastern Ghats in South-east Orissa have communities of considerable biodiversity interest including many endemic species. In the north of the state the Similipal massif is a biological refuge of very great value. The state has rich mangrove vegetation, which supports the country's largest population of estuarine crocodiles and other estuarine fauna. The Gahirmatha is the largest rookery for Olive Ridley sea turtles in the world. Similipal and Eastern ghats include many semi-evergreen elements and are important biogeographic stepping stones in the link between the forest species of north east & south west India.

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The peninsula forests have fragmented elephant sub populations at least four of which are potentially viable in the long term, given adequate protection. Other wildlife values include Gaur, Sambar and in the southern valleys, relics wild buffalo populations. An isolated relict swamp deer population persisted until recently. Tiger and other carnivores are farely widespread.

Orissa has population of all three crocodilians. Chilika lake is a brackish water lagoon and is considered as one of the best wintering ground for migratory birds. The coast has major values in its mangroves of Bhitarkanika and Mahanadi Delta.

The wildlife in Orissa is classified under the Indian peninsular sub-region, which forms a part of the Oriental zoo-geographical realm of the world. It is the home of the true Indian fauna, of which the spotted deer, the nilgai (blue bull), the black buck, the four horned antelope (chausingha) and the sloth bear are typical representatives. The list of threatened animals/birds of Orissa is given in Table 1. So far 86 species of mammals, 473 species of birds, 110 species of reptiles and 19 species of amphibians have been recorded in Orissa (Govt. of Orissa, Forest Department, Wildlife Wing 1996).

Table-1- LIST OF THREATENDED MAMMALS/BIRDS/REPTILES IN ORISSA MAMMALS

Sl. No.	Family	Common English Name (Zoological Name)	Threatened category as per ZSI-RBD	Included in Schedule –I of Indian Wildlife (Protection) Act. 1972 or not.
1	2	3	4	5
		ORDER-ARTIODACTYLA		
1	Bovidae	Blackbuck (Antelope cervicapra)	Vulnerable	Included
2		Four-horned Antelope (Tetracerus quadricornis)	Vulnerable	Included
3		Gaur (Bos gaurus)	Vulnerable	Included
4		Wild Buffalo (Bubalus bubalis)	Endangered	Included
5	Cervidae	Swamp Deer (Cervus duvauceli)	Vulnerable	Included
6	Tragulidae	Mouse Deer (Tragulus meminna)	Vulnerable	Included
7	Elephantidae	Indian Elephant (Elephas maximus)	Vulnerable	Included
		ORDER – PHOLIDITA		Included
8	Manidae	Indian Pangolin (Manis Crassicaudata)	Vulnerable	Included
		ORDER – CARNIVORA		Included
9	Canidae	Indian Wolf (Canis lupus)	Vulnerable	Included
10	Procyonidae	Honey Badger (Mellivora capensis)	Insufficiently known	Included
11	Felidae	Leopard cat (Felis bengalensis)	Vulnerable	Included
12		Marbled cat (Felis marmorata)	Endangered	Included
13		Rusty-spotted Cat (Felis rubiginosa)	Insufficiently known	Included
14		Fishing Cat (Felis viverrina)	Vulnerable	Included
15		Caracal (Felis caracal)	Endangered	Included
16		Leopard (Panthera pardus)	Vulnerable	Included
17		Tiger (Panthera tigris)	Vulnerable	Included
18	Ursidae	Sloth Bear (Melursus ursinus)	Not listed in ZSI-RDB	Included
		ORDER – CETACEA		
19	Platanistidae	Gangetic dolphin (Platanista gangetica)	Vulnerable	Included
20	Delphinidae	Irraweddy dolphin (Orcaella brevirostris)	Not listed in ZSI-RDB	Included
21		Humpbacked Dolphin (Sousa chinensis)	Not listed in ZSI-RDB	Included
22	Phocoenidae	Little Indian Porpoise (Neophocaena phocaenoides)	Insufficiently known	Included
		ORDER – SIRENIA		

23	Dugongidae	Dugong (Dugong dugon)	Vulnerable	Included

BIRDS

Sl. No.	Family	Common English Name (Zoological Name)	Threatened category as per ZSI-RBD	Included in Schedule –I of Indian Wildlife (Protection) Act. 1972 or not.
1	2	3	4	5
		ORDER- PELECANIFORMES		
1	Pelecanidae	Dalmatian Pelican (Pelecanus philippensis)	Vulnerable	Not listed
		ORDER - CYCONIDFORMES		
2	Ardeuidae	Giant Heron (Ardea goliath)	Rare	Not included
3	Ciconiidae	Adjutant stork (Leptotilos dubius)	Endangered	Not included
4		Lesser adjutant stork (Leptotilos javanicus)	Endangered	Not included
5		Eastern white stork (Ciconia ciconia)	Endangered	Included
6	Threskiotrni thidae	White spoonbill (Platalea leucorodia)	Endangered	Included
		ORDER – ANSERIFORMES		
7	Anatidae	Large whistling teal (Dendrocygna bicolor)	Vulnerable	Included
		ORDER – FALCONIFORMES		
8	Accipitridae	Sparrow-hawk (Accipiter nisus)	Not included in ZSI-RDB	Included
9		Besra sparrow-hawk (Accipiter virgatus)	Not included in ZSI-RDB	
10		Whitebellied sea-eagle (Haliaetus leucogaster)	Vulnerable	
11		Osprey (Pandion haliaerus)	Vulnerable	
12	Falconidae	Falcon (Falco peregrinus)	Not listed in ZSI-RDB	
		ORDER – GALLIFORMES		
13	Phasianidae	Indian peafowl (Pavo cristatus)	Vulnerable	
		ORDER – CHARADRIIFORMES		
14	Laridae	Indian skimmer (Rhynchops albicollis)	Endangered	
		ORDER – STRIGIFORMES		
15	Strigidae	Forest spotted owlet (Athene blewitti)	Critical	
16	Bucerotidae	Malabar pied hornbill (Anthracoceros malabaricus)	Vulnerable	

REPTILES

Sl. No.	Family	Common English Name (Zoological Name)	Threatened category as per ZSI-RBD	Included in Schedule –I of Indian Wildlife (Protection) Act. 1972 or not.
1	2	3	4	5
		ORDER-CROCODYLIA		
1	Gavialidae	Gharial (Gavialis gangeticus)	Endangered	
2	Crocodylidae	Estuarine or salt water crocodile (Crocodylus porosus)	Endangered	
3		Marsh or Mugger crocodile (Crocodylus palustris)	Endangered	
		ORDER – TESTUDINES		
4	Cheloniidae	Green sea turtle (Chelonia mydas)	Endangered	
5		Hawks bill sea turtle (Eretmochelys imbricata)	Endangered	
6		Olive ridley sea turtle (Lepidochelys divacea)	Endangered	
7	Dermochelyidae	Leathetback sea turtle (Dermochelys coriacea)	Endangered	
8	Emydidae	Batagur (Batagur baska)	Endangered	
9		Indian tent turtle (Kachuga tecta)	Vulnerable	

10		Audithia turtle (Pelochelys bibroni)	Not included in ZSI – RDB	
11	Trionychidae	Indian Flap shelled turtle (Lissemys punctata)	Vulnerable	
12		Indian soft-shelled turtle (Trionyx gangeticus)	Vulnerable	
13		Peacock-marked soft shelled turtle (Trionyx hurum)	Vulnerable	
		ORDER- SQUMATA		
14	Varanidae	Common Indian monitor (Varanus bengalensis)	Endangered	
15		Yellow monitor (Varanus flavescens)	Endangered	
16		Water monitor (Veranus salvator)	Endangered	Not included
17	Boidae	Indian rock python (Python molurus)	Endangered	

With dwindling of forest cover, there is greater loss of habitat and corridors. Most of the wildlife is safe only in protected areas of the state. There are 18 wild life sanctuaries, one marine national park (Gahirmatha) and two national parks(Similpal and Bhitarkanika). Together these constitute 6059 sq.km which is about 10% of the total forest area and within 4 % of the geographical area of the state.

The state is the southern most limit of sal which is completely replaced by miscellaneous species near Malkangiri. Out of 16 forest types of India identified by Champion and Seth, we have 13 forest types and their subsidiary and seral types in Orissa.

Orissa boasts of 480 km long coastline creating delightful estuaries & lagoons. Gahirmatha marine sanctuary stretches over a length of approximately 70 km along eastern coast of Orissa covering 1408 sq. km of water body and 27 sq.km of landmass. It has great ecological significance for resting of Olive Ridley Sea turtles. Out of eight species of marine turtles found in the world five species in habit the Indian coastal waters of these four species of turtles are sun in Orissa. These are Leather back (Dermochelys coriacea) Green (Chelonia mydas), Hawksbill (Eretmochelys imbricata) and Olive Ridley (Lepidochelys olivacea). All these four species of sea turtles are included in schedule 1, of the Wildlife (Protection) Act, 1972 and listed endangered under IUCN “Red Data Book”. Further they are also protected under the Convention on Migratory Species (CMS) & Convention on International Trade in Endangered Species of wild flora and fauna (CITES).

Chilika is the Asia’s largest brackish water lagoon covering about 1100 sq.km Chilika has been declared as the wet land of international importance i.e Ramsar site. The country side of coastal Orissa abounds with numerous wetlands. The mangrove mud flats, tidal rivers, estuaries, sea grass beds and coral reef are ideal habitat for myriad number of aquatic fauna. Notable among these are king crabs, giant water monitor lizards, salt water crocodiles, fresh & brackish water terrapins tiger prawns, water fowl as well as magnificent marine mammals like Irrawady Dolphins & Purpoises. Bhitarkanika mangroves have a rich floristic value with 64 mangrove species. The Bhitarkanika Sanctuary boasts of the largest salt-water crocodiles of the world.

Similipal is synonymous with ‘Project tiger’. It has largest concentration of Royal Bengal Tigers next only to Sundarbans. The Similipal massif is compact biomes of moist deciduous and moist tropical forests. More than 3000 flowering plants & 90 orchids have been recorded from Similipal forests. Similipal is the only Biosphere Reserve of the state. It is a biological hot spot of immense potential.

The Gandhamardhan Hill system is famous for its rich medicinal plant reserves. Similarly the Mahendragiri & Deomali hills of southern Orissa are rich repository of biodiversity with more then 600 angiosperm species including 38 orchid species recorded from these area.

The floral extravaganza of Orissa is rich & varied. More than 3000 species of angiosperms have been recorded out of 15000-16000 species found in India. All together 127 species of orchids are found in Orissa, which comes to 12% of the total orchid flora of India. Southern Orissa is a part & parcel of the Deccan Endemic Centre. Similarly Sundargarh and Mayurbhanj districts form a part of Bihar-Orissa Endemic Centre. The state of Orissa is the meeting point of the floral assemblage of North & North-eastern India and the home of endemic flora of the Southern India. Thus Orissa as a whole provide an ideal data- base for the physiographical analysis of the flora of the Indian sub-continent in as much as many Malayasian elements extended their range to Orissa. Presence of some South Indian & Himalayan floral element on the hill tops of Meghasani (Similipal massief) Deomali (Rayagarha),

Malyagiri (Dhenkanal) & Mahendragiri (Gajapati) suggest that Orissa is the meeting ground of Himalayan & South Indian flora. Presence of natural teak & sal in close association is a significant ecological feature, which is peculiar to the flora of Orissa. The loss of forest cover due to various developmental activities & anthropogenic factors has resulted in decline of indigenous germplasms over the years.

BIO-DIVERSITY OF FISHES AND AQUATIC FAUNA IN ORISSA

Wetlands of the state are ecological fragile and biologically very rich area. Chilika lagoon boasts of 225 species of fish fauna. Estuarine waters are reported to have the maximum number of fish species but census reports of the same have not been made available.

FLORISTIC WEALTH OF ORISSA

So far 2754 number of plant species have been recorded in Orissa. Out of these 10 taxa are gymnosperms, 2576 taxa are angiosperms & 168 taxa belong to pteridophytes. The flora of Orissa by Saxena & Brahman (1994-96) comprises of four volumes and deals with the systematic account of 2727 species of gymnosperms, angiosperms & pteridophytes including 166 species of cultivated plants.

About 29 endemic taxa have been reported from Orissa out of which 27 species under 27 genera & 14 families belong to angiosperms. It is also estimated that 144 species distributed with in 119 genera & 41families of flowering plants occur either as rare or endangered. According to Red Data Book published by IUCN, the species viz Curculigo orchioides, Gymnema sylvestre, Gloriosa superba, Rauwlfia serpentina, Aristolochia indica & Uriginea indica are considered endangered & vulnerable. Similarly Eleiotis sooria, Rhynchosia suaveaolens, Cajanus cajanifolia, Tephrosia roxburghiana, Dimeria mahendragiriensis , Erythrina resurpinata, Dimera acutipes etc. are considered threatened. The list of rare, endangered and threatened plants of Orissa is given in Table 2.

Table-2 RARE/ENDANGERED/THREATENED PLANTS OF ORISSA

Acacia donaldii Haines	Goodyera thailandica Seidenf
Acacia tomenmtosa Willd	Gynura nitida DC
Acampe rigida (Buch-Ham.ex.Sm.) Hunt	Halophila beccarii Asch
Acanthephippium sylhetense Lindl	Heterostemma tanjorensis Wight & Am.
Aerides crispum Lindl	Hypericum gaitti Haines
Aglaia cucullata (Roxb)Pellegrin	Intsia bijuga (Colebr.) Kuntze
Aglaia elaeagnoidea (Juss.) Benth	Lasianthus truncatus Bedd.
Albizia orissensis Sahni & Bennet	Lasiococca comberi Haines
Alocasia montana (Roxb.) Schott	Leucas clarkei Hook.f
Alphonsea madraspatana Bedd.	Liparis resupinata Ridley
Anaphalis lawii (Hook. f.) Gamble	Luisia primulnia Par. & Raichb. F.
Atylosia cajanifolia Haines	Malaxis purpurea (Lindl.) Kuntze
Atylosia sericea Griff	Maerua oblogifolia A. Rich
Balanophora polyandra Griff.	Maytenus bailadillana (Narayan & Mooney) Raju & Babu
Bulbophyllum crassipes Hook. f.	Micrococca mercurialis (L.) Benth
Bulbophyllum guttulatum (Hook.f.) Balak	Neanotis montholoni (Hook. f.) Lewis
Bulbophyllum macraei (Lindl.) Reichb.	Nervilia punctata (BI.) Makino
Bulbophyllum polyrhizum Lindl.	Nothopegia heyneana (Hook.f.) Gamble
Cassipourea ceylanica (Gardn.) Alston	Oberonia gammiei King & pantl
Cryptocarya amygdalina Lour	Ormocarpum cochinchinense (Lour.) Merr.
Cryptocoryne ciliata (Roxb.) Schott	Nogra grahamii (Wall. Ex. Benth.) Merr.
Dendrobium cathcartii Hook. f.	Pachystylidium hirsutum (Bl.) Pax & Hoffm.
Dendrobium peguanum Lindl.	Pavetta brevifolia DC. Var. ciliolaa Gamble ex. BI
Dendrodium regium Prain	Peristylus parishii Reichb. f.

Desmodium ritchiei Sanjappa
Dimeria acutipes Bor
Dimeria lehmanii (Nees ex Steud) Hack
Dimeria mahendragiriensis Ravi, Saxena & Brahman
Dimeria trimenii Hook. F.
Dimeria mooneyi Raizada & Mooney
Dimorphocalyx glabellum Thw.
Diplopora championii (Lindl) Hook.f.
Dracaena spicata Roxb
Elaeotis sororia (L.) DC.
Elaeotis sororia Lindl
Eriocaulon echinulatum Mart.
Erythrina resupinata Roxb
Eulophia dabia (D. Don) Hochr.
Fimbristylis sericea R.Br
Fimbristylis tristachya R.Br.
Flemingia nilgheriensis (Baker) Wight ex Cooke
Gnetum montanum Markgraf
Gentum ula Brongn
Zeuxine lindleyana N. Rao
Phoenix paludosa Roxb.
Pomatocalpa decipiens (Lind.) J.J. sm.
Premna calycina Haines
Psoralia corylifolia Linn
Rhaphidophora decursiva (Roxb.) Schott.
Rhynchosia suaveolens (L.f.)DC.
Senecio candicans DC
Senecio corymbosus Wall. Ex. DC.
Smilax lancifolia Roxb.
Sophora bakeri C.B. Clarke ex Prain
Stemona tuberosa Lour
Strobilanthes circarensis Gamble
Strobilanthes jeyporensis Bedd.
Tainia hookeniana King & Pantl
Tephrosia roxburghiana Drumm
Toona ciliata Roem. Var. pubinervis (C.DC)Bahadur
Tragia bicolor Miq.
Wendlandia gamblei Cowan

Some potential centres of greater plant diversity have been identified in the state of Orissa. Each of these centres has a few species specific to that locality and is not found elsewhere in the state. These are biological hot spots of the state and includes Similipal hills (1076 species) Gandhamardhan hills (920 species), Bhitarkanika (64 species of mangrove & their associates), Mahenhagiri hills in Gajapati district, Sunabeda plateau, Deomali hills (Rayagada district), Chilika lake (711 species) & Malyagiri (510 species) Examples of some plants species specific to these locality are given in Table-3.

Table-3

Similipal Hills	Ganghamardan Hills	Deomali Hills	Mahendragiri Hills	Chilika lake
Dichrocephalus integefolia	Erythrina resupinata	Habenaria grandifloriformis	Stemona tuberosa	Cassipourea ceylanica
Hyperium gaitii	Tylophora fasciculate	Emilia zeylanica	Senecio candicans	Macrotyloma ciliatum
Cyathea spinulata	Heterostemma piperifolium	Gyanura lycopersicifolia	Senecio corymbosa	Neptunia triquetra
Gomphostemma parviflorum	Heterostremma tanjorense		Senecio nudicaults	Halophila ovalis
Neocinnamomum caudatum	Atylosia sericea		Sophora interrupta	Halophila beccarii
Sophora bakeri			Peperomia dindigulensis	Ruppia maritime
Taxocarpur kleinii			Anaphalis lawii	Najas graminea
			Syzigium cuneatum	Potamogeton cctandrus
			Tephrosia roxburghii	Potamogeton crispus
				Diplachne fusca

The flora of Orissa represents admixture of tropical Southeast Asian and Malayan elements. High hill of the state viz: Deomali (1673 mt), Turia Konda (1599 mt), Singharaj (1515 mt), Mahendragiri (1165 mt) of eastern ghats have several sub-tropical and temperate taxa of the Himalayas and other South Indian hill species; these have

been substantiated as below.

a) High hills of Orissa served as stepping stones for migration of species from high lands of the peninsula in Western ghats to the newer Himalayas and vice-versa through Assam bridge (Haines,1925).

b) Relict taxa, from the time Deccan peninsula had land connection with Indo-Malayan region (Biswal and Sampat Kumaran, 1949).

c) High altitude Southeast Asian and Himalayan flora is because of convergence in evolution. The present disjunction is because of favourable ecological niche obtaining in these hill tops (Nayaar,1977)

Himalayan taxa : Ajuga macrosperma, Galium asperifolium, Ophiopogon intermedius, Phoebe lanceolata, Rhus chinensis, Plectranthus japanicus, Rhamnus nepalensis, Rubus ellipticus, Thalictrum foliolosum, Zanthoxylum armatum.

South Indian hill speices : Anaphalis lawii, Desmodium ritchiei, Dospyros candollena, Flemingia nilgherrensis, Indigofera wightii, Plectranthus nilgherricus, Senecio candicans, Tephrosia roxburghiana, Wendlandia gamblei.

Assam Species : Acampe rigida, Bulbophyllum crassipes, Cissus assamica, Elaeocarpus wallichii, Licuala peltata, Lirsea laeta, Natsiatum herpaticum, Syzygium cuneatum.

ORCHIDS OF ORISSA

Orchids are fascinating group of flowering plants with tremendous commercial value due to the unique quality of interbreeding liberally resulting in inter specific & inter generic hybrids.

Orchids are distributed mainly in the mountain forests of the state of Orissa lying within a altitudinal range of 300 to 1500 meters. Thus orchids are restricted to northern plateau, eastern hills, central river basins and coastal plains. Out of 1200 species of orchids found in India about 129 species have been reported to occur only in Orissa including several rare ones. The list of wild orchids of Orissa based on the work of Sarat Mishra (1968-2001) is given in Table- 4.

Table - 4

Terrestrials

Acanthephippium bicolor Lindl.

A.sylhetense Lindl.

Calanthe triplicata (Willem) Ames

Crepidium mackinnoni (Duthie) Szlach

C.purpureum (Linl.) Szlach

Dienia ophrydis (Koen) Ormer. & Sied

Eulophia explanata Lindl.

E. graminea Lindl.

E. Orchreata Lindl.

E. spectabilis (Dennst) Suresh

Geodorum densiflorum (Lam) Schltr.

G. Purpureum R.Br.

G. recurvum (Roxb) Alst.

Goodyera fumata Thw.

G. hispida Lindl.

G.procera (Ker-Gawl) W. J. Hook

G. thailandica Seid.

Habenaria commelinifolia (Roxb.) Wall ex. Lindl. H . crassifolia A. Rich

H. digitata Lindl.

H. furcifera Lindl.

H. gibsoni var. foetida Blatt. & MeCann

H. gibsoni var. gibsoni J.D. Hook

H. grandifloriformis Blatt. McCann

H. longicorniculata Graham

H. marginata Coleb

H. panigrahiana var. panigrahiana S. Mishra

H. pelorioides Par & H.G. Rchb.

H. panigrahiana var. parviloba S.Mishra

H. plantaginea Lindl.

H. reniformis (D.Don) J.D. Hook

H. roxburghii Nicols

H. stenopetala Lindl

Liparis deflexa J.D. Hook.

L. nervosa (Thunb.) Lindl.

L. paradoxa (Lindl.) H.G. Rchb.

Nervilla aragoana Gaud.

N. crociformis (Zolla & Mor.) scid.

N. gammieaena (J.D.Hook) Schltr.

N. infundibulifolia Blatt. & McCann

N. plicata (Andr.) Schltr.

N. scottii (H.G. Rchb) Schltr.

N. pachystoma Pubescens BI.

Pecteilis gigantea (J.E. Sm.) Rafin.

P.henryi Schltr. Peristylus constrictus (Lindl.) Lindl.
P.goodyeroides (d.don) Lindl.
P.lawii Wight
P. parishii H.G. Rchb.
P. plabtagineus Lindl.
Phaius tankervilleael (I,Herit.) BI.
Seidenfia rheedii (Sw.) Szlach.
Spiranthes sinensis (Pers.) Ames.
Tainia hookeriana King & Pantl.
Tropidia angulosa (Lindl.) BI.
P. pedunculata
BI. Zeuxine affinis (Lindl.)
Benth ex J.D. Hook
Z. gracilis (Breda) BI.
Z. lindleyana A.N. Rao.
Z. Nervosa (Wall.ex.Lindl.) Benth ex. Clarke
Z. strateumatica (L.) Schltr.

Saprophyte

Didymoplexis pallens

Epiphytes

Acampe carnata (Griff.) Panigr.
A. Ochracea (Lindl.) Hochr.
A. Praemorsa (Roxb.) Blatt & McCann
A. rigida(Buch. Ham.ex.J.E. Sm.) Hunt
Aerides maculosa Lindl.
A. multiflora roxb.
A. odorata Lour.
A. ringens Fischer.
Bulbophyllum cariniflorum H.G. Rchb.
B. crassipes J.D. Hook
B. guttulatum (J.D. Hook) Balkr.
B. macraei (Lindl) H.H. Rchb.
B. polyrhizum Lindl.
B. triste H.G. Rchb.
B. umbrellatum Lindl.
Chiloschista parishii Seid
Ctrrhopetalum panigranianum (S.Misha)
Clesisostoma appendiculatum (Lindl) Benth & J.D. Hook. Ex. Sied
Cottonia peduncularis (Lindl) H.G. Tchb.
Cymbidium aloifolium (L) Sw.
C. bicolor Lindl.
Dendrobium aphyllum (Roxb) Fischer
D. bicameratum Lindl.
D. cathcartii J.D. Hook
D. crepidatum Lind.
D. fimbriatum W. J. Hook.
D. formosum Roxb. Ex. Lindl.
D. herbaceum Lindl.
D. macrostachyum Lindl.
D. moschatum (Buch. Ham.) Sw.
D. regium pain
D. peguanum Lindl.
D, transparens Lindl.
Diploprora championi
Eria bambusifolia
E. lasiopetala
E. meghasaniensis
Flickingeria macraei
Gastrohilus acaulis
G. inconspicuum
Kingidium deliciosum
Lipars elliptica
Vestita spp. seidinfadenii
V. viridiflora
Luisia brachystachys
L.trichorhiza
L.zeylanica
Mastigion ornatissimum et al
M. putidum et al
Micropera pallida
Oberonia ensiformis
O. falconeri
O. gammiei
O. mucronata
O. proudlokii
O. pyrulifera
Papiionanthe teres
Pelatantheria insectifera

Pholidota imbricata

Polystachya concreta

Pomatocalpa decipiens

Rhynchostylis retusa

Smitinandia micrantha

Staurochilus ramosus

Thunia bracteata

Vanda tessellata

V. testacea

MANGROVE FLORA OF ORISSA

Out of 65 mangrove species found in India, 63 species are found in Orissa. Thus the mangroves of Bhitarkanika and Mahanadi delta are rich and varied. They belong to 37 genera under 25 diverse plant families. Occurrence of Sonneratia griffithii, Avicennia marina var acytissima, Heritiera globosa and Rhizophora stylosa are new records for Indian mangrove floral diversity. Heritiera kanikensis (Majumdar and Banerjee, 1987) is a new species recorded in Bhitarkanika mangrove area. There are 215 sq. km. Of mangrove forest recorded in Orissa. Littoral scrub jungles with some specific plant characteristics to deltaic swamps also occurs in salt marshes near Chandipur, Astaranga, Gopalpur and rocky faces of Chilika lake.

AGRICULTURAL BIODEVERSITY

Agricultural advancement is dependent upon the wild & related taxa of cultivated crops. The floristic wealth of Orissa indicates that there are about 2630 angiospermic species belonging to 194 families & 1060 genera. Out of these 1868 are dicots and 762 are monocots. Among the cultivated species, there are 121 dicot species, 38 monocot species & 7 gymnosperms. Families identified are Poaceae (265), Fabaceae (254), Cyperaceae (140), Orchidaceae (129), Asteraceae (117), Euphorbiaceae (108), Rubiaceae (89), Acanthaceae (82), Lamiaceae (59) and Scrophulariaceae (56).

Sl. No.	Orissa	India
1	Fabaceae (316)	Orchidaceae
2	Poaceae (261)	Fabaceae
3	Cyperaceae (125)	Poaceae
4	Orchidaceae (127)	Pubiaceae
5	Asteraceae (103)	Euphorbiaceae
6	Euphorbiaceae (97)	Acanthaceae
7	Rubiaceae (81)	Asteraceae
8	Acanthaceae (79)	Cyperaceae
9	Scrophulariaceae (53)	Lamiaceae
10	Lamiaceae (50)	Urticaceae

Orissa is the secondary Vavilov centre for rice. It is a potential region for occurrence of diversity in crop plants and centre of diversity for many agri-horticutural relatives of crop plants, Richness of the diversity of the agri-horticultural crop is exhibited in crops viz. rice, maize, millets (Panicum miliaceum, Panicum miliare, Echinochloa, Paspalum scrobiculatum, Setaria italica), legumes (Vigna unguculata, Cajanus cajan), vegetable (pumpkin, cucumber, oil seeds (sesame, castor),fibre crops (jute, cotton), spices and condiments (ginger, turmeric), horticultural crop plants. Table-5.

Table-5 Checklist of crop plants & wild relatives Cereals & Millet

Crop group/ English name	Botanical name
Rice	Oryza sativa Linn (Poacceae)
Maize	Zea mays Linn. (Poaceae)
Ragi	Eleusine coracana Gaertn (Poaceae)
Kodo millet	Paspalum scrobiculatum Linn.(Poaceae)
Pearl millet	Pennisetum typhoides Stapf. & Hubb. (Poaceae)
Barnyard millet	Echinochloa crus-galli Beauv (Poaceae)
Italian millet	Setaria italica Beauv (Poaceae)
Little millet	Panicum miliare Linn (Poaceae)
Monitor millets	Panicum spp.(Poaceae)
Job's tears	Coix lacryma-jobi Linn(Poaceae)
Sorghum	Sorghum vulgare Pers.(Poacceae)
Pulses	
Chickpea	Cicer arietinum Linn (Fabaceae)
Pigeonpea	Cajanus cajan Mill (Fabaceae)
Black gram	Vigna mungo Linn (Fabaceae)
Green gram	Vigna radiata Roxb.
Horse gram	Macrotyloma uniflorum Linn (Fabaceae)
Lentil	Lens culinaris Moench (Fabaceae)
Cowpea	Vigna unguiculata (Linn.) Walp (Fabaceae)
Rice bean	Vigna umbellata (Thumb)ohwi & Ohashi (Fabaceae)
Lathyrus	Lathyrus sativus Linn. (Fabaceae)
Moth bean	Phaseolus aconitifolius Jacq (Fabaceae)
Pea	Pisum sativum (Fabaceae)
Oilseeds	
Til	Sesamum indicum Linn. (Pedaliaceae)
Groundnut	Arachis hypogaea Linn. (Fabaceae)

Niger	Guizotia abyssnica Cass (Asteraceae)
Rape seed & mustard	Brassica spp. (Brassicaceae)
Castor	Ricinus communis Linn. (Euphorbiaceae)
Linseed	Linum usitatissimum Linn.(Linaceae)
Sunflower	Helianthus annus Linn. (Asteraceae)

Vegetables & root crops

Brinjal	Solanum melongena Linn. (Solanaceae)
Chillies	Capsicum annuum Linn. (Solanaceae)
Capsicum annuum var. Minimum (Solanaceae)	
Capsicum frutesuns Roxb. (Solanaceae)	
Okra	Abelmoschus esculentus Linn. (Malvaceae)
Ridge ground	Luffa acutangula Roxb. (Cucurbitaceae)
Pole bean	Lab lab purpureus Linn. (Fabaceae)
French bean	Phaseolus Vulgaris Linn.(Papilionaceae)
Amaranthus	Amaranthus spp. (Amaranthaceae)
Papaya	Carica papaya Linn. (Caricaceae)
Tomoto	Lycopersicon esculentum Will (Solanaceae)
Bitter ground	Momordica charantia Linn. (Cucurbitaceae)
Bottle ground	Lagenaria siceraria (Mol.) Standl. (Cucurbitaceae)
Yam	Dioscorea alata Linn. (Dioscoreaceae)
Field bean	Dolichos lab lab Var. lignosus prain (Fabaceae)
Pumpkin	Cucurbita maxima. Swartz (Cucurbitaceae)
Basella	Basella alba Linn. (Basellaceae)
Taros	Colocasia esculenta (Linn.) Schott (Araceae)
Potato	Solanum tuberosum Linn. (Solanaceae)
Spine gound	Momordica dioica Roxb. (Cucurbitaceae)
Sponge gourd	Luffa aegyptica Willd (Cucurbitaceae)
Pointed gourd	Trichosanthes dioica Roxb. (Cucurbitaceae)
Cucumber	Cucumis sativus Linn. (Cucurbitaceae)
Snap melon	Cucumis melo Linn. (Cucurbitaceae)
Guar	Cyamopsis tetragonoloba Linn. Taub(Fabaceae)
Canavalia	Canavalia ensiformis (Linn.) DC (Fabaceae)
Elephant yam	Amorphophallus campanulatus (Araceae)
Arrowroot	Maranta arundinacea Linn. (Marantaceae)
Chocho	Sechium edule (Cucurbitaceae)

Fibre Crops

Jute	Corchorus olitorius Linn. (Tiliaceae)
Kenaf	Hibiscus sabdariffa Linn. (Malvaceae)
Cotton	Gossypium spp. (Malvaceae)
Sunnhemp	Crotalaria juncea Linn. (Papilionaceae)
Sisal	Agave sisalana Perr. (Agavaceae)

Spices & Condiments

Ginger	Zingiber officinale Rosc. (Zingiberaceae)
Turmeric	Curcuma domestica Valeton (Zingiberaceae)
Coriander	Coriandrum sativum (Apiaceae)
Postok	Amaranthus hypochondriacus (Amaranthaceae)
Onion	Allium cepa Linn. (Liliaceae)
Garlic	Allium sativum Linn. (Liliaceae)
Fenugreek	Trigonella foenum gracecum Linn. (Fabaceae)
Fennl	Foeniculum vulgare Mill. (Apiaceae)

Horticultural & forest Plants

Custard apple	Annona squamosa Linn. (Annonaceae)
Ber	Zizyphus jujuba Mill (Rhamnaceae)
Aonla	Phyllanthus emblica Linn. (Euphorbiaceae)
Cashewnut	Anacardium occidentale Linn. (Anacardiaceae)
Citrus	Citrus spp. (Rutaceae)
Hogplum	Soondias mangifera Willd. (Anacardiaceae)
Tamarind	Tamarindus indica L. (Caesalpiniaceae)
Arjun	Terminalia arjuna (Roxb.) (Combretaceae)
Semecarpus	Semecarpus anacardium L (Anacardiaceae)
Nux vomica	Strychnox num-vomica (Longaniaceae)
Korua	Holarrhena antidysenterica Linn. Wall (Apocynaceae)
Jaffri	Bixa orellana (Bixaceae)
Sesban	Sesbania grandiflora Pers. (Fabaceae)

Medicinal, aromatic & narcotic plants

Holy basil	Ocimum sanctum Linn. (Lamiaceae)
Lemongrass	Cymbopogon martini Stapf (Poaceae)
Kalmegh	Andrographis paniculata Nees (Acanthaceae)
Phyllanthus	Phuyllanthus niruri Linn. (Euphorbiaceae)
Jyotishmati	Celastrus paniculatus Willd. (Celastraceae)
Sarpagandha	Rauwolfia serpentina Benth. (Apocynaceae)
Aloe	Aloe barbadensis (Liliaceae)
Datura	Datura metel (Solanaceae)
Cowhage	Mucuna prurita (Fabaceae)
Pueraria	Pueraria tuberosa (Fabaceae)
Tobacco	Nicotiana tabacum (Solanaceae)

Wild relatives of crop plants

Wild okra	Abelmoschus crinitus (Malvaceae)
Wild okra	Abelmoschus ficulneus(Malvaceae)
Wild okra	Abelmoschus manihot(Malvaceae)
	Alocasia Montana (Araceae)
	Amaranthus mangostanus (Amaranthaceae)
	Amorphophallus bulbifer (Araceae)
	Cajanus Cajanifolia (Fabaceae)
	Atylosia volubilis (Fabaceae)
Wild jute	Corchorus acutangulus (Tiliaceae)
	Curcuma angustifolia (Zingiberaceae)
	Curuma aromatica (Zingiberaceae)
	Dioscorea bulbifera (Dioscoreaceae)
	Dioscorea glabra (Dioscoreaceae)

	Dioscorea hamiltonii (Dioscoreaceae)		Phyllanthus mukerjeeanus (Euphorbiaceae)
	Dioscorea hispida(Dioscoreaceae)		Piper longum (Piperaceae)
	Dioscorea kalkapershadii (Dioscoreaceae)		Porteresia coarctata (Poaceae)
	Dioscorea oppositifolia (Dioscoreaceae)		Saccharum bengalense (Poaceae)
	Dioscorea pentaphylla (Dioscoreaceae)		Saccharum nerenga (Poaceae)
	Dioscoria wallichii (dioscoreaceae)		Saccarum spontaneum (Poaceae)
	Echinochloa crusgalli (Poaceae)		Setaria glauca (Poaceae)
Wild rice	Hibiscus radiatus (Malvaceae)		Setaria intermedia (Poaceae)
	Momordica dioica (Cucurbitaceae)		Solanum erianthum (Solanaceae)
	Mucuna minima (Fabaceae)		Solanum giganetum (Solanaceae)
	Oryza granulata (Poaceae)	Wild brinjal	Solanum indicum (Solanaceae)
Wild rice	Oryza nivara (Poaceae)	Wild brinjal	Solanum khasianum (Solanaceae)
Wild rice	Oryza offficinalis (Poaceae)		Solanum surattense (Solanaceae)
Wild rice	Oryza rufipogon (Poaceae)	Wild brinjal	Solanum torvum (Solanaceae)
	Panicum auritum (Poaceae)		Solanum trilobatum (Solanaceae)
	Panicum colonum(Poaceae)		Solanum xanthocarpum (Solanaceae)
	Panicum isachne(Poaceae)		Syzygium cumini (Myrtaceae)
	Panicum javanicum(Poaceae)		Trichosanthes cucumerina (Cucurbitaceae)
	Panicum kurzii (Poaceae)		Trichosanthes palmata (Cucurbitaceae)
	Panicum remotum (Poaceae)	Wild mung	Vigna pilosa (Fabaceae)
	Panicum repens (Poaceae)		Vigna sublobata (Fabaceae)
	Panicum trypherom (Poaceae)		Vigna vexillata (Fabaceae)
	Paspalum paspalodes (Poaceae)		Zingiber capitatum (Zingiberaceae)
	Pennisetum hordeoides (Poaceae)		Zingiber rubens (Zingiberaceae)
	Pennisetum pedicellatum (Poaceae)		Ziziphus rugosa (Rhamnaaceae)
	Phoenix robusta (Arecaceae)		

MEDICINAL PLANTS

Ethno medicines are important to most of the rural people of the state. As most of the medicinal plants are collected from wild, their status in the wild is very crucial. The list of threatened medicinal plants is given in Table -6

Table-6 List of threatened medicinal plants of Orissa

Sl.No.	Species	Local Name	Status	Parts Used	Used for	Remarks
1	Acorus calamus	Bacha	Critically Endangered	Rhizome	Throat Disease	
2	Alstonia scholaris	Chhatian	Vulnerable	Bark	Fever	Trees being felled for collection of bark
3	Baliospermum montanum	Danti	Vulnerable	Root	Stomach Disorder	
4	Celastrus paniculata	Penru/Phutkel	Vulnerable	Seed	Intelligence booster	
5	Chlorophytum arundinaceun	Sweta musli	Endangered	Root	Aphrodisiac	
6	Convolvulus pluricaulis	Shankhapuspi	Vulnerable	All Parts	Booster	
7	Cordia macleodii	Sambarsingha Panaki	Endangered	Leaves	Cut wounds	Tree being felled for manufacturing furniture
8	Premna latifolia	Agibathu	Vulnerable	Bark	Fever	
9	Creteva magna	Barun	Vulnerable	Bark	Diuretic	
10	Curculigo orchioides	Talmuli	Endangered	Root	Aphrodisiac Stomach disorder	

11	Cureuma caesia	Kala Haldi	Endangered	Rhizome	Aphrodisiac Stomach disorder	
12	Evolvulus alsinoides	Shankhapuspi	Vulnerable	All parts	Intelligence booster	
13	Gloriosa superba	Pancha angulia	Endangered	Tuber	Rheumatism	
14	Gymnema sylvestre	Gudmari	Vulnerable	Leaf	Diabetes	
15	Litsae glutinosa	Maida/Medha/ Masania	Endangered	Bark	Rheumatism	Trees being felled for collection of bark for Agarbatti Industries
16	Operculina turpethum	Tihudi	Vulnerable	Root	Laxative	Great Demand in the market
17	Oroxylum indicum	Phanaphana/ Phaphen/Phampunia	Vulnerable	Bark	Fever chicken pox	Trees being felled for collection of bark for Agarbatti Industries
18	Emblica officinalis	Amla	Data deficient	Fruits	Respiratory disease	Fruit bearing Aonla tree being felled for collection of fruits.
19	Rauwolfia serpentina	Patalgaruda	Endangered	Root	Hypertension Insomnia	
20	Plumbago indica	Rakta chitaparu /Rakta	Chintamul	Endangered	Root	Stomach
21	Symplocos recemoss	Lodhra	Endangered	Bark	Uterine disorder	
22	Steriospermum	Patuh/Padhel	Vulnerable	Bark	Fever	
23	Strychnos nuxyomica	Kochila	Vulnerable	Fruit	Rheumatism	
24	Terminalia chebula	Harida	Date Deficient	Fruit	Tonic	Fruit bearing Harida trees being felled forcollection of fruits.
25	Tylophora indica	Antamul	Vulner-able	Leaf	Asthma	

CONCLUSION

Orissa state biodiversity strategy and action plan contemplates to promote long term survival of populations including sustained recovery of depleted stocks and safeguarding of critical habitats, integrating into the well being and needs of human communities with which they interact. Both in-situ and ex-situ conservation measures need to be taken up and bio-diversity conservation to be taken up encompassing entire landscapes and ecosystems. The general strategy of biodiversity conservation must include (i) status survey of all wild floral and faunal resources (ii) identification of all potential habitats having assemblage of rare and critically endangered ecosystems (iii) developing compatible technologies (iv) encouraging community and conservation measures (v) capacity building of communities staff (vi) incentives and awards to communities, individuals, organizations etc. for promoting biodiversity conservation (vii) education and awareness on biodiversity conservation.

Specific strategies for conservation of wild biodiversity would include (i) conservation of coastal aquatic fauna with emphasis on marine sea turtles, king crabs, water fowl and aquatic mammals (ii) strategy for conservation of ethno medicinal biodiversity (iii) strategy and action plan for conservation of sacred groves (iv) conservation of genepools of agri-diversity (v) conservation of fish and aquatic fauna diversity (vi) specific biodiversity conservation in eco regions viz. Mahendragiri (Gajapati district), Chilika lake, Gandhamardhan (Bargarh and Bolangir district) etc. In order to achieve our goal for long-term conservation of our genetic resources, we have to consolidate our national legal and policy framework on biodiversity and policy framework on biodiversity and environment.

REFERENCES

Orissa state Bio-diversity strategy and Action plan (2002) Nodal Agency: Nature and Wildlife conservation society of Orissa.

Wildlife wealth of Orissa, Government of Orissa, Forest Department, Wildlife Wing (1996)

BUTTERFLIES OF SIMILIPAL TIGER RESERVE : A PRELIMINARY STUDY ON SPECIES DIVERSTY, SPECIES COMPOSITION AND HABITAT PREFERENCE

M. V. Nair

ABSTRACT

Despite being an acknowledged repository of floral and faunal diversity, Similipal Tiger Reserve (STR) has been largely unstudied with respect to lower forms like invertebrates, even conspicuous and better-known insect groups like butterflies. The present ongoing study addresses to this gap in information, and aims to inventorise the available range of butterfly species diversity in STR. This paper discusses the results of preliminary surveys undertaken from March to December 2006, in the core area of the reserve. A total of 106 species belonging to 5 families and 15 sub-families were recorded from the study area. Nymphalidae was the dominant family with 42 species (39.6%), followed by Lycaenidae with 25 species (23.5 %), Hesperiidae and Papilionidae with 14 species each (13.4%) and Pieridae with 11 species (10.5%). Fifteen species were found exclusively in semi ever green forests, three species exclusively in open forests (dry deciduous forests and moist deciduous forests with < 40% canopy cover) and one species only in grasslands. *Graphium antiphates, Cyrestis thyodamas, Libythea lepita, Parathyma nefte, Mycalesis anaxias*, and *Cheritra freja,* whose known distributions are from Himalayan and North-eastern hills in northern India, and Western Ghat mountains in southern India have been recorded during the course of this study. These form significant range extensions and have been possibly recorded for the first time in peninsular India. This further substantiates the role of Similipal as a link habitat in peninsular India, and a possible historical corridor connecting north-eastern India and the Western Ghats. As more data is gathered and analysed during the future course of the study, more interesting patterns are expected to emerge.

Key words - Faunal diversity, butterflies, deccan peninsular zone, similipal tiger reserve, STR

INTRODUCTION

Similipal Tiger Reserve (STR) has been acknowledged as a significant repository of floral and faunal diversity as brought out by a series of studies Srivastava, 2001). But almost all the faunal studies have dealt with higher vertebrates. Apart from a few scattered studies on invertebrates (ZSI 1995; Sahu *et al*; 2006), no serious investigation into the invertebrate diversity has been carried out. This holds true for butterflies too, a conspicuous, colourful and better-known group of insects. Till date no comprehensive account of the butterflies of STR is available. The ZSI report (1995) mentions only five species belonging to two families, while Sahu *et al*; reported 21 species belonging to five families from Chahala range of STR. Sethy (2004) communicated from an unpublished study by ZSI that 42 species belonging to five families were recorded from Similipal Tiger Reserve (Swain, 2006). Nevertheless, given the total number of species that can potentially occur in peninsular India, all the above figures are doubtlessly underestimated ones. Hence, it was decided that a comprehensive survey be undertaken to sample the entire range of species diversity of butterflies that is found within the limits of STR. The initial surveys commenced from March 2006 and are currently under progress, the preliminary results of which are discussed in this paper.

STUDY AREA

Similipal Tiger Reserve is spread over a compact block of elevated plateau located in the central portion of the Mayurbhanj district, and lies between 21^0 16' and 22^0 20' north latitude and 86^0 01' and 86^0 39' east longitude, encompassing an area of 2,750 km^2 . It falls within the Deccan Peninsula zone in the biogeographic classification of Rodgers and Panwar. The altitude varies from 40 m to 1100 m with Khairiburu, the highest peak at 1,168 m. It is a high rainfall area with 1800-2900 mm precipitation in 135-158 days annually. Temperature ranges between 1^0C in winter to 39^0 C in summer. Similipal has a unique and diverse mixture of different types of forests such as northern tropical moist deciduous forest, northern tropical semi-evergreen forest, mixed deciduous hill forest, dry deciduous forest, grasslands and savannahs. Year round availability of water with numerous perennial rivers dotting the landscape is a

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characteristic feature of STR. The present study was taken up in the core area, comprising of seven ranges, viz. National Park, Chahala, Pithabata, Nawana North, Nawana South, Jenabil and Upper Barakamara covering a total area of 845 km^2.

Methodology

As the emphasis was on building up a database on butterfly diversity in the reserve, and not on arriving at relative abundances or density figures, sampling protocols like transects and point counts (Pollard, 1977; Southwood, 1978), which have been used in earlier studies, were not followed. Butterflies were recorded in an *ad libidum* basis, as and when encountered, either while driving along the forest roads or walking through the forest trails/foot-paths. The broad habitat type and the exact microhabitats of the butterflies were recorded for every sighting. Congregation areas like mud-puddling patches along river banks, and preferred flowering patches, flowering shrubs and trees were searched actively to cover maximum number of butterfly species. Random searches were carried out inside forest patches to detect elusive and cryptic species. Except for some confusing Hesperiids and Lycaenids, no attempt was made to collect any specimen; on the other hand, substantial effort was invested in photographing taxonomically confusing species for later identification. Nikon made (8 x 42) binoculars were used to identify butterflies in the canopy. Standard identification manuals and field guides (Bell, 1911-16; Evans, 1932; Kunte, 2000; Haribal, 1992; Wynter-Blyth, 1957) were used in conclusive identification of butterflies. Doubtful/inconclusive sightings were not taken into account and have been discarded from the final checklist.

Results and Discussion

A total of 106 species belonging to five families and 15 sub-families were recorded from the study area (see Table 1). Of them, Nymphalidae was the dominant family with 42 species (39.6%), followed by Lycaenidae with 25 species (23.5 %), Hesperiidae and Papilionidae with 14 species each (13.4 %) and Pieridae with 11 species (10.5 %) (Fig1). Fifteen species were found exclusively in semi - evergreen forests, three species exclusively in dry deciduous forests (and degraded forests with scrub) and one species only in grasslands (Table 2). Twenty six species were found in dense forests (both semi-evergreen forests and moist deciduous forests with canopy cover >40%), 24 species in open forests (moist deciduous forests with canopy cover <40% & dry deciduous forests), while 10 species were found both in open forests and grasslands put together (Fig.2). This preliminary analysis of habitat preferences of butterflies indicate that semi-evergreen forests are crucial in supporting certain habitat specialist species, while most of the common general species are able to use multiple habitat types. As more data is gathered about the relative abundance of butterfly species across these habitat types, a fine grain analysis will bring out species-habitat linkages more clearly.

Interestingly, species like *Graphium antiphates, Cyrestis thyodamas, Libythea lepita, Parathyma nefte, Mycalesis anaxias*, and *Cheritra freja*, whose known distributions (as recorded in the literature) are from Himalayan and North-eastern hills in the north, and Western Ghat mountains in the south, have been recorded during the course of this study. These form significant range extensions and have been possibly recorded for the first time in peninsular India. This further substantiates the role of Similipal as a link habitat in peninsular India, and a possible historical corridor connecting north-eastern Indian mountains and those of the Western Ghats.

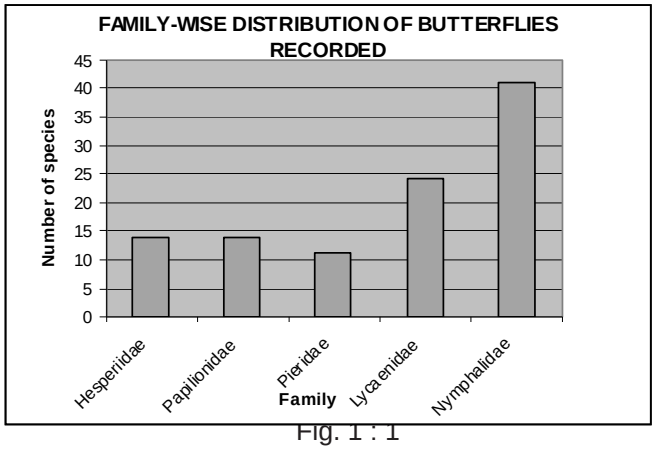

Fig. 1 : 1

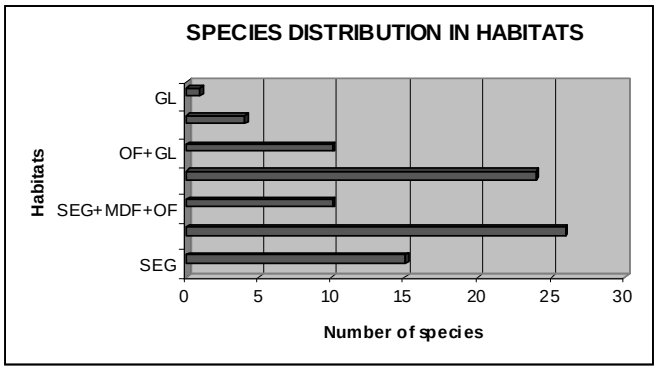

Fig. 2 : 1

Table - 1 : CHECK-LIST OF THE BUTTERFLIES OF SIMILIPAL TIGER RESERVE

Taxonomic Position Name	Habitat	Larval Food Plant
FAMILY HESPERIIDAE		
Sub-family Coeliadinae		
Common Banded Awl *Hasora chromus*	MDF, SEG, OF	Derris sp.
Brown Awl *Badamia exclamationis*	MDF, SEG, OF	Combretum extensum, Terminalia belerica (Combretaceae)
Sub-family Pyrginae		
C.Spotted Flat *Celaenorrhinus leucocerca*	MDF, SEG, OF	Eranthemum sp. (Acanthaceae)
Suffused Snow Flat *Tagiades gana*	MDF, SEG	Dioscorea sp. (Dioscoreaceae)
Water Snow Flat *Tagaides litigiosa*	SEG	Dioscorea sp. (Dioscoreaceae) and Smilax sp.(Liliaceae)
Common Small Flat *Sarangesa dasahara*	MDF,OF	Acanthaceae plants , esp. Blepharis sp.
Sub-family Hesperiinae		
Indian Skipper *Spialia galba*	GL,OF	Waltheria indica
Chestnut Bob *Iambrix salsala*	MDF,GL	Grasses and bamboo
Indian Palm Bob *Suastus gremius*	GL , OF	Phoenix acaulis
Grass Demon *Udaspes folus*	GL,OF	Curcuma sp., Zingiber sp. (Zingiberaceae)
Common Redeye *Matapa aria*	OF,GL	Bamboos (Graminae)
Giant Redeye *Gangara thyrsis*	MDF,OF	Palms (Palmaceae)
Dark Palm Dart *Telicota ancilla*	SEG,MDF	Bamboos (Graminae)
Rice Swift *Borbo cinnara*	GL,OF	Grasses
FAMILY PAPILIONIDAE		
Sub-family Papilioninae		
Common Bluebottle *Graphium sarpedon*	SEG,MDF	Polyalthia longifolia, Miliusa sp., Michelia doltsopa
Tailed Jay *G.agammemnon*	SEG,MDF	Polyalthia longifolia, Michelia doltsopa, Annona squamosa
Common Jay *G.doson*	SEG,MDF	Polyalthia sp., Michelia sp., Trachelospermum asiaticum
Common Rose *Pachliopta aristolochiae*	MDF,OF	Aristolochia sp. (Aristolochiaceae)
Common Birdwing *Troides helena*	SEG	Aristolochia sp. (Aristolochiaceae)
Spot Swordtail *Graphium nomius*	MDF,OF	Miliusa tomentosum, Polyalthia longifolia
Fivebar Swordtail *Graphium antiphates*	SEG	Annona sp., Miliusa sp.
Lime Butterfly *Papilio demoleus*	MDF,OF	Citrus sp. (Rutaceae)
Common Mime *Chilasa clytia*	SEG,MDF	Litsea sp, Alseodaphne sp.
Common Mormon *P.polytes*	SEG,MDF,OF	Citrus sp. , Murraya sp., Zanthoxylum sp. (Rutaceae)
Blue Mormon *Papilio polymnestor*	MDF,OF	Citrus sp, Glycosmis sp.
Yellow Helen *P.chaon*	SEG	Citrus sp. , Zanthoxylum sp. (Rutaceae)
Common Banded Peacock *Papilio crino*	MDF,OF	Chloroxylon swietenia

Paris Peacock *Princeps paris*	SEG	Citrus sp. , Zanthoxylum sp. (Rutaceae)
FAMILY PIERIDAE		
Sub-family Pierinae		
Psyche *Leptosia nina*	MDF,OF	Capparis sp., Crataeva sp. (Capparidceae)
Clouded Yellow *Colias croceus* #	??	
Indian Cabbage White *Pieris canidia*	MDF,OF	Cruciferaeceae
Common Gull *Cepora nerissa*	MDF,OF	Capparidaceae plants
Common Wanderer *Pareronia valeria*	SEG,MDF,OF	Capparis sp., (Capparidceae)
Chocolate Albatross *Appias lyncida*	SEG	Capparis sp., Crataeva sp. (Capparidceae)
Painted Jezebel *D.hyparete*	MDF,MDF	Loranthus sp.
Common Jezebel *D.eucharis*	MDF,OF	Loranthus sp., Viscum sp.
Sub-family Coliadinae		
Common Emigrant *Catopsila pomona*	MDF,OF	Cassia sp., Butea sp., Bauhinia sp. (Leguminosae)
Mottled Emigrant *C.pyranthe*	MDF,OF	Cassia sp., Butea sp., Bauhinia sp. (Leguminosae)
Common Grass Yellow *Eurema hecabe*	MDF,OF,GL	Cassia sp., Acacia sp., Caesalpinia sp., Albizzia sp.(Leguminosae)
FAMILY LYCAENIDAE		
Sub-family Theclinae		
Common Acacia Blue *Surendra quercetorum*	MDF,OF	Acacia sp.
Common Silverline *Spindasis vulcanus*	OF	Clerodendrum, Zizyphus
Common Leaf Blue *Amblypodia anita*	SEG,MDF,OF	Olacaceae plants
Yamfly *Loxura atymnus*	SEG,MDF	Dioscorea sp.
Common Imperial *Cheritra freja*	SEG	Numerous foodplants
The Monkey Puzzle *Rathinda amor*	MDF,OF	Ixora sp.
Common Red Flash *Rapala jarbas*	SEG,MDF	Rubus sp.
Sub-family Polyommatinae		
Common Caerulean *Jamides celeno*	SEG,MDF,OF	Derris, Xylia, Abrus and other Legumes
Dark Caerulean *J.bochus*	SEG,MDF	Xylia xylocarpa
Zebra Blue *Syntarucus plinius*	OF	Plumbago, Indigofera,Albizia, Sesbania
Common Pierrot *Castalius rosemon*	MDF,OF,GL	Zizyphus sp.
Angled Pierrot *Caleta caleta*	SEG,MDF	Zizyphus rugosa
Rouded Pierrot *Tarucus nara*	OF,GL	Zizyphus sp.
Grass Jewel *Zizeeria trochilus*	OF,GL	Oxalis sp
Pale Grass Blue *Pseudozizeeria maha*	GL	Oxalis, Legumes, Strobilanthes (Acanthaceae)
Common Hedge Blue *Acetolepis puspa*	SEG,MDF	Schleichera oleosa, Xylia xylocarpa
	Gram Blue *Euchrysops cnejus*	MDF,OF Phasiolus, Dolichos and other Legumes
Lime Blue *Chilades laius*	OF	Citrus sp.
Pea Blue *Lampides boeticus*	OF	Legumes
Plains Cupid *Chilades pandava*	GL	Xylia xylocarpa, Cycas sp.

Forget-me-not *Catochrysops strabo*	MDF,GL	Desmodium sp.
Red Pierrot *Talicada nyseus*	OF,MDF	Kalanchoe sp
Slate Flash *Rapala manea*	SEG,MDF	Acacia sp.
Malayan *Megisma malaya*	SEG	Allophyllus cobe (Sapindaceae)
Sub-family Riodininae		
Plum Judy *Abisara echerius*	SEG	Embelia sp., Ardisia sp. (Myrsinaceae)
FAMILY NYMPHALIDAE		
Sub-family Acraeinae		
Tawny Coster *Acraea violae*	OF,GL	Passifloraceae plants
Sub-family Satyrinae		
Common Evening Brown *Melanitis leda*	SEG,MDF	Oryza, Panicus, Apluda, Eleusine and other Grasses
Common Palmfly *Elymnias hypermnestra*	MDF	Bamboos and Palms
White-bar Bushbrown *Mycalesis anaxias*	SEG	Oryza, and other Grasses
Common Bushbrown *Mycalesis perseus*	SEG,MDF,OF	Oryza, and other Grasses
Darkbrand Bushbrown *M.mineus*	MDF	Microstegium, Capillipedium sp. and other grasses
Nigger *Orsotrioena medus*	MDF	Oryza, Imperata sp.
Common Fivering *Ypthima baldus*	MDF,SEG	Grasses
Common Fourring *Y.hubenri*	MDF,SEG	Grasses
Sub-family Charaxinae		
Tawny Rajah *Charaxes polyxena*	SEG	Tamarindus (Leguminosae), Saccopetalum tomentosum (Annonaceae),
Black Rajah *C.solon*	SEG,MDF	Tamarindus (Leguminosae)
Common Nawab *Polyura athamas*	SEG,MDF	Acacia, Delonix, Albizia, Caesalpinia, Adenanthera (Leguminosae) Grewia (Tiliaceae)
Sub-family Nymphalinae		
Angled Castor *Ariadne aradne*	MDF,OF	Ricinus communis
Common castor *A.merione*	MDF	Ricinus communis, Tragia
Common Leopard *Phalantha phalantha*	MDF,SEG	Flacourtia, Smilax
Indian Fritillary *Argyreus hyperbius*	GL, MDF	Violaceae herbs
Vagrant *Issoria sinha*	SEG,MDF	Not known
Yellow Pansy *Precis hierta*	OF,GL	Barleria, Hygrophila
Blue Pansy *P.orithya*	OF,GL	Justicia, Lepidagathis
Lemon Pansy *P.lemonias*	MDF,GL	Barleria, Sida
Peacock Pansy *P.almana*	MDF,OF	Acanthus, Barleria, Hygrophila
Grey Pansy *P.atlites*	MDF,OF	Barleria, Hygrophila
Chocolate Soldier *P.iphita*	SEG,MDF	Justicia, Hygrophila
Danaid Eggfly *Hypolimnas misippus*	MDF	Portulaca oleracea
Great Eggfly *H.bolina*	SEG,MDF	Sida, Portulaca,Elatostemma
Orange Oakleaf *Kallima inachus*	SEG	Strobilanthes sp
Common Map *Cyrestis thyodamas*	SEG	Ficus sp
Common Sailor *Neptis hylas*	SEG,MDF,OF	Bombax, Helicteres, Grewia, Flemingia, Mucuna
Chestnut-streaked Sailor *N.jumbah*	SEG	Grewia, Bombax, Xylia
Common Lascar *Pantoporia hordonia*	SEG,MDF	Acacia, Albizia
Colour Sergeant *Parathyma nefte*	SEG,MDF	Glochidion
Common Sergeant *P.perius*	MDF	Glochidion
Baronet *Symphaedra nais*	MDF,OF	Shorea, Diospyros
Common Baron *Euthalia aconthea*	MDF,OF	Mangifera, Anacardium

Grey Count *Tanaecia lepidea*	SEG,MDF	Melastoma malabathricum, Careya arborea
Commander *Moduza procris*	SEG,MDF	Mussaenda, Wendlandia
Sub-family Danainae		
Glassy Tiger *Parantica aglea*	MDF,OF	Tylophora, Cryptolepis, Calotropis
Blue Tiger *Tirumala limniace*	SEG,MDF	Vallaris, Dregea
Common Tiger *Danaus genutia*	MDF,OF	Tylophora, Marsdenia,Asclepias
Plain Tiger *D.chrysippus*	MDF,OF	Calotropis, Cryptolepis, Asclepias
Common Crow *Euploea core*	SEG,MDF,OF	Ficus, Sreblus, Hollarhena,Nerium, Ichnocarpus
Sub-family Libytheinae		
Common Beak *Libythea lepita*	SEG	Celtis sp. (Urticaceae)

recorded in an earlier study; confirmation desirable

Habitat Codes

SEG : Dense forests (Semi-evergreen & Moist-deciduous forests with >40% canopy cover)
MDF : Moist deciduous forests with <40% canopy cover)
OF : Dry deciduous forests and degraded forests with scrub
GL : Grasslands and Edges of grassland-forests

REFERENCES

Bell, T.R. (1911-1916) Common butterflies of plains of India (including those met with at hill stations of Bombay Presidency. J.Bombay Nat.hist.Soc. 19:16-58; 438-474;635-682;846-879. 20: 279-330;1115-1136; 21: 517-544,740-766,1131-1157; 22: 92-100,320-334,517-531, 23: 73-103,481-501, 24 : 656-665.

Boggs, C. L., Watt W. B. and Ehrlich (2003) Butterflies - Ecology and Evolution Taking Flight, The University Of Chicago Press Ltd, London.

Evans, W. H. (1932) *The identification of Indian Butterflies (Revised II Ed.)* Bombay Natural History society, Bombay.

Gaonkar, H. (1996) The butterflies of the Western Ghats with notes on those of Sri Lanka : Distribution and Status – A biodiversity assessment of a threatened mountain system. Unpub.document. Centre for ecological sciences, Bangalore.

Gilbert, L. E. and Singer, M. C. (1975.) Butterfly Ecology *A.Rev.Ecol.Syst*. 6 : 365-397.

Haribal, M. (1992) The butterflies of Sikkim Himalayas and their natural history. Sikkim Nature Conservation Foundation, Gangtok, Sikkim.

Kunte, K. (2000) Butterflies of peninsular India, Project Lifescape, Centre of Ecological Sciences, Indian Institute Of Science, Bangalore.

Pollard, E. (1997) A method for assessing changes in the abundance of butterflies. *Bio. Conserv*. 12 : 115-134.

Sahu,H.K., Jena,J., Dutta, SK and Rout,SD (2006) Common butterflies of Chahala Range of Simlipal Tiger Reserve, Orissa, India, *Indian Forester*, 132 (10).

Sethy,P.G.S. (2004) : Inventorisation of invertebrate faunal resources in Similipal Biosphere Reserve, Mayurbhanj, Unpublished official communication of Zoological Survey Of India, Berhampur to Director, STR.

Shahabuddin,G. (1993) Butterflies as indicators of habitat type and forest condition in Siruvattukkadu Kombei, Lower Palni Hills, W.Ghats, M.Sc dissertation, Salim Ali School of Ecology and Environmental Sciences, Pondicherry University, Pondicherry.

Southwood, T. R. E. (1978)Ecological Methods with special reference to the study of insect populations. Chapman & Hall, London.

Srivastava.S.S. (2001) Management plan of Similipal Tiger Reserve (2001-2011), Forest Department, Govt. of Orissa.

Swain,D. (2006) : Management plan of Similipal Tiger Reserve (Revised), Vol I &II, Forest Department, Govt. of Orissa.

Vane-Wright, R. I. and Ackerey, P. R. (1984) (Eds.). The biology of butterflies : Symposium of the Royal Entomological Society of London. Number 11. Academic Press, London.

Wynter-Blyth, M. A. (1957) Butterflies of the Indian Region. Bombay Natural History Society, Bombay.

ZSI (1995) : Fauna of Conservation Areas, No. 8 : Fauna of Similipal Tiger Reserve: Zoological Survey Of India : 105-127

SOIL AND CROP PRODUCTIVITY UNDER THE INFLUENCED OF PAPER MILL SLUDGE AND OTHER LIMING MATERIALS

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ABSTRACT

Soil acidity is one of the major limiting factors for improving crop productivity in Orissa. A significant part of area in Orissa is under acid soils and it necessitates the implementation of soil management practices like reclamation. Paper mill sludge has been found to be an ideal reclamation material in acid soils as it increases the soil pH and it is available in cheaper rates than other liming materials. Hence its usage has to be encouraged in large scale in areas nearer to the paper mills. The present paper discusses the types of liming materials and their advantages, and the impact of paper mill sludge on soil and crop productivity in Orissa.

Key words : Paper mill sludge, liming materials, soil acidity, soil and crop productivity.

INTRODUCTION

Acidic soils are characterized by low pH, low CEC (cation exchange capacity), low active clay, high phosphorus fixing capacity and high exchangeable aluminum. Soil acidity arises from exchangeable H and Al ions on colloid surfaces but soil solute acidity is attributed to absorbed H and Al ions in colloids (Harvey, 1989). Such soils, come under problematic soils as they restrict the crop productivity due to above characteristics. The main causes of soil acidity are i) acid parent material, ii) usage of acid forming fertilizers, (Martini and Mutters, 1985a). iii) release of CO_2 by plant roots, and iv) removal of calcium and magnesium either by plants or by excess precipitation (Sahu, 1993).

NEED FOR LIMING

A large chunk area of our country comes under acid soils (49 million hectares). Orissa possesses 4.5 million hectares of cultivable area of acid soils having the pH range between 4.5 to 5.5. Hence, lots of effort have to be made to enhance the productivity of these soils. Reclamation of acid soils is the right solution. The reclamation may be done with various liming materials.

Liming the agricultural land is an ancient practice. The advantages of liming have been recognized since time immemorial. A liming material is any compound capable of increasing soil pH by combining with hydrogen ions in the soil solution (Pradhan and Mishra, 1985). Although most agricultural liming materials contain calcium, it is the negatively charged component of the compound, i.e. the carbonate (CO_3^{-}), which actually neutralizes the acidity.

TYPES OF LIMING MATERIALS:

Various studies have been made on efficiency of liming materials on crop production. The commonly used liming materials are as follows:

- Calcite aglime : a ground lime stone composed mostly of calcium carbonate ($CaCO_3$).
- Dolomite aglime : a ground lime stone containing a mixture of calcium carbonate and magnesium carbonate ($CaCO_3$, $MgCO_3$).
- Hydrated or slaked lime: a liming material composed of calcium hydroxide {$Ca(OH)_2$} or a mixture of calcium and magnesium hydroxides.
- Quick lime or burnt lime: a liming material containing calcium oxide (CaO) or a mixture of calcium and magnesium oxides.
- Marl : a deposit of calcium carbonate ($CaCO_3$) derived from mollusk shells, and mixed with silt and clay
- Industrial by-products including slags, refuse sludges, and flue dusts : these materials commonly contain a high percentage of calcium carbonate ($CaCO_3$), although the slags are mostly calcium and

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magnesium silicates ($CaSiO_3$, $MgSiO_3$). Flue dusts may contain a substantial quantity of oxides.

QUALITY PARAMETERS OF LIMING

The lime quality is judged by how effectively it raises the soil pH to a desirable level within three years. Two properties of lime influence its quality: Purity (percent calcium carbonate equivalent) and fineness (particle size). These two factors are used to calculate the neutralizing index, a measurement of the relative value of the liming material. The calcium carbonate equivalents for several commonly used liming materials are given in Table1 (Peters *et al.*, 1996). The calcium carbonate equivalent is directly proportional to the effectiveness of the liming material in neutralizing pH.

Table -1 : Relative neutralizing values of some common liming materials containing no contaminants

Material equivalent (%)	$CaCO_3$
Calcite lime ($Ca\ CO_3$)	100
Dolomite lime [$Ca\ Mg(CO_3)$]	109
Hydrated or slaked lime [$Ca\ (OH)_2$]	136
Quick lime or burnt lime (Ca O)	179
Slag ($Ca\ Si\ O_3$)	86

The lime requirement of a particular soil depends upon its pH, buffering capacity, textural class and organic matter content of the soil. Generally 25 to 50 % of lime requirement is recommended, which is determined either by chemical test or textural class. The lime requirement of different textural classes is given in Table 2.

Table 2 : Lime requirement based on soil texture

Soil textural class	Lime (Pure $Ca\ CO_3$ needed in t/ha)
Sandy, loamy sand	1.0
Sandy Loam	1.75
Loam	2.50
Silt loam	3.50
Clay and Clay loam	5.0

IMPACT OF LIMING ON SOIL PROPERTIES:

The experimental results revealed that after lime was applied to the soils, pH and exchangeable Al + H and K, plant available Fe, Mn, Zn and Cu decreased drastically (Metin Turan, 2005). With CaO application, the maximum of the soils' pH, available Fe, Mn, Zn and Al was obtained at the highest dose (200 % lime requirement), but in view of the other soil properties, CaO and MgO effectiveness were similar. (Table 3).

Table 3 : Effects of liming on soil properties

Soil Properties	Initial soil test value	Lime doses of lime requirement (%)											
		CaO				MgO				CaO + MgO			
		0	50	100	200	0	50	100	200	0	50	100	200
PH (1 :2.5)	4.2	4.2	6	6.9	7.7	4.2	5.7	6.7	7.3	4.2	5.8	6.7	7.4
Ca (cmol/kg)	7.8	7.8	9.7	13.1	17.9	7.8	7.2	7	6.5	7.8	8.1	9.6	12.4
Mg (cmol/kg)	2.6	2.6	2.2	2	1.9	2.6	5.4	8.2	13.6	2.6	3.7	5.1	6.9
K (cmol/kg)	0.3	0.3	0.3	0.25	0.22	0.3	0.28	0.25	0.2	0.3	0.28	0.2	0.2
Al +H (cmol/kg)	12.1	12.1	10.3	8.1	3.1	12.1	9.7	7.2	2.6	12.1	10.6	7.9	3.4
Fe (ppm)	33.6	33.6	18	12.2	3.6	33.6	23.5	13	4.2	33.6	23	18	3.8
Mn(ppm)	26.1	26.1	14.8	9.6	2.5	26.1	14.1	9.5	3.7	26.1	10.2	8.4	3.4
Zn (ppm)	3.2	3.2	1.1	0.6	0.5	3.2	1.6	1.5	1.4	3.2	1.9	0.8	0.8
Cu (ppm)	1.6	1.6	1.5	1.5	1.3	1.6	1.5	1.4	1.1	1.6	1.3	1.5	1.1

IMPACT OF LIMING ON PLANT NUTRIENT STATUS

Nitrogen, P, K, Ca and Mg contents of plant were found to be increased by increasing rates of lime application. This may be attributed to basal fertilizer and lime material application. (Metin Turan, 2005 ;Reith, 1983; Martini and Mutters, 1985b; Feger *et al.*, 1991). However, the content of Fe, Mn, Zn and Cu of plants decreased with the lime material application (Table 4).

Table 4: Effect of different liming materials on mineral composition of plants

Lime	Doses *	%	ppm								
materials		N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
CaO	0	2.71	0.27	4.03	0.46	0.46	0.14	176.5	70.7	108.0	22.3
	50	3.33	0.35	4.23	0.57	0.74	0.16	148.9	61.3	92.0	18.0
	100	3.46	0.43	4.21	0.68	0.97	0.15	142.2	56.0	80.0	15.0
	200	3.92	0.49	4.08	0.67	1.16	0.15	114.7	54.6	73.7	13.3
	Mean	3.36	0.39	4.14	0.60	0.83	0.15	145.6	60.7	88.4	17.2
MgO	0	2.73	0.27	4.06	0.45	0.47	0.15	170.4	69.3	108.6	21.3
	50	3.15	0.35	4.24	0.73	0.58	0.14	143.9	60.3	98.0	16.3
	100	3.26	0.44	4.18	1.07	0.65	0.15	114.1	58.0	89.3	13.7
	200	3.72	0.42	4.09	1.31	0.65	0.16	104.3	58.3	80.3	13.0
	Mean	3.22	0.37	4.14	0.89	0.59	0.16	133.2	61.5	94.1	16.1
CaO + MgO	0	2.73	0.28	3.96	0.45	0.47	0.14	173.8	72.3	109.3	21.7
	50	3.24	0.34	4.25	0.62	0.69	0.15	149.4	64.6	99.0	17.0
	100	3.48	0.43	4.29	0.74	0.76	0.15	134.8	59.7	87.6	14.3
	200	3.75	0.44	4.21	0.95	0.88	0.15	129.5	53.3	82.0	13.3
	Mean	3.30	0.37	4.18	0.69	0.70	0.15	146.6	62.5	94.5	16.6

STUDIES ON LIMING IN ORISSA

The positive impact of liming on iron toxic acid soils of Orissa has been reported by several researchers. Lime application @2 t/ha when applied in combination with Boron and Molybdenum has resulted in enhancement of pod yield, oil content and oil yield of groundnut compared to that of sole Boron application (Sahu *et al*., 1995). The application of lime to acid soils at right dose and time increases crop yield significantly over control (no liming). Research results revealed that the liming of acidic red and lateritic soils of Orissa (pH < 5.0) with 50 % lime requirement as lime sludge produced higher crop yields in redgram (138%), mustard (68%), greengram (59%), cowpea (46%), ginger (39%), soyabean (32%), groundnut (30%) and maize (29%) over no lime application (Sahu,1994).

What is Paper Mill Sludge ? Sludge is the solid residue that remains after wastewater is treated at pulp and paper mills. It is composed of input materials for making paper, which are primarily wood fiber, lime, clays, as well as excess organisms produced as part of the wastewater treatment process.

How does sludge benefit the soil?

Land application of pulp and paper sludge can benefit the soil in many ways. It can add valuable nutrients to the soil such as nitrogen, phosphorus, potassium, and trace elements. Sludge can also contain a significant lime value which helps to raise the pH of acidic agricultural soils. Finally, sludge can add organic matter to soils which can improve a soil's water holding capacity, permeability and tilth, and help to reduce soil erosion.

The beneficial reuse of pulp and paper sludge has been a common practice for many years. Sludge has been used for many purposes, including agricultural horticultural, and silvicultural production, and reclamation of disturbed lands. Applying sludge can provide important nutrients and other benefits to the soil that are not provided by many chemical fertilizers.

There has been tremendous potential to utilize the paper mill sludge as liming material in Orissa because of following reasons:

1. It is available free of cost, hence the cost of reclamation includes only the transportation charges.

- The farmers located nearer to Paper mills (For example, farmers in Rautrapur village, Orissa are in close proximity of Emami paper mill) will get the material easily.
- This practice not only helps in chemical reclamation of acid soils but also enhances the water holding capacity and organic matter content of these soils. This would be of great advantage to poor upland farmers of Orissa.
- There is a huge production of paper mill sludge by paper mills located in Orissa (>1.2 lakh tones)

RESEARCH STUDIES ON PAPER MILL SLUDGE

Several research studies have been conducted to assess the impact of paper mill sludge on crop productivity. Majority studies reveal that the paper mill sludge enhances the crop productivity of the crops, especially in uplands. The research trials conducted at Regional Research Station, Semiliguda, Koraput during 1981-82 in acid red soils (Sahu and Nanda, 1988) revealed that ginger (additional yield of 2,869 kg/ha), arhar (additional yield of 476 kg/ha), mustard (additional yield of 439 kg/ha) and wheat (additional yield of 1220 kg/ha) exhibited very favourable response in terms of economic yield. Ginger and arhar resulted in generating a net profit of Rs. 5,338/- and Rs.1,266/- respectively (Table 5) with the application of paper mill sludge compared to the control (no paper mill sludge). Similarly, other crops like finger millet, cowpea, sorghum, soyabean, blackgram, pearl millet, and groundnut responded positively to the practice of paper mill sludge application @5 t/ha. The sludge was collected from JK Paper Mills Ltd, Rayagada and was applied 15 days before sowing of the crops.

Table 5 : Additional yields and net profits of various crops with paper mill sludge application

Crops	Yield (Kg/ha) with out PMS	Yield (Kg/ha) with PMS	Additionla yield (Kg/ha)	Net profit (Rs./ha)
Arhar	344	820	476	1266
Mustard	643	1082	439	917
Greengram	175	278	103	-40
Wheat	2174	3394	1220	820
Finger millet	1419	2268	849	449
Cowpea	2192	3204	1012	612
Sun flower	238	333	95	-115
Sorghum	1267	1759	492	584
Ginger	7428	10,297	2869	5338
Soyabean	520	700	180	230
Blackgram	392	518	217	41
Pearl millet	1067	1384	317	234
French bean	724	922	198	95
Groundnut	463	593	130	120
Kharif potato	4984	5951	967	567
Rice	1350	1192	142	258
Turmeric	8263	8399	136	-128
Castor	138	138	-6	-406

Time of application of paper mill sludge: Investigations made by Sahu and Senapati (1997) resulted in higher pod yield of groundnut and redgram in upland conditions when a single dose of lime sludge was applied @ 0.5LR and 0.25LR as basal application (15 days before sowing). The split dose of application of lime sludge has not shown any positive effect. Sahu (1988) also reported that the ideal time of application of lime material, including lime sludge, is 20 days before sowing. The yields of redgram (arhar) got improved significantly with the application of paper mill sludge up to 20 days before sowing (Table 6) in upland acid soils of Orissa.. Even the exchangeable aluminum got reduced when lime sludge was applied 20 days before sowing.

Table 6: Effect of lime sludge and calcite lime stone on yield of redgram (arhar) at different days of application

Treatments	
A. Liming materials	Arhar yield (kg/ha)
(i) Lime Sludge	1467
(ii) Calcite lime stone	1483
S.E.M	61
C.D.(0.05)	N.S
B. Time of application (Days before sowing)	
(i) 0	1150
(ii) 5	1356
(iii) 10	1339
(iv) 15	1467
(v) 20	1575
(vi) 25	1611
(vii) 30	1786
S.E.M	113
C.D (0.05)	332

Pollutants released by paper mill effluent

Fig- 1: Concerns about pollutants in Paper mill sludge:

No doubt, the paper mill sludge contains some of the pollutants like arsenic, nickel, mercury, selenium and lead. However, they are present in very minute quantity which will not affect the ground water quality. In some countries regulations have been made to utilize the paper mill sludge within the critical limit decided for agricultural soils (Table 7). As long as we follow these critical limit standards, there will not be any problem as of pollution is concerned. In majority cases, the sludge samples have very low doses of heavy metals.

* = "Can pose a significant hazard"[6] n/a = Not available n = Number of sludges sampled

Source: Anonymous,

CONCLUSION

Tremendous potential is there for utilizing the paper mill sludge in order to the acid upland soils of Orissa due to its low cost compared to other liming materials. As it enhances the crop productivity and net returns to the farmers, the application of Paper mill sludge would be of great advantage to the poor farmers of this state. The application procedure of paper mill sludge has already been scientifically determined; hence its adoption in large scale in all the areas in the proximity of paper mill is the need of the hour.

Table 7: Heavy Metals present in various paper mill sludge samples

Metal	Concentration of metals in sludge sample (ppm)						
	Celgar sludge (n=3)	Celgar composted sludge (n=3)	Powell River primary (n=3)	Powell River secondary (n=3)	Paprican range primary	Paprican range secondary	CMCS limit for agricultural soils
Arsenic	0.14 - 0.18	0.07 - 3.3	0.09 - 1.7	0.2 - 0.98	0.5 - 1.1 (n=1)	0.9 (n=4)	20 ppm
Chromium	15 - 19	28 - 31	17 - 29	31 - 46	Aug-73 (n=8)	20 - 40 (n=3)	750 ppm
Cobalt	<1 - 2	3-Feb	<1 - <5	<1	<1 - 4 (n=2)	<1 (n=1)	40 ppm
Copper*	24 - 26	3-Feb	15 - 26	30-Dec	Nov-46 (n=6)	14 - 65 (n=4)	150 ppm
Lead	5-Apr	8-Jun	<1 - <10	<4 - <10	Mar-92 (n=6)	May-37 (n=4)	375 ppm
Mercury	0.46 - 0.59	0.39 - 0.50	0.02 - 0.19	0.14	0.02 - 0.1 (n=4)	0.1 - 1 (n=2)	0.8 ppm
Molybd enum*	<4	<4	<4 - <20	<4	<2 (n=2)	<10 (n=1)	5 ppm
Nickel*	24 - 30	26 - 32	7 - <10	<2 - 9	Aug-56 (n=6)	Sep-38 (n=4)	150 ppm
Selenium	<0.5	<0.5	<0.5 - <2	<0.5 - <2	0.05 - 2.7 (n=4)	n/a	2 ppm
Zinc*	140 - 172	154 - 169	26 - 83	30 - 79	30 - 94 (n=6)	88 - 475 (n=4)	600 ppm

REFERENCES

Anonymous (1997) What We Know about Sludge, Grate Ash and Lime Dregs A Reach for Unbleached! Working Document - March 12, 1997.

Feger K H, Zöttl H W and Brahmer G (1991) Assessment of the ecological effects of forests fertilization using an experimental watershed approach. Fert. Res. 27: 49-61.

Harvey H H (1989) Effects of acidic precipitation Lake ecosystems. In: D.C. Adriono and A. II. Johonson .

Acidic Precipitation. Vol. 2. Biological and Ecological effects. Springer,Berlin : pp137-164.

Marini J A and Mutters R G (1985) a. Effect of lime rates n nutrient availability, mobility and uptake

during the soybean growing season; 1. Aluminium, Manganese and Phosphorus. Soil Sci. 139 : 219-216.

Marini J A and Mutters R G (1985) b. Effect of lime rates n nutrient availability, mobility and uptake

during the soybean growing season; 2. Calcium, Magnesium, Potassium, Iron, Cooper and Zinc. Soil Sci. 139 : 333-343.

Peters J B, Kelling K A and Schulte E E (1996). Choosing between liming materials. A3671. Cooperative

extension publications, University of Wisconsin-Extension.

Pradhan N and Misra C P (1985) J.Indian Soc. Soil Sci. 33 : 885-869.

Reith J W S (1983) Trace elements in soil and herbage. Norgrass. No:23

Sahu S K (1988) Liming management of upland acid soils with respect to the source & time of application.

Indian Journal of Agricultural chemistry. Vol. XXI (3) : 227-229.

Sahu S K (1994) Management of acid soils for higher yield. Rural Link 1993-1994. P : 3-5.

Sahu S K, Dhal J K, Das B B and Das P K (1995) Response of groundnut to boron with and with out

molybdenum and lime in lateritic soils (Aeric Haplaquept) in Orissa, India. IAN 15 : 79-80.

Sahu S K and Senapati H K (1997) Effect of basal and split application of lime sludge in an intercropping

system of Pigeon pea and groundnut in acid clay loam soil of Orissa. Indain J. agric. Chem. 30 (1) : 41-42.

RICE BASED CROPPING SYSTEMS UNDER IRRIGATED ECOLOGY IN INDIA - AN OVERVIEW

S. K. Samantarai[1] and Dinesh Chandra[2]

A B S T R A C T

Due to new rice (Oryza Sativa L.) varieties and modern technology, the yield of rice in India have been rising steadily. But there is still tremendous scope for increasing productivity through proper adjustment in cropping system under irrigated ecology to meet the food requirement of ever increasing population. Among different types of crop sequences, the present study reveals that the Rice – Wheat crop sequence is the most important which amounts to 9.5 mha. Uttar Pradesh (45%), Bihar (17%), Punjab (16%), Haryana (5%) and West Bengal (3%) possess about 95 percent area of Rice–Wheat–Green gram followed by Rice–Gram– Mustard are identified as the most profitable cropping systems.

Keywords : Rice Production, Irrigated ecology nutrient management, cropping system, crop rotation, crop sequences,

INTRODUCTION

Rice (Oryza Sativa L.) is the major crop of irrigated as well as favourable rainfed areas of the World, particularly in the humid and sub humid tropics under varied ecosystems and different environmental conditions. Due to new rice varieties and developed technologies, the rice yields all over Asia have been rising steadily, but there is still tremendous scope for increasing productivity per unit area per unit time and per unit amount of water and other inputs. Development of photo–thermo insensitive, high yielding rice varieties of early growth duration and assured water supply has facilitated multiple cropping involving a wide range of crops which could be grown in quick succession. In areas of assured water supply there is immense scope for recasting cropping system and for developing moisture conservation and water use practices to maximise income from every unit of water and land. Many low yield environments for cereals may transform to high productivity system covering oilseed and pulses crops through proper adjustments in cropping systems. The cropping systems area and their contribution to national food production is presented in Table – 1.

Table 1 : CROPPING SYSTEMS, AREA AND THEIR CONTRIBUTION TO NATIONAL FOOD PRODUCTION IN INDIA

Crop Sequence	Area (M.ha)	Contribution (%)
Rice – Wheat	9.77	25
Rice – Rice	2.12	5
Cotton –Wheat	1.39	2.4
Pearl Millet Sorghum	1.35	1.7
Maize Wheat	1.29	2.3
Pearl-Millet-Wheat	1.03	1.7
Sorghum – Sorghum	0.74	1.7
Rice gram	0.59	0.8

Source **:** 50 years of crop science research in India, ICAR, 1996.

RICE GROWING ECOSYSTEM

In India rice is generally grown in two situations mainly under rainfed (up land and low land) and irrigated under different soils. In rainfed ecosystem sole crop of rice is generally grown but in some areas of rainfed situation dry crops are gentally grown after rice. In case of well irrigated or uniformly distributed rainfall situations two or three vice crops are grown. Growing of two or three rice crops in a year causes problems of nutrient management. Particularly in Punjab, Hariyana & Western U.P. rice–wheat sequence causes depletion of ground water level and detoriate soil health.

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In hilly and rainfed upland condition the major rice based cropping systems are rice-fallow, rice-pulses, rice oil seeds while in irrigated conditions the major cropping systems in northern part of the country is rice–wheat followed by rice–potato, rice–pulses, rice–oilseeds. Under southern part of the country the major rice based cropping with irrigated condition in rice-rice, rice-rice-rice and rice-irrigated dry crops. To make rice based cropping systems more economic there is urgent need to use integrated nutrient management and also find out some more efficient cropping systems for sustainable agricultural productivity.

MODERN TECHNOLOGY FOR RICE CULTIVATION

Proper land preparation and seed bed preparation are essentially required to achieve optimum germination, proper seeding establishment, adequate plant density and yield. Under well puddled condition, transplating about three weeks seedlings (2-3 seedlings/hill) at 20 x 10 or 20 x 15 cm spacing with shallow depth gives higher yield of paddy. Alternatively use of sprouted seeds of suitable rice varieties by rwo seeder with a seed rate of 55 kg/ha in puddled condition while in rainfed upland conditions use certified seed at the rate of 90 kg/ha when optimum moisture prevails in soil for germination and given proper weed control.

NUTRIENT MANAGEMENT

Intensive cropping systems are highly exhaustive for soil nutrients. When two or more crops are grown in sequence with higher inputs secondary micro and macro-nutrients are removed in large quantities from soil. Further use of fertiliser creates deficiency of secondary and micronutrients over the period. Application of phosphorus to winter crops and growing rainy season crops on residual phosphorus have been recommended in most of the soils. Hence the sustainability of cropping system depends mostly on nutrient management practices.

IMPORTANT RICE BASED CROPPING SYSTEMS IN INDIA

Rice–wheat crop sequence is the most important cropping system in India under irrigated situation, which amounts to 9.5m.ha. Punjab (16%), Haryana (5%), Uttar Pradesh (45%), Bihar (17%) and West Bengal (3%), Possess about 95 percent areas of Rice–wheat system. Second most important rice based cropping system in India is Rice-Rice Particularly in Andhrapradesh, Karnataka, Tamilnadu and Kerala followed by oilseeds and pulses. State wise area under different rice based cropping systems in India is presented in Table-2. It reveals from Table -2that in the rice based cropping system Rice–vegetables is grown in the states like Orissa, West Bengal, Gujrat, Tamilnadu and Maharastra particularly under irrigated medium lands situations.

Table - 2 : Area under different rice based cropping systems in India

Cropping system	State	Area ('000 ha)
Rice–wheat	West Bengal	233.1
	Uttar Pradesh	4122.7
	Gujarat	248.7
	Punjab	1750.0
	Madhya Pradesh	594.8
	Jammu & Kashmir	305.5
	Himachal Pradesh	58.3
	Haryana	867.0
	Bihar	1511.1
	Maharashtra	56.1
	Assam	100.0
	Total	9847.3
Rice–Rice	Andhra Pradesh	1393.0
	Kerala	143.3
	Tamil Nadu	2145.2
	Assam	1131.0
	Orissa	139.5
	Gujarat	257.3
	Karnataka	684.7
	Total	5894.0
Rice–fallow	Bihar	1554.0
	Karnataka	242.0
	Madhya Pradesh	2038.1
Cropping system	State	Area ('000 ha)
	Jammu & Kashmir	127.0
	Maharashtra	458.8
	Total	4419.9
Rice–vegetables	Orissa	100.0
	West Bengal	941.9
	Gujarat	90.7
	Tamil Nadu	20.9
	Maharashtra	89.1
	Total	1243.5
Rice–groundnut	Tamil Nadu	760.1
	Maharashtra	5.1
	Andhra Pradesh	188.0
	Orissa	14.7
	Karnataka	55.0
	Total	1022.9

Rice–lathyrus	Madhya Pradesh	862.0
	Bihar	88.0
	Total	950.
Rice–mustard	Uttar Pradesh	35.8
	Madhya Pradesh	52.0
	Bihar	12.0
	Orissa	22.6
	West Bengal	358.3
	Total	480.7
Rice–chickpea	Uttar Pradesh	78.5
	Orissa	24.5
	Maharashtra	105.9
	Total	208.9
Rice–blackgram	Andhra Pradesh	367.0
	Orissa	231.9
	Total	598.9
Rice–green gram	Karnataka	19.0
	Andhra Pradesh	143.0
	Orissa	435.5
	Total	597.5
Rice–sugarcane	Gujarat	370.4
	Tamil Nadu	10.2
	Bihar	52.0
	Total	432.6
Rice–potato	West Bengal	462.4
Rice–chickpea	Madhya Pradesh	304.0
Rice–horsegram	Orissa	245.9
Rice–jute	West Bengal	120.1
	Total	27915.0

(Source : Yadav, 2001)

Three crop sequences involving rice in Kharif, wheat, patato and mustard in Rabi and green gram sesame in summer season have been recommended and common practice in the states like West Bengal, Orissa, Andhra Pradesh. The potential rice–based cropping systems are rice–wheat,–green gram, rice–rai/potato–green gram, rice–maize, Jute–rice–wheat, are identified as promising cropping systems under irrigated conditions in Bihar. For Madhya Pradesh rice–gram–cowpea/okra, rice–linseed–cowpea and rice–wheat–green gram are identified are promising croppin gsystem under irrigated conditions. Rice –Wheat cropping system is the most common sequence in eastern Uttar Pradesh, each crop occupies nearly 70% of the area. However,, rice–wheat–green gram followed by rice–gram–mustard are identified as the most profitable crop rotation for irrigated areas. In Assam rice–rice–mustard, rice-mustard–potato and rice–wheat are generally followed as crop rotation in rice based cropping systems. (Table - 3).

Table - 3 : MAJOR CROPPING SYSTEMS IN DIFFERENT ZONES OF INDIA

Zone	States	Major Cropping systems
I	Himachal Pradesh,	Maize - Fields pea/lentil
	Jammu & Kashmir,	Rice-Lentil/Field pea;
	Parts of Punjab	Maize - G.G./B.G.
		Rajmash (Kh) - Cabbage/ Cauliflower
		Potato - Rajmash (Kh)
		Pp - Wheat
		PP + B.G./Greengram
		Greengram – Wheat
II	Assam, Himalayan areas of	Rice (Ahu) – Bengalgram/ Greengram (Kh)
	W.B., Darjeeling	
	Siligori, Jalpaigori, Cooch	Rice(Sali) - Lentil/Field pea
	Bihar and West	
	Dinazpur of W.B., NE	Maize -Pigeonpea
	Himalan region	
	Meghalaya Thripura	Maize - Blackgram
	Manipur, Mizoram,	
	Arunachal Pradesh	Jute - Pea/Lentil pea
		Maize + Pigeonpea
		Rice - Lathyrus
III	Lower Gangetic plain region,	Jute - Lentil
	West Bengal,	
	Bihar and parts of Eastern	Rice - Lentil
	U.P.	Rice - Chick Pea
		Rice - Pigeon pea
		Blackgram - Wheat
IV	Middle Gangetic Plain	Maize - Lentil/pea/chick pea
	consists of U.P.	Rice-Chickpea/Lentil/Pea,
		Bengalgram/Greengram–Wheat,
		Bengalgram/Greengram–Oil Seed
		(Mustard/Linseed)
		Sorghum/Pigeonpea
		Maize Chickpea/Lentil+linseed
		Rice-Wheat-Greengram
		Sugarcane-Greengram
		Potato/Mustard–Greengram/ Bengalgram
		Pigeonpea - Wheat
		Wheat/Rice-Chickpea

		(Fieldpea/lentil+ Mustard)
		Rice-Chickpea + Mustard/ Lentil
		Wheat-Chick pea + Mustard.
V	Upper Gangetic Plain (Western U.P.)	Maize-Chickpea
		Rice - Chick-pea
		Pigeon Pea - Wheat
		Rice-Potato-Greengram/ Bengalgram.
		Rice/Maize - Chickpea+Mustard
		Sugarcane+Greengram/ Bengalgram.
		Pearl millet + Bengalgram - chickpea/Lentil
VI	Haryana, Punjab and Rajasthan	Pigeonpea - Wheat, Pigeonpea + Bengalgram.+ Greengram
		Rice-Wheat-Greengram (Summer)
		Sorghum+moth-Wheat
		Cotton+Bengalgram/ Greengram-wheat/Mustard
		Pealmillet + Bengalgram/ Greengram-wheat
		Fallow-Chickpea (Rajasthan)
		Maize - Chickpea - Groundnut-wheat (two years rotation)
		Clusterbean - wheat
		Pearlmillet + Clusterbean-Mustard
		Perlmillet – Chickpea + Mustard
		Pearlmillet/moth/BG/GG/ Ggram/Cow Pea/Chickpea/Wheat
VII	Eastern Plateau dand hill region Chotanagpur plateau and Santhhal Pargana of Bihar, Chhatisgarh and Bastar area of M.P. and Eastern Vidarbha Zones	Maize/rice-Lentil/feildpea/ chickpea
		Maize/rice+pigeonpea
		Maize/Blackgram–Wheat
		Rice-Lathyrus
		Jowar +pigeonpea
		Rice – Chickpea
VIII	Central Plateau and hill region of M.P., Semiarid and eastern Plain	Sorghum + pigeonpea
		Maize + Bengalgram/ Greengram
	Rajasthan, Southern and Eastern humid region of Rajasthan	Rice - Chick pea
		Rice - wheat - Greengram
	Bundelkhan region of U.P.	Rice/Maize-Chickpea/lentil/ pea
		Rice/Maize - Chickpea/lentil/Mustard/ Linsed 1
IX	Malwa Plateau (Indore) Nimar vally	Cotton + Pigion pea G:1 or 8:1
		Sorghum + pigeonpea 2:1 or 3:1
	Hills zone of M.P. and Western Ghat, Sub-mountain and Western Maharastra Plain, scarcity zone Central Maharashtra and Central Vidarbha	pigeonpea + Bengalgram/ Greengram
		Mustard/Urd-Rabi Jowar
		Cotton/Sorghum + Chickpea/ Lentil
		Sugarcane+Greengram/ Bengalgram
X	Southern Plateau and hill region of Northern Telangana and Nandyal districts of A.P. and parts of Karnataka and Tamilnadu	Sorghum + pigeon pea
		Pearlmillett + Pigeon pea
		Groundnut + Pigeonpea
		Sorghum-Chick pea
		Greengram/Bengalgram-Safflower
		Cotton/Sorghum-Bengalgram/ G.gram
		Pearlmillett - Horsegram
		Sorghum/Castor+Cowpea
XI	East Coast Plain and hill region of A.P., T.N. and Pondicherry and Orissa	Rice-Greengram/ Bengalgram(Rice fallows)
		Sorghum + Greengram./ Bengalgram
		Cotton + Greengram+ Bengalgram

		Pegeion pea - Maize - Groundnut Tapioda - Greengram/ Bengalgram Rice-Rice-Greengram
XII	West Coast Plains and Ghat region, parts of Maharashtra, Karnataka, Kerala and T.N.	Rice-Cowpea/Blackgram-fallow Rice-Chickpea-Western Ghats of Maharashtra
XIII	Gujarat Plains and Hill region	Moong-Tobacco Sorghum + Blackgram/ Greengram Pearmillet/Groundnut/ Sorghum + pigeon pea Pearmillet - Chickpea Cowpea + mustard
XIV	Western Dry parts of Rajasthan	Pearlmillet/Greengram/ Clusterbean/ Safflower + chickpea Cenchrus + month/cluster grass Moong-Tobacco Sorghum+Blackgram/ Greengram Pearmillet/Groundnut/ Sorghum + pigeon pea Pearmillet - Chickpea Cowpea + mustard Pearlmillet/Greengram/ Clusterbean/ Safflower + chickpea Cenchrus + moth/cluster grass Not common Some parts Greengram-rice rotation is followed.

CONCLUSION

Rice is the most staple food of millions of people throughout the world and more particularly in India. Degradation of resources like soil and water, declining use efficiency of inputs and dwindling profit margin to the grower prompted the researches to advocate development of ecologically and economically viable rice based cropping systems. Balanced and efficient fertilizer application is essential to compensate for the increased yields and greater removals of soil nutrients. Use of all other resources of plant nutrients to complement and supplement the mineral fertilizer should also be adopted under integrated plant Nutrition system. It aims at sustainable crop production levels with minimum deleterious effect of chemical fertilizers on soil health and least disturbance to the rice ecosystems by the combined use of inorganic fertilizers and organic manures.

India's self sufficiency in food grain production in the middle of tenth five year plan now calls for diversification of crops and cropping systems. The rice based cropping systems of one state can also be tried on other states under irrigated condition after conducting research in these aspects. In response to commercialization of agriculture, it will be important to shift from routine food grain production system to newer crops within suitable varieties and cropping systems to meet ever increasing demand of rice, pulses, oil seed, fodder fruits, vegatable, flowers, cented grass and other commercial crops and make agriculture on attractive and profitable business. Now it is essential to involve the farmers in technology assessment of rice based cropping systems to go through the test of socio-economic environment stress around the farmers. Further the genotypes can be evaluated under actual rice sequential cropping situations to find its suitability in systems approach. No doubt this is a challenging task in front of the agricultural scientist which is the need of the hour. The newer cropping systems will also generate more income to the farmers and enhance the employment opportunities among rural unemployed youth.

REFERENCES

B. Mishra, High yielding rice varieties of India (2000) DRR Bulletin 2001 (1), Rajendranagar, Hyderabad-200030 : 102.

R.L Yadav and Subba Rao (2001) Atlas of Cropping Systems in India. Project Directorate for cropping systems Research, Modipuram, Meerut - 250110, Bulletin No : 96.

Annual Progress Report(2003) Agronomy, Soil Science & Physiology). DRR, Rajendra Nagar, Hyderabad-500030: 3.

S.V. Subbaiah and R.M. Kumar (2005) Rice Based Cropping systems in Irrigated Rice of different states of India, DRR, Rajendranagar, Hyderabad-500030 : 1-17.

INDIGENOUS PHYTOTHERAPEUTICAL LEADS FROM THE TRIBALS FOR ASTHMA AND RESPIRATORY DISORDERS

M. Brahmam

ABSTRACT

Many plants and their constituents have become chief ingredients of a number of pharmaceutical preparations used against a variety of human and animal diseases. Medico-ethno-botanical surveys coupled with interactions with the herbal healers and patients were undertaken for the last several years in the tribal belts of Orissa to identify plants used in folk medicine especially for asthma and associated respiratory disorders. revealed that more than 20 species have been employed to cure. In all 16 herbal healers and 113 patients (87 males and 26 females) were interviewed and the data generated showed that out of 22 plant species employed 8 i.e. *Toddalia asiatica, Adhatoda vasica, Boswellia serrata, Solanum xanthocarpum, Tephrosia purpurea, Terminalia belirica, T. chebula* and *Tylophora indica* have potentiality and these were used either alone or in combination. Poly-herbal preparations gave better results over single plants.

Keywords : Sensor, allergen, asthma, bronchitis, histamine, diaphragm, sneezing, respiratory disorder.

INTRODUCTION

Plants and their constituents have become chief ingredients of a number of pharmaceutical preparations used for a variety of diseases and more than 75 % of the leads for the discovery of new drugs have come from ethnophytotherapy. Of the various ailments, asthma is attracting the global attention as 15-20 % of world population suffer from this malady unabated (Abouzgheib *et al*., 2007). Asthma is a chronic inflammatory disorder of the airways of bronchi and bronchioles characterized by i). Breathlessness or shortness of breath, ii).Wheezing (whistling sound in the chest), iii). Chest tightness and iv).Coughing (Jindal, 2007).

When a person is exposed to one or more of the irritants or triggers, the oversensitive air passages react by becoming narrower, swollen and even more inflamed. This obstructs airflow to and from the lungs and makes it very difficult to breathe. Common asthma is caused by airborne allergens such as pet dander (hair and skin flakes), pollens, house dust mite faeces etc. During asthma attack, by and large, three phenomena take place to narrow down the airway – a). muscle wall of the airway contracts (squeezes) reducing the size of the lumen, b). mucus secretion increases blocking the airway further and c) inner lining of airway becomes inflamed and swells, adding to further narrowing of the airway. The resulting narrowing of the airways in the lungs makes breathing difficult and the inflammation of the airways make them super-sensitive to irritants.

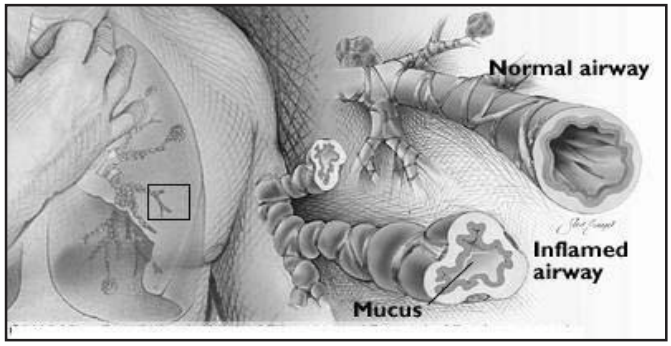

Fig. 1 : Constricted airways in asthma affected patient.

RESPIRATORY SYSTEM

The respiratory system includes an upper apparatus consisting of nose, throat and associated structures and a lower apparatus embracing larynx, trachea, bronchi and lungs. During breathing, air is normally brought into the windpipe called trachea through the nose. The trachea divides into 2 large tubes called the right bronchus and left bronchus. These then split into much smaller tubes, which in turn branch into thousands of very small airways called bronchioles (Chetta et al., 2007). Asthma is caused by the spasms in the smooth muscles surrounding the bronchi and bronchioles causing the air passageways to partially close. Here, the air passages get inflamed and the airways become red and swollen thus making the whole system extra-sensitive to a number of things that trigger asthma symtoms (D'amato et al., 2007).

Now the question is what are the frequently encountered irritants? Common asthma triggers are airborne aller-

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gens such as 1. Pet dander (hair and skin flakes), 2. Pollens, 3. House dust mite faeces etc., 4. Molds, and 5. Food or medication. When an allergen enters the body the body immune system reacts and this phenomenon results in the production of chemicals such as histamine (Ni and Dang, 2005). These chemicals are responsible for sneezing, runny nose, itchy eyes, hives, swelling, shortness of breath, wheezing, and other signs and symptoms of asthma (Li and Srivastava, 2006).

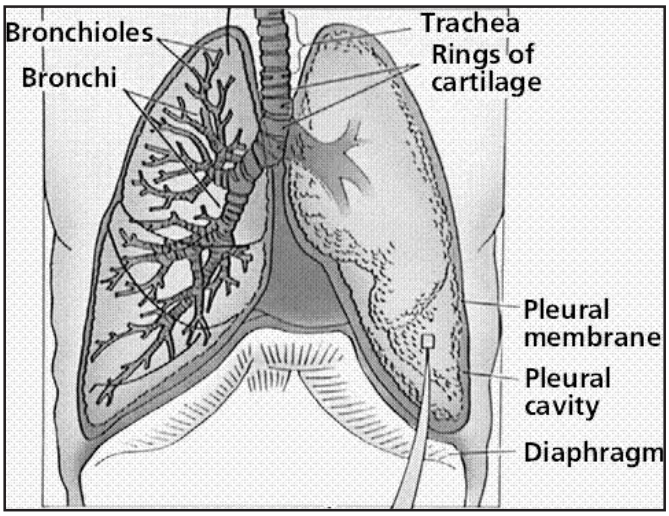

Fig. 2 : Schematic diagram of the airways and lungs

PLANTS AND PLANT BASED MEDICAMENTS

There is a high prevalence of usage of complementary medicine for asthma (Bentley and Trimen, 1980). The historical importance of herbals for asthma is indisputable as four of the five classes of drugs currently used to treat asthma-namely B2 agonists, anticholinergics, methylxanthines and cromones - have origins in herbal treatments going back at least 5000 years (Bielory and Lupoli (1999). The pharmaceutical industry is under constant pressure to discover, develop and deliver chemicals and biological entities for the treatment of various diseases (Barton and Ollis,1986). Many Indian plants and their constituents have become chief ingredients of a number of pharmaceutical preparations used for a variety of diseases and more than 75 % of the leads have come from ethnophytotherapy. Use of plant based drugs and chemicals for curing various ailments and personal adornment is as old as human civilisation.

Orissa state is one of the tribal rich states of India with 62 different tribes. Nearly 25 % of the tribal population belonging to 18 tribes can be termed as most primitive as they still eke out their living as 'food gatherers'in secluded hilly terrain away from civilization. In the absence of any modern medical facility in their remote areas, they still depend on plants for their various ailments. Tribal preparations and prescriptions vary from single plant to polyherbal combinations Alford, 2005).

RESULTS

Data is generated by interacting with Tribal healers and 113 asthmatic patients (87 men and 26 women) on the aspects of Bronchodilation, Reduction of bronchial mucosa oedema, Lessening of airway secretions etc. after administration. Therapeutic records maintained by the healers were also examined wherever possible. One common thing noticed with all the healers was that they prescribed about 20 gm of powder twice daily for 2 months to their patients. Mixtures were prepared by combining plants or plant parts in equal quantities. The parameters studied are:

A - Cough

B - Breathlessness

C – Chest tightness

D- Sneezing

E - Wheezing

F- Itchy eyes

When an allergen enters the body the body immune system reacts and this phenomenon results in the production of chemicals such as histamine. These chemicals are responsible for sneezing, runny nose, itchy eyes, hives, swelling, shortness of breath, wheezing, and other signs and symptoms of asthma (Zang, 2000).

Kolha tribe of Dhenkanal use *Toddalia asiatica* (leaf)

Santhals, Ho, Munda and Bhumij of Sundargarh, Mayurbhanj and Sambalpur districts employ *Adhatoda vasica* (leaf) for asthma.

Juang tribe prescriptions are rated high for curative value as their *Swasanasini* preparation invariably contain the following four plants in equal quantities. These are- *Toddalia asiatica* (leaf - nitidine, magnoflorine) + *Adhatoda vasica* (leaf – vasicine, vasicinone) + *Terminalia chebula* (fruit - tannins) + *Solanum xanthocarpum* (berry –solasodin).

Bonda tribe of Malkangiri prepare by mixing *Boswellia serrata* (gum – boswellic acids) + *Tylophora indica* (leaf – tylophorine, tylophorinine) + *Terminalia belerica* (fruit -

tannins).

Savara and Kondh tribes of Ganjam district employ *Toddalia asiatica* (leaf) + *Tephrosia purpurea* (root –Rutine) and *Solanum (S. trilobatum* or *S. xanthocarpum*, solasodin) fruits.

The effect of the SBR (Strengthening Body Resistance) was taken care by supplementing with 30 gm twice a day of *Withania somnifera* (root) or *Curculigo orchioides* (root-tubers) or *Asparagus recemosus* (root-tubers) or *Chlorophytum tuberosum* (root-tubers) either alone or in combination.

A-Cough; B-Breathlessness; C–Chest tightness; D-Sneezing; E-Wheezing; F-itchy eyes.

Table - Percentage reduction in Asthmatic sympto

Sl. No	Species	Tribes	A	B
1	asthma and associated respiratory disorders	Santal, Ho, Munda, Bhumij	80	10
2	*Toddalia asiatica*	Kolha	30	50
3	*Toddalia asiatica* + *Tephrosia purpurea* + *Solanum xanthocarpum*	Savara, Kondha	45	65
4	*Boswellia serrata* + *Tylophora indica* + *Terminalia belerica*	Bonda	70	60
5	*Toddalia asiatica* + *Terminalia chebula* + *Adhatoda vasica* + *Solanum xanthocarpum*	Juang	85	90

DISCUSSION

Kolha tribe of Dhenkanal use *Toddalia asiatica* (leaf) where as Santhals, Ho, Munda and Bhumij of Sundargarh, Mayurbhanj and Sambalpur districts employ *Adhatoda vasica* (leaf) for asthma. The 'Juang tribe' prescriptions are rated high for curative value and invariably contain four plants viz *Toddalia asiatica* (leaf - nitidine, magnoflorine) +*Adhatoda vasica* (leaf – vasicine, vasicinone) + *Terminalia chebula* (fruit - tannins) + Solanum xanthocarpum (berry –solasodin). The 'Bonda' tribe of Malkangiri use *Boswellia serrata* (gum – boswellic acids) + *Tylophora indica* (leaf – tylophorine, tylophorinine) + *Terminalia belerica* (fruit - tannins). Savara and Kondh tribes of Ganjam district employ *Toddalia asiatica, Tephrosia purpurea* (root –Rutine)) and fruits of *Solanum (S. trilobatum or S. xanthocarpum*, solasodin). The effect of the SBR (Strengthening Body Resistance) was taken care by supplementing with 30 gm twice a day of *Withania somnifera* (root), *Curculigo orchioides* (root-tubers), *Asparagus recemosus* (root-tubers) and *Chlorophytum tuberosum* (root-tubers) either alone or in combination. In the present study, data generated by critically applying the prescribed methodology adopted by the Siddha healers while interacting with the patients in different tribal communities on the aspects of bronchodilation, reduction of bronchial mucosa oedema, lessening of airway secretions etc. after administration (Swain, 1972). Poly-herbal approach is suggested for effective tackling of asthma and other respiratory disorders (ziment, 1978).

Picrorrhiza kurroa root powder (300 mg thrice daily) to treat lung diseases such as asthma and bronchitis. Decoction of *Solanum trilobatum* whole herb (250 gms of

herb boiled in 250 ml of water for one hour and reduced to 80 ml by evaporation) given twice 40 ml each time in the coastal districts, and *Solanum xanthocarpum* similar way in the hilly tracts of Malkangiri. *Tylophora indica* leaves . Toddalia asiatica is another taxon gaining popularity as a most sought after. The modus operandi studied was it involved bronchodilation, reduction of bronchial mucosa oedema and lessening of airway secretions. Here, the active ingredients in the extract act as anti-inflammatory agents and reduce airway hyper responsiveness and bronchospasm (dong et al., 2004). Different tribal healers follow different combinations and the composition depends on the availability of plants in their localities. Based on the ethno-medical clues, various species have been tested using rodent, duck, monkey and dog models but the results are not promising. Since, tribals obtain better results by combining more than one species in their preparations, synergic effect needs to be explored in the drug development programme to combat this deadly problem (Farnsworth, 1990). *Adhatoda vasica* showed pronounced protection against allergen-induced bronchial obstruction

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REFERENCES

Abouzgheib W, Pratter M R and Bartter T (2007), Cough and Asthma. *Current Opinion in Pulmonary Medicine*, 13 (1): 44-48.

Alford G (2005), Not food, not medicine: Understanding dietary supplements- What are they, and how are they regulated? *Asthma Magazine* 10 (6): 18-21.

Barton D H R and Ollis W D (1986) *Advances in Medicinal Phytochemistry* 1, John Libbey Euretex Ltd., London.

Bentley R and Trimen H (1980) *Medicinal Plants* Vol. I-IV., J. & A. Churchill, London.

Bielory L and Lupoli K (1999), Herbal interventions in asthma and allergy. *J. Asthma.* 36 (1):1-65.

Chetta A Zanini A and Olivieri D (2007), Therapeutic approach to vascular remodelling in asthma. *Pulmonary Pharmacology and Therapeutics*, 20: (1): 1-8.

D'Amato G Liccardi G and Frenguelli G (2007), Thunderstorm-asthma and pollen allergy, *Allergy: European Journal of allergy and clinical Immunology* 62 (1): 11-16.

Dong J C, Ni J and Gong J H (2004), Experimental study on prevention and treatment of bronchial asthma by compound Chinese herbal monomer recipe. *Chinese journal of integrated traditional and Western medicine*. 24 (8): 717-721.

Farnsworth N R (1990) The role of ethnopharmacology in drug development. In: *Bioactive compounds from plants*. Ciba Foundation, Chi Chester, John Wiley & Sons, 154: 2-21.

Jindal S K (2007), Bronchial asthma: The Indian Scene. *Current Opinion in Pulmonary Medicine*, 13 (1): 8-12.

Li X M and Srivastava K (2006), Traditional Chinese medicine for the therapy of allergic disorders. *Current opinion in otolaryngology and head and Neck Surgery*. 14 (3): 191-196.

Ni J and Dong J C (2005), Critical study on ginkgolide nebulised inhalation in treating bronchial asthma. *Chinese journal of integrated traditional and Western medicine*. 25 (8): 696-699.

Swain T (1972) *Plants in the Development of modern medicine*, Harvard University Press, Cambridge, Massachusetts, USA.

Zang J (2000), TCM treatment of bronchial asthma. *Jour. Traditional Chinese medicine*, 20 (2): 101-103.

Ziment I (1998), Western alternative medicine: What you need to know, *Jour. Respiratory Diseases*, 19 (9): 747-756.

VENTILATION FOR THERMAL COMFORT: PROPORTION OF WINDOW OPENING FOR BHUBANESWAR

M. Praharaj

ABSTRACT

A healthy house should have proper and proportionate planning of the ventilators. The provision of ventilators helps in removing the expelled air and allows the fresh air. The temperature of the room is maintained the ventilators. As Bhubaneswar is warm and humidity place, there should be proper planning of ventilators and also there is great variation of temprature in the different seasons windows and doors are to be kept open in both windward direction. To provide large amounts of ventilation.

Keywords : Sensor, evaporation, humidity, ventilation.

INTRODUCTION:

Architects with an understanding of air movement control have an opportunity to create climatic responsive residential structure. The utilization of air movement principles and techniques may contribute to relatively comfortable homes year-round. In addition, the air quality within residences may be greatly improved while the buildings energy consumption is significantly reduced. In short good air movement control can improve the quality of life in residential structures.

Provision of ventilation becomes necessary for the supply of fresh air for breathing, for the removal of products of combustion and for maintaining satisfactory thermal environment in buildings. For this purpose the external environment due to the geographical location of the place becomes important. For the maintenance of satisfactory thermal environment in the residential building by means of ventilation, it is necessary to take into consideration the climate of the regions and to study the main problem in summer season.

CLIMATIC STUDY OF BHUBANESWAR

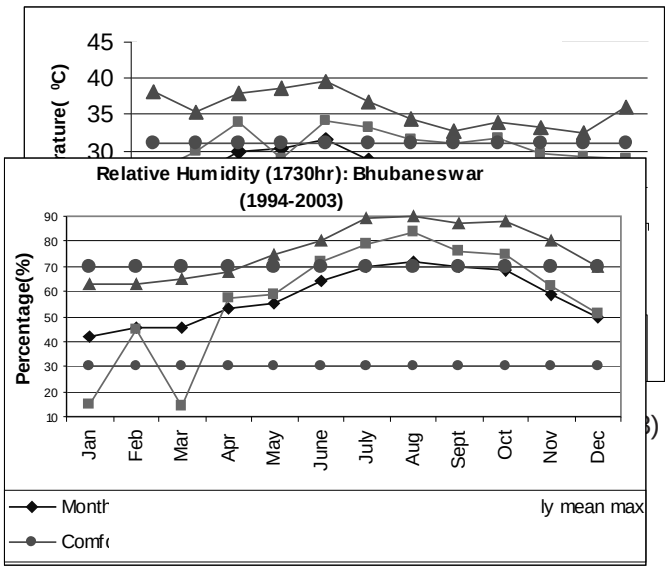
TEMPERATURE & RELATIVE HUMIDITY

Each climatic region has its own set of weather-related problems.However, comfort can be obtained in each region if the designer understands the specific climate and develops a working knowledge of that climate.

Bhubaneswar is coming under warm-humid climate**,** where the overheating is not as great as in hot-dry areas, but it is aggravated by very high humidities, restricting the evaporation potential. The diurnal temperature variation is within 10-15^{0}C.

Humidity appears to have a more effect on comfort. Although humidity does not add to the body heat load, it affects the body's capacity to dissipate heat through evaporation.

Graphs 1 and 2 shows the dry bulb temperature (DBT) and relative humidity (RH) for Bhubaneswar. These clearly show both temperature and relative humidity are high during summer months. Therefore, the main objective is to provide free-air movement. For this purpose, buildings should be oriented to face the direction of prevailing wind, and windows and doors are to be kept open in both windward and leeward sides to provide large amounts of ventilation.



Relative Humidity (1730hr) : Bhubaneswar (1994-2003)

Research scholar,College of Engineering & Technology, Bhubaneswar, Orissa, India.

WIND DIRECTION AND SPEED

The wind direction and speed for Bhubaneswar is shown in Fig.1 and 2. It has been observed that the wind speed is quite comfortable outside and it will be comfortable inside with properly designed openings for ventilation.

Fig.1 : Wind direction for Bhubaneswar (January to December)

Fig.2 : Wind Direction: Bhubaneswar

PROPORTION OF OPENINGS FOR VENTILATION

The general direction of prevailing winds can be made useful, as far as possible, in the location of openings in building for natural ventilation. For comfort it is necessary that air movement is created in living spaces; more so during high humidity.

Based on the wind speed and angle of incidence of wind on the openings in buildings, the rate of flow of air can be calculated. The quantity of air forced through ventilation opening by wind is given by

Q = KAV

Where Q = Volume of air, m^3/h

A= free area of inlet opening, m^2

V= Wind velocity

K= Effectiveness of opening

The effectiveness of opening (K) depends on the direction of the wind with respect to the opening and on the ratio between the areas of inlet and outlet openings.

COMFORT FACTOR FOR VENTILATION

For comfort ventilation, the amount of fresh air required depends on the air space available per person. In India, the number of persons per dwelling unit is, generally, assumed to be five. Therefore, in the design of ventilation requirements for individual occupancies, the number of persons and the air space per person has to be taken into account.

An attempt is made here to work out a model example (proportion of opening for Bhubaneswar) of a living room of size 4x3.5x3.2 m concerning ventilation.

<u>Living room</u>

4m x 3.5m x 3.2 m

Floor area = 14 m^2

Volume = 44.8 m^3

No of persons = 5

<u>Air space per person</u> = 9 m^3

Volume of space required = 9 x 5 = 45 m^3

Out door air supply = 24 m^3 / hr

<u>For Month of March</u>

For city of Bhubaneswar in summer (March) the wind speed is 17.1Km/h.

Therefore the area of inlet

A = 24 / 0.6 X 17.1 = 2.33 m (1:6)

(Assuming effectiveness of opening k=0.6 and the ratio between the inlet and outlet openings =1)

<u>For Month of April</u>

Area of inlet

A = 24 / 0.6 x 24.7 = 1.61 m^2 (1:9)

For Month of May

Area of inlet

A = 24 / 0.6 x 27.6 = 1.44 m^2 (1:10)

For Month of June

Area of inlet

A = 24 / 11.46 = 2.09 m2 (1:7)

Taking the average of 4 months the average size of opening is coming to

1/8 of Floor area = 1.75 m^2

It may be noted that the proportion of opening will be effective for thermal comfort if the building is not obstructed by other buildings and the building should have proper set back.

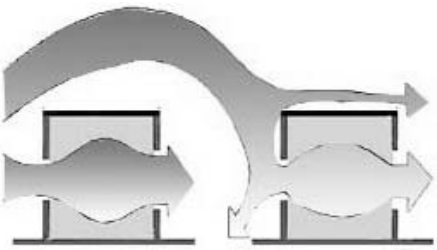


Fig.3: Building with proper set-back for natural ventilation

CONCLUSION

Air movement control offers a method of improving the quality of life within residential structures. Three benefits are obtained. First the air quality within the residence is significantly improved. Second residential energy consumption is reduced. Third, human comfort both physical and mental is provided through increased convection and body evaporation rates. The lack of air movement may have the reverse effect in all three situations. Therefore, controlled movement of air allows nature to assist designers in achieving acceptable human comfort levels in their buildings.

Natural ventilation is achieved by correct building orientation and strategic location of size of inlets and outlets. The orientation of the home should allow for the channeling of cool summer breezes that can be captured by vertical projections and overhangs that direct the flow of air into the living areas.

REFERENCES

IS: 3362-1977, Code of Practice for natural ventilation of residential buildings.

D. Ajitha Simha, 1985, “Building Environment”, McGraw Hill Publishing company ltd.Delhi

Terry S. Boutet,1987, “ Controlling Air Movement”, McGraw-Hill Book Company,ISBN 0-07-006713-9

O.H. Koenigsberger, 1980,”Manual of Tropical Housing and Building”: Part – I, Climatic design”, Longman Inc. New York, ISBN 0582 44546.

Victor Olgyay, 1992, “Design with Climate: Bio Climatic approach to architectural regionalism”, Van Nostrand Reinhold, New York.

National Building code of India, 1983, Bureau of Indian Standards, New Delhi, 110002, ISBN 81-7061-026

SP-41, Hand Book on Functional requirements of buildings, Part I-IV, 1987, Bureau of Indian Standards, 1988.