GENERAL CONSIDERATIONS AND RECOMMENDATIONS

GENERAL CONSIDERATIONS

A woodland or a forest is a self regenerating and self sustaining ecosystem, and hence represents a stable phase of a biosphere. It is the culmination of several cycles of replacement communities, both plants and animals. Each cycle of succession has followed the routine chain of events over a period of time. Thus, the early settler like grass is replaced by herbs; herbs are replaced by shrubs; shrubs by trees and trees by large shade trees with extensive canopy. Orice a canopy is formed, changing soil texture and lack of sunlight may prevent the growth of all other plants, and later even the seeds of shade trees will fail to germinate. Ultimately these shade trees die and are replaced by new species if trees or the area may give way to open grass land and the cycle may repeat itself. This slow process ultimately leads to the formation of a mixture of trees, spaced out properly so that no single species is crowded out, at the same time ensuring survival and continuity of grass, herbs, shrubs and trees. In this stable phase, plant and animal communities establish cooperative association and live in perfect harmony with climate, geology and geography (Bazzaz, 1979). The fauna and flora of the forest is the product of several physical factors woven into a fabric over a period of time. The ecological succession thus leads to the establishment of what Yapp (1962) calls a 'web of life'. Plant and animal interactions are few of the prime factors that produce a stable system.

Forests have always been important to people. In fact, there is a link between forests and civilization. Forests are now and always have been a major economic resource. Wood provided one of the major source of fuel for early towns and cities and helped pave the way for the rise of civilization. Even today, nearly half the people in the world depend on wood for cooking. In developing nations like India, wood remains the primary heating fuel. Forests affect people indirectly as well. They retard erosion and moderate the availability of water, improving the water supply from major watersheds to cities. As with the Gir, forests are habitats for endangered species and other wildlife; and they are important for recreation, for hiking and bird and wildlife viewing. At regional and global levels, forests may be significant factors in the climate (Botkin and Keller, 1995).

There are approximately 2.5 billion ha of closed forest and 1.2 billion ha of open woodlands and savannas in the world (Council of Environment Quality and the U.S. Department of State, 1981). Countries differ greatly in forest resources, depending on the potential of the land and climate for tree growth and on the history of land use and deforestation. About 50% of Indonesia is forest, 40% of Brazil, 18% of India and less than 13% of China (Smil, 1984).

Of the total geographical area of India, 22.74% is forest as against a minimum of 33% forest cover prescribed under National Forest Policy. Increased urbanization, industrialization and mining has entailed indiscriminate felling of trees and denudation of forests. India alone is loosing more than 1.5 million ha of forest cover each year and 22 million ha of forests have been destroyed during the last three decades due to over exploitation, misuse and conversion to agricultural fields (Trivedi and Raj, 1992). The depleted forest wealth would simply deprive the man of economic and environmental values offered by forest.

The wildlife which is an integral and important part of forest is also essential for balancing the ecosystem. India is endowed with a rich biological heritage. Over 500 mammalian and 1,200 avian species contribute to the richness of this wealth (Trivedi and Raj, 1992). Unfortunately, today the Indian wildlife, as in many other parts of the world, is threatened because of man's unprecedented intervention with nature leading to loss of forested areas.

The most common reason that people cut forests is to use or sell the timber for lumber and paper products or for fuel. Logging by large commercial timber companies and local cutting by villagers are both major causes of deforestation. Another important

cause is the clearing of forestland for use in agriculture, including conversion to crops and pasture (Buschbacher, 1986). Being a global phenomenon the clutches of deforestation has not spared even Gujarat. Last few good patches of forest are Dangs and Shoolpaneshwar Wildlife Sanctuary in Gujarat. Worah (1992) while studying the fragmented forests of Dangs has attributed the human pressure, by means of over exploitation, a causative agent for forest degradation. The SWS, being a woodland adjacent to Dangs forest and having nearly 104 villages inside the sanctuary, a similar situation of forest fragmentation and degradation due to anthropogenic activities cannot be ruled out. Towards this end a detailed study on the physiography and bioinventory have been carried out in Shoolpaneshwar Wildlife Sanctuary, the last of its kind in Gujarat.

The Shoolpaneshwar Wildlife Sanctuary is situated at the confluence of western end of Satpura range with Western Ghats and on the southern side of the Sardar Sarovar, a reservoir which is coming up on the Narmada river. The forests in this area are moist mixed deciduous and dry mixed deciduous type (Champion and Seth, 1982). The major tree species of the area include *Tectona, Terminalia, Lagerstroemia, Holarrhena, Mitragyana, Dalbergia, Bridelia, Madhuca, Butea,* etc. *Azanza, Helicteres, Moghinia, Nyctanthes, Carvia, Kirganelia* form the understorey (shrubs and herbs). Though, the floristic aspect of the sanctuary has been studied by Pradeepkumar (1993), the fauna by large has not been explored. The authentic studies of fauna were limited to birds and that too, covered only a part of the sanctuary (Ali, 1956; Monga and Naoroji, 1984). Therefore an attempt was made to study the faunal diversity in the sanctuary (Chapter I).

The study revealed that the SWS is rich in its faunal diversity. The area supports a large number of invertebrates 77% of which are insects. They occupy all the trophic levels and play a vital role in maintaining the equilibrium of the ecosystem. The population diversity of insects may be due to thick vegetation, absence of pesticide usage by natives in their sparse agricultural holdings and high rainfall and moist conditions. The moist soil conditions and organic food formed from the vegetation and leaf litter are necessary for ground dwelling and crawling insects. These insects form the food of spiders, amphibians, reptiles and birds. There are about 50 species of nectar feeders and pollen chewers. Notable among them are several species of butterflies and moths, three species of honey bees and some species of bumble bees, wasps and flies. Large number of flowering trees present in the sanctuary serve the need of these insects. Nepa,

Ranatra, Cybister, Dragon and Damselflies are the major predatory insects. They play an important role as food link and occupy the third trophic level in the food web.

Spiders are the second major group of the invertebrates recorded from the study area. Spiders successfully survive in dry soil, extremely damp soil, on tree trunk or barks and also on the surface of aquatic vegetation. All the 53 species of spiders observed and/or collected from the study area are either predacious or carnivorous. These spiders with their myriad designs of web, trap or lure insects. There are special webs to trap flying insects and there are web traps to lure and capture crawling insects at the ground level. Many are active hunters and they do not use webs. Thus, spiders are useful in keeping the insect population in check. However, the spiders also form a part of the diet for many birds, reptiles and amphibians.

The annelids, though represented by only four species, play a major role in 'tilling' forest floor and thus help in increasing or maintaining the fertility of the soil. Nine species of mollusks are observed in the sanctuary. They occupy second trophic level in the food chain and are the chief source of food for many waders like sandpipers and lapwing.

The two most striking groups of vertebrates in the study area are amphibians and birds. The moist conditions, loose soil, fairly good vegetation cover and large insect population are very congenial for a variety of amphibians. The abundant tall trees, high population density of insects, amphibians and also reptiles support about 26 species of birds of prey. The preponderance of insect population in the area has also resulted in having more than 100 species of insect eating birds in the sanctuary.

The Shoolpaneshwar Wildlife Sanctuary is thus a unique biosphere supporting a wide variety of wildlife. However, the survey of the whole sanctuary has revealed that the area is under intense biotic pressure. A total of 34,368 people and 26,672 cattle (Amin, 1992) are distributed over 104 villages in the sanctuary. The residents and their cattle are fully dependent on the forest for their sustenance. The cumulative effect of biotic pressures (human and cattle) results in the degradation of natural vegetation leading to heavy runoff from the areas. Due to this heavy biotic pressure the natural habitat of plant species and wildlife undergo shrinkage.

Birds are one of the best indicators of environmental quality of any ecosystem (Ripley, 1978). The council of Environmental Quality (USA) identified birds as the commonly used indicator of environmental change (Morrison, 1986). Habitat loss or

destruction is one among the agents for environmental degradation and it is the main agent for the extinction of many bird species (Leck, 1979; Brash, 1987). Most of the birds have specific habitat requirements from season to season (Karr, 1989). Thus, the conservation value of a habitat could be assessed by the presence of various species of birds in an area. Hence, in the present study major emphasis was given to the avian community, their abundance and distribution (chapters II and III).

A total of 175 bird species were observed from the study area out of which nearly 48 species were scarce and 42 species were rare whereas 27, 22 and 14 species were very common, common and fairly common respectively. The natural densities of bird species differ considerably. Body size and diet are two factors broadly related to density. Larger species tend to have larger territories and lower densities. Scavengers and birds that feed on vertebrates are generally much scarcer than insectivores and seed eaters. Whitebacked Vulture, Egyptian Vulture, Crested Honey Buzzard, Bonelli's Eagle and Crested Hawk-Eagle are widespread species but they typically occur in much lower numbers than most of the small passerines that are equally widespread. All of the raptors and owls and to a lesser extent corvids (the crow family) occur at low densities. The most widespread species include a far higher proportion of passerines. High proportion of non-passerines is confined to a small segment of woodland with better wooded area (Kokam, Ninai Ghat and Sagai). This may be because non-passerine include more of those type of species with exacting habitat requirements and also non-passerines tend to be larger birds with larger territories or home range which may lead to wide spacing between individuals and consequent absence from some smaller fragments of forest. There is also a weak tendency for migrants like Marsh Harrier, Pied Crested Cuckoo, Indian Pitta and other such bird species to be less widespread than resident species.

The bird life of a wood consists of several different populations which form a community. Avian ecologists have attempted to define bird communities in relation to plant communities. The distribution and abundance of most terrestrial bird species are determined primarily by the vegetation. Other factors such as food availability, predators and parasites are thought to play a secondary role in determining the distribution and abundance (Worah, 1992).

However, species richness *per se* cannot be used as the major criterion for evaluating the ecological importance of forest areas (Worah, 1992). It is important to determine the relative value of a species before taking management decisions. A patch

of natural forest and an adjacent field may both have the same number of species, but the species found in the field are usually those that can survive in disturbed as well as non-modified habitats and therefore are not usually endangered. On the other hand, the species found within the forest are often those that require undisturbed habitats to survive, and management decisions should generally be carried out in favour of these species. Therefore, it is apparent that the composition of the bird species in different forest areas is equally, if not more important than the overall number of species.

Overall bird abundances in SWS were related more to habitat diversity than area. Smaller forest patches like Sagai, Ninai Ghat, Kokam, Chopdi and Junaraj with good habitat diversity have a greater conservation value in terms of avifauna than larger, less diverse forest patches *viz.* Namgir, Kalvat and Vav. This observation supports the view of Lynch and Whigham (1984) that habitat quality and area are to some extent compensatory in their influences on bird occurrences. This means that above a certain critical minimum patch area, floristically and physiognomically "rich" forest patches may support bird communities that are qualitatively and quantitatively similar to those found in larger but "poorer" forests.

The other important observation is the negative effect of forest fragmentation on bird species numbers. The smaller forest fragments have experienced a loss of species following fragmentation. Examples of such a loss of species are Indian Banded Bay Cuckoo, Greenbilled Malkoha, Malabar Trogon, Indian Cuckoo and Booted Warbler, which were reported earlier from the area (Ali, 1956; Monga and Naoroji, 1984) but were not observed during the present study, might be due to habitat fragmentation. Bird species are found to differ in their vulnerability to forest fragmentation. Relatively rare species and forest and forest-edge species are more adversely affected by habitat fragmentation, than relatively common or edge-forest species (Blake and Karr, 1987). Present study confirmed that forest and forest-edge species *viz.* Grey Hornbill, Large Green Barbet, Crested Hawk Eagle, Velvetfronted Nuthatch, Indian Pitta, Lesser Whitethroat and Whitethroated Ground Thrush were most likely to be underpresented in small and less diverse forest patches. Nevertheless, it can be expected that continual loss of forest habitat and its fragmentation into smaller, more isolated parts can be expected to adversely affect the populations of many species over the long term.

Over the years, much effort has been expended trying to understand how communities of animals are constructed. Much of this work has focused on bird

communities, and woodland has been examined in considerable detail because it is structurally complex and rich in species. Despite this, we still know rather little about whether there are any underlying principles determining how many and what sorts of species can coexist in a particular habitat. There are truly daunting problems to overcome in really understanding what makes bird communities the way they are (Wiens, 1989).

The traditional view is that no two species can occupy precisely the same niche. This idea is widely known as the 'competitive exclusion principle'. More recently, the principle has been developed into elaborate theories concerning the numbers of species that can be packed into a community, taking account of the similarity of their niches. It is undeniable that many closely related species show detailed differences in the ways in which they use their environments, either with respect to their habitats, nest sites, feeding sites or foods and that they often exhibit what are generally taken to be physical adaptations to their preferred niche (Lack, 1971).

Competition was usually assumed to be for food, though it could also be for other resources potentially in short supply, such as nest sites or roost sites. In general, one would expect the most closely related or ecologically most similar species, to be in the greatest competition because they tend to use similar resources. Observations and experiments involving the removal of birds have demonstrated that some species are effectively kept out of certain foraging sites by other species that are either behaviourally dominant or simply better at exploiting the food on offer (Fuller, 1995).

The avian community in SWS also followed a distribution at par with the availability of food resources. The carnivores and frugivores preferred interiors of the sanctuary which is deeply wooded having abundant flower and fruit bearing trees. The core of the sanctuary is also rich in mollusks, fishes, amphibians, reptiles and small mammals which constitute the prey base. The village vicinity and the surrounding cropfields are the preferred areas for both omnivores and granivores. However, insectivorous birds are found distributed all over the sanctuary owing to the diverse population of insects all throughout the sanctuary.

Segregation by vertical feeding heights is particularly common in foliage insectivores and sallying flycatchers. It also frequently distinguishes aerial insectivores, such as swallows and swifts, as species of the former often feed within a hundred feet of the ground but the swifts customarily higher. Species which, but for this tendency to

forage at different heights, would be ecologically extremely similar. In a sense these species are ecological counterparts at different heights in the vegetation (Cody, 1974).

In contrast, vertical overlap is much greater in other groups of ecologically similar species such as Woodpeckers, Spotted Grey Creeper and others which are the trunk insectivores, branch- and twig-insectivores like Velvetfronted Nuthatch, Tits and Flycatchers and slow-moving and steadily-searching canopy insectivores *viz.*, Plaintive Cuckoo, Large Green Barbet and Large Cuckoo Shrike. These species are distinguished from the others discussed above by their higher 'search/pursuit' ratios, that is, they spend relatively more time searching for prey and less time pursuing it.

Species which find themselves at the same point in space, can still differ in their resource use by using different food items. This can be so because (i) they may encounter different food items and/or (ii) they may be morphologically equipped to eat different sizes, shapes or hardness of food items (Fuller, 1995). As bird species seem to be largely opportunistic in what they feed on, every food item encountered and found to be manageable will be incorporated into the diet, and none such is likely to be passed over.

Bird species that co-occur in a habitat might breed at different times of the year and thereby avoid severe competition with each other. Cody (1985), has noticed a similar behaviour in some groups of seabirds. Birds of prey, the dominant group of birds in the sanctuary also followed above pattern of breeding adjustment. They were found to be breeding during different seasons *viz.* winter and summer. Since most of the raptors and owls share a common breeding habit, this separation in breeding season might be to avoid competition for food and nesting site. Lack (1968) has opined that in terrestrial ecosystem the selective factors involved in breeding season, the time when parents will be feeding young, is the time when their food supply is most abundant. Raptors occupy high canopy for nesting which may enable them to avoid competition for nesting sites with other small birds which breed in summer. Moreover, defoliation in summer makes the favoured prey species like lizards, snakes and rodents more visible for predation by the raptors. This, along with the chicks of other breeding birds provide enough food supply to breeding birds of prey such as Crested Serpent Eagle, White-eyed Buzzard Eagle, Osprey, Egyptian Vulture, Shaheen Falcon and Barred jungle Owlet in summer. In the sanctuary, it was observed that relatively few species of birds of prey breed in winter. This facilitates those birds of prey (Bonelli's Eagle and Crested Hawk Eagle)

which breed during colder months to capture enough prey as food and also lesser competition for nest building materials.

Safety of the eggs and youngones are the prime factors which the birds consider for choosing appropriate trees for nest building. Raptors and owls with powerful flight muscles, prefer the height of trees for the safety of nests and nestlings. Raptors which were found preparing twig nest as well as cup-shaped nest showed different height preferences. Though Crested Serpent Eagle, Honey Buzzard, White-eyed Buzzard, Crested Hawk Eagle, Bonelli's Eagle and Greyheaded Fishing Eagle build twig nests, Crested Serpent Eagle and Bonelli's Eagle use lower strata whereas all the others use the canopy of the trees. This reduces the interspecific competition for nesting sites and hence helps in accommodating more diverse species. The hole nesters like owls use natural tree holes which can give more protection to the nestlings.

RECOMMENDATIONS FOR ECO-ENHANCEMENT

On the whole, the present study on biological resource inventory of Shoolpaneshwar Wildlife Sanctuary reveals that the area is rich in its biodiversity. Moreover, the SWS is singularly fortunate to have a bird population rich in number and diversity. By preserving the biosphere, the sanctuary can be developed into a veritable aviary. A sanctuary for land based birds is a need of the hour when agricultural practices shrink virgin vegetational cover as well as pump lethal pesticides that kill a wide spectrum of animal life especially insects.

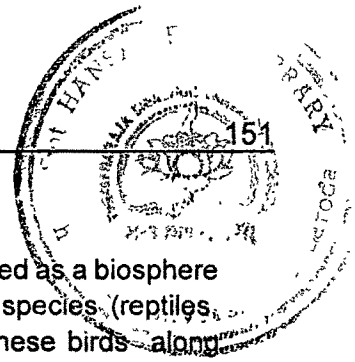
The first step in development and management of Shoolpaneshwar Wildlife Sanctuary should be from the point of establishing a stable system viable in the region. Protection of the area is the first step and by and large nature will take care of the rest, resulting in a natural recovery. But it may take a long time and time is what we do not have because as we human being are proliferating at an alarming rate, the encroachment and subsequent degradation as well as commercial exploitation of the forests are even at a higher rate. Special efforts to protect and develop a biosphere then have to be initiated. These remedial measures are:

- Minimize human resident population's dependency on forest land for cultivation and livelihood.
- Stop commercial exploitation of the forest by private or forest agencies.

- Minimize cattle grazing by providing them with better breeds, encouraging them to go for stall feeding or to keep buffaloes instead of cows (buffaloes have higher capacity to digest dry leaves and fodder than cow and their productivity is higher)
- Initiate long term measures to protect the total ecosystem from human interference by promoting small scale industries, cooperative farming, dairy and poultry farming, etc. This will increase the income of the natives and they need not cut trees for additional income.
- Create more small scale industrial estate with schools, dispensaries and shops in nearby places. Provide people with better health and education and, an awareness of the importance of forests in life. Gradually, the natives will themselves protect the forests.
- Supply gober gas plants so that the villagers need not go for collecting fire wood from the forests.

Above measures will go a long way in the efforts to protect the ecosystem from further deterioration. If efforts are also initiated to augment the rate of natural recovery at the same time by planting varieties of trees, then the improvement of the sanctuary can also be achieved. The other measures to improve the sanctuary ecosystem are:

- Create captive water bodies deep inside the sanctuary: Propagation and survival of all plants, trees and animals depend largely on the availability of water. Several check dams holding rain water to form shallow but extensive water bodies shall be a boon to animals and plants alike. Check dams on small streams will enhance the natural recovery of the degraded system much faster.
- Careful afforestation programme should be initiated after taking into consideration the requirement of animals in the sanctuary. Monoculture plantation practices should be dispensed with. Instead a planned propagation of native and endemic species should be encouraged. Plant and animal interactions are very important and afforestation programme should take into consideration such associations which are crucial for survival of animal species that are pollinators and seed dispersers in off season times. All throughout the year, there are some plants and trees that are in flowering and fruiting state. This ensures the survival of a large number of animals in the sanctuary all throughout the year. Afforestation with all types of trees is a must to preserve the biosphere.



- The Shoolpaneshwar Wildlife Sanctuary should be developed as a biosphere preserve with emphasis on birds of prey and their prey species (reptiles, amphibians, spiders and insects). An intensive study of these birds along with animals should be undertaken to identify the problems faced by them in the sanctuary. Detailed studies of movement, habitats and food requirements would help to formulate measures to improve the lot and the number.

All that is required to develop SWS into a total biosphere preserve is to reduce the biotic pressure on it with the help of all Government and non-government organizations and people living there.