CHAPTER III

AVIFAUNAL DISTRIBUTION ACCORDING TO RESOURCE AVAILABILITY IN SHOOLPANESHWAR WILDLIFE SANCTUARY

The competitive exclusion principle states that two species that have exactly the same requirements can not coexist in exactly the same habitat—one must win. The reason that most species do not die out from competition is that they have developed a particular niche and thus avoid competition. It is also likely that the competitive exclusion principle does not work when there are several competing species rather than just two (Fuller, 1995).

The number of species in a given habitat is affected by many factors, including latitude, elevation, topography, severity of the environment and diversity of the habitat. Predation and moderate disturbances, such as fire, can actually increase the diversity of species. The number of species also varies over time. Of course, people also affect diversity (Botkin and Keller, 1995).

The habitat preferences of birds are determined by an individual's ability to obtain food and shelter against predators and weather, which are the main selective pressures related to fitness (Hilden, 1965; Cody, 1985). Animals tend to feed in areas of high food availability (Nilsson, 1972; Newton, 1980; Herrera, 1981) and low predation risk (Ekman, 1987; Hogstad, 1988; Wiens, 1989).

Another characteristic feature of the biotic community is the vertical stratification. In a woodland like the SWS distinct layers of canopy, middlestorey, understorey and ground cover vegetation are observed. These layers are associated with different organisms, as each stratum provides a different type of habitat. Stratification also helps in niche separation. Increased habitats and niche separation reduce competition and this enable a large number of species to occupy a community (Dash, 1993).

Since birds form the dominant community in the SWS and also our understanding about biotic community of any ecosystem remains scanty, an attempt has been made to study the structure and composition of avian community in relation to food, vegetational structure and vertical stratification.

DISTRIBUTION ACCORDING TO FOOD AND FEEDING HABITS

Shoolpaneshwar Wildlife Sanctuary is a relatively stable biosphere with densely wooded gorges and slopes, patches of open area and grassland with innumerable water sources in the form of river, rivulets and streams, that support vast and diverse groups of birds with different habitat preferences. The nutrient cycle is the prime factor that determine the natural succession and carrying capacity in such stable biosphere. The nutrient cycle in the sanctuary is a complete one (Figure III.1). There are enough primary producers—trees, plants and shrubs—providing ample food to various primary consumers. Countless insects feed on juices, stems, leaves, pollen and nectar form the primary consumer along with fruit eating birds and bats. A region supporting rich insect life can support a large number of secondary and tertiary consumers. There are plenty of birds that feed on insects, either facultatively or obligatorily. These birds together with spiders, amphibians and reptiles constitute the secondary consumers. At the apex of the pyramid are the birds of prey that feed on amphibians, reptiles as well as small birds and mammals (Figure III.2). The presence of about 26 different species of birds of prey, which are the tertiary consumers in the SWS testifies to the biodiversity and resilience of this system.

According to their food preferences, the 175 bird species which are sighted in the sanctuary area can be classified into five major groups—Carnivores, Insectivores, Frugivores, Omnivores and Granivores.

CARNIVORES

Birds of prey and other carnivores form the dominant group of birds in the sanctuary. Piscivorous birds of prey like Osprey, Brahminy Kite, Brown Fishing Owl, Marsh Harrier

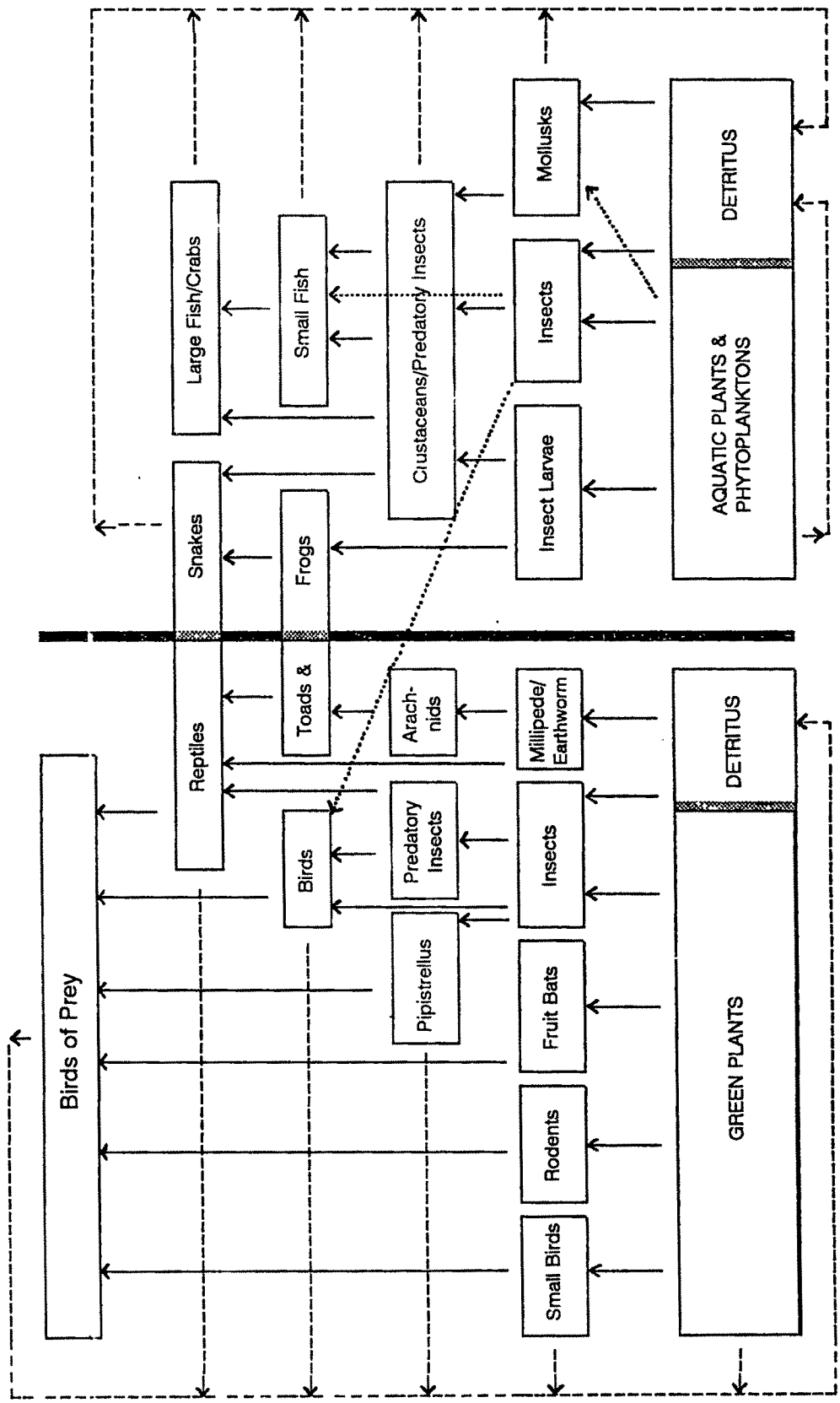
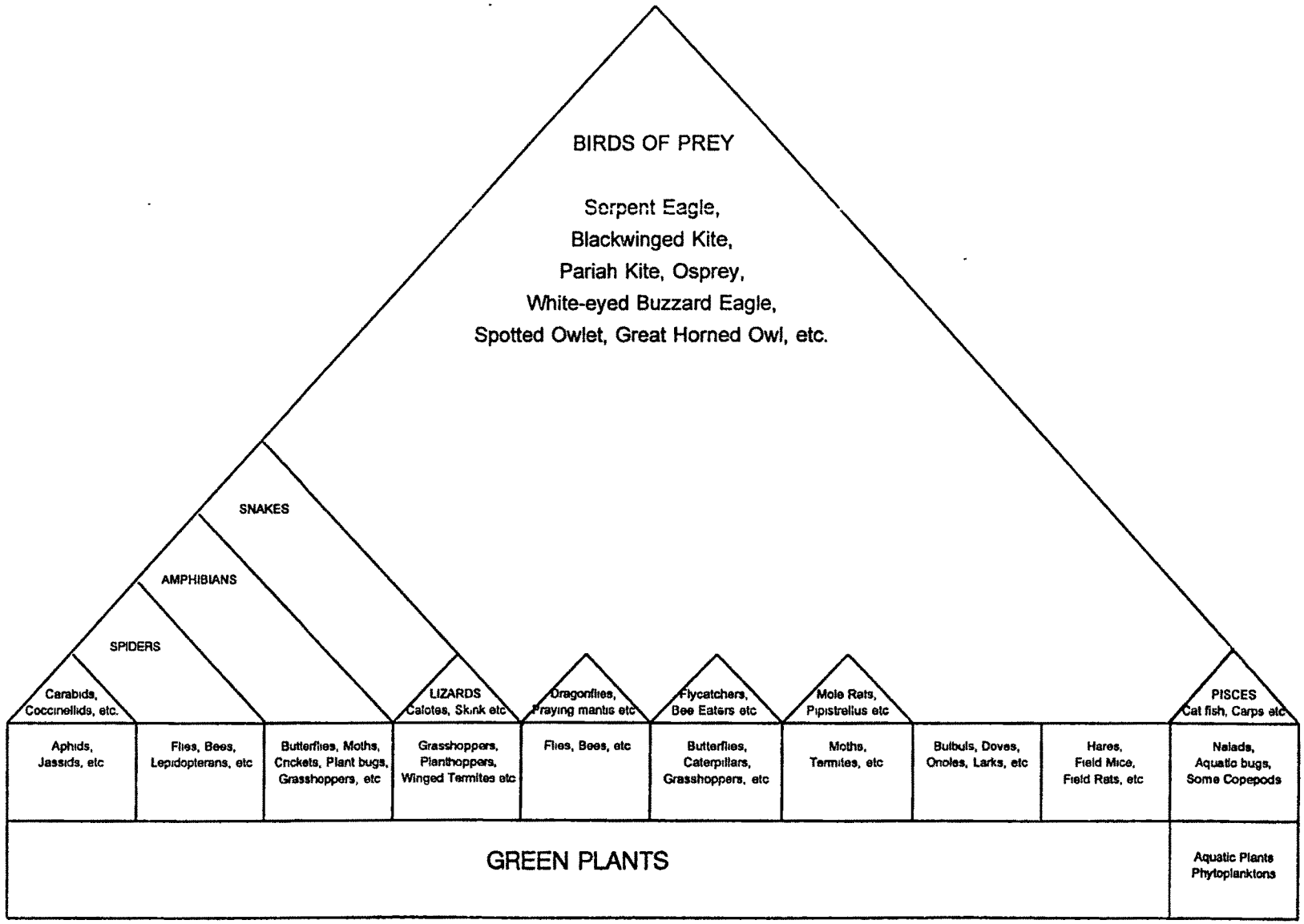


Figure III.1 Illustration of Nutrient Cycle in the Study Area

Figure III.2 Food pyramid of the Sanctuary showing birds of prey at the apex



are concentrated more towards the western boundary of the sanctuary, where the Karjan reservoir provides them with ample food. Population of rodents and feral bird species like fowl, quail, etc. are more in the vicinity of the villages. These attract birds like Pariah Kite, White-eyed Buzzard Eagle, Shaheen Falcon, Blackwinged Kite, Shikra, Spotted Owlet, etc. towards the northern and southern boundaries, where the human settlements are more. Seen also in these areas are carrion-feeders like Whitebacked Vulture, White Scavenger/Egyptian Vulture and Longbilled Vulture. Junaraj, Kalwat, Duther, Namgir, Piplod, Sagai form a belt diagonally across the sanctuary with a high canopy and better wooded patches of forest (Figure III.3), which support a number of birds of prey such as Crested Honey Buzzard, Crested Serpent Eagle, Crested Hawk Eagle, Greyheaded Fishing Eagle, Bonelli's Eagle, Brown Hawk Owl, Great Horned Owl, etc. These areas provide nesting and roosting sites for a number of birds of prey. Water birds and waders such as Little Cormorant, Grey Heron, Pond Heron, Openbill Stork, Whitenecked Stork, Kingfishers, etc. are found to be distributed around perennial water sources all along the Tarav river and its tributaries (Figure III.4).

INSECTIVORES

Although insects are primary consumers, they are vital to all secondary and tertiary consumers. It is needless to say that a high population of insects supports a thriving population of secondary consumers (spiders, fishes, amphibians, reptiles, birds and mammals) and they in turn support the tertiary consumers, the birds and mammals at the apex of the food pyramid.

Shoolpaneshwar Wildlife Sanctuary has a high population of insects due to **a.** thick vegetation, **b.** absence of pesticide usage by natives in their sparse agricultural holdings and **c.** high rainfall and moist conditions prevailing there. 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 amphibians, reptiles, spiders and birds preferring ground cover. Ground dwelling birds like Partridge, Frogmouth, Nightjar, Hoopoe, Pipit, etc. thrive upon these crawling insects.

Large number of insects feed on nectar and pollen. Trees such as *Butea, Sterculia, Helicteres, Bombax, Mangifera, Madhuca, Bauhinia, Diospyros, Embelica, Ficus, Derris, Erythrina,* provide food to the insects during flowering and fruiting seasons. Birds feeding upon insects as well as pollen and nectar also visit these trees and feed upon those insects attracted to feed upon nectar and pollen. Though insects are considered as pollinators of those flowers that they visit, birds are equally efficient

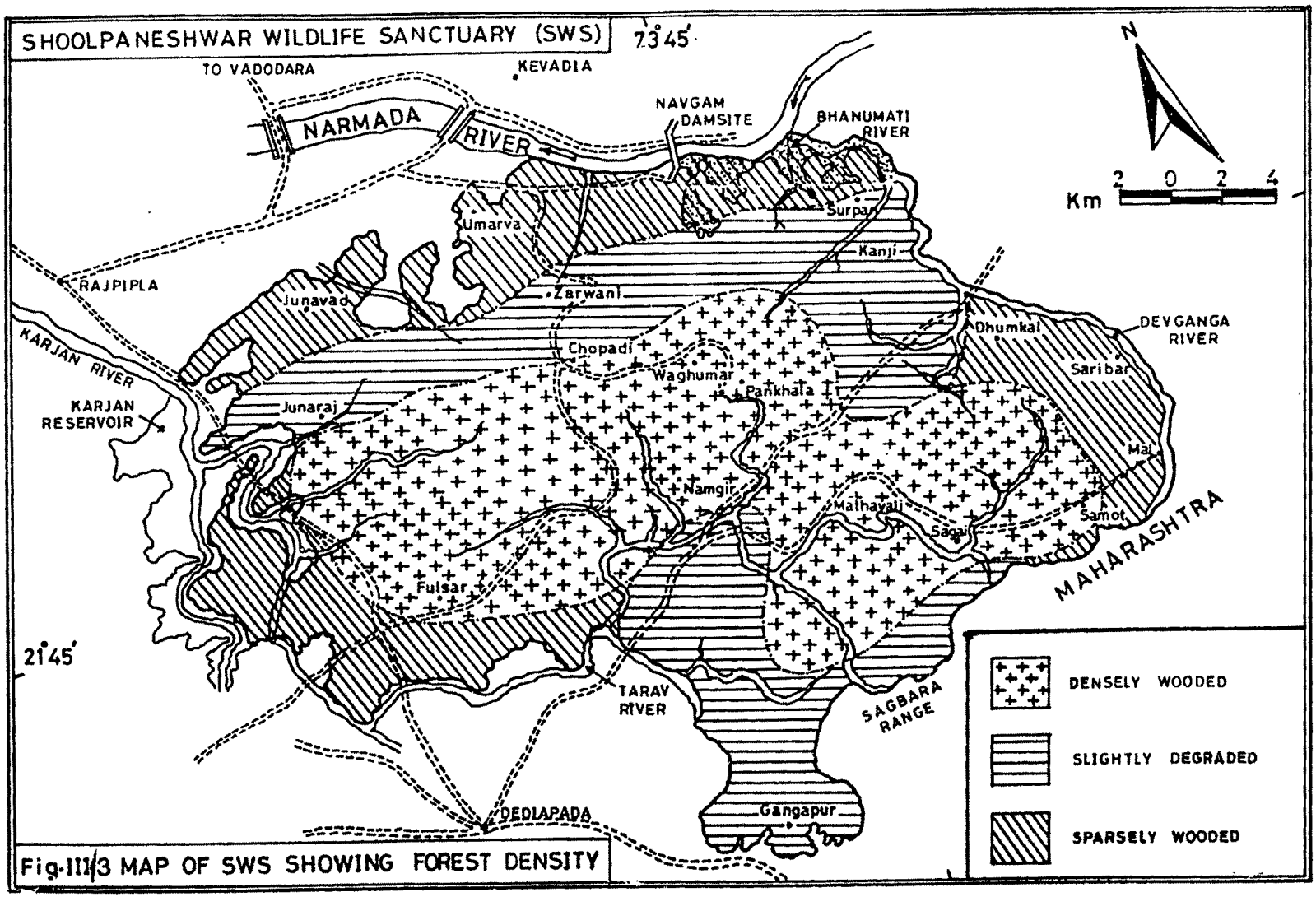


Fig-III.3 MAP OF SWS SHOWING FOREST DENSITY

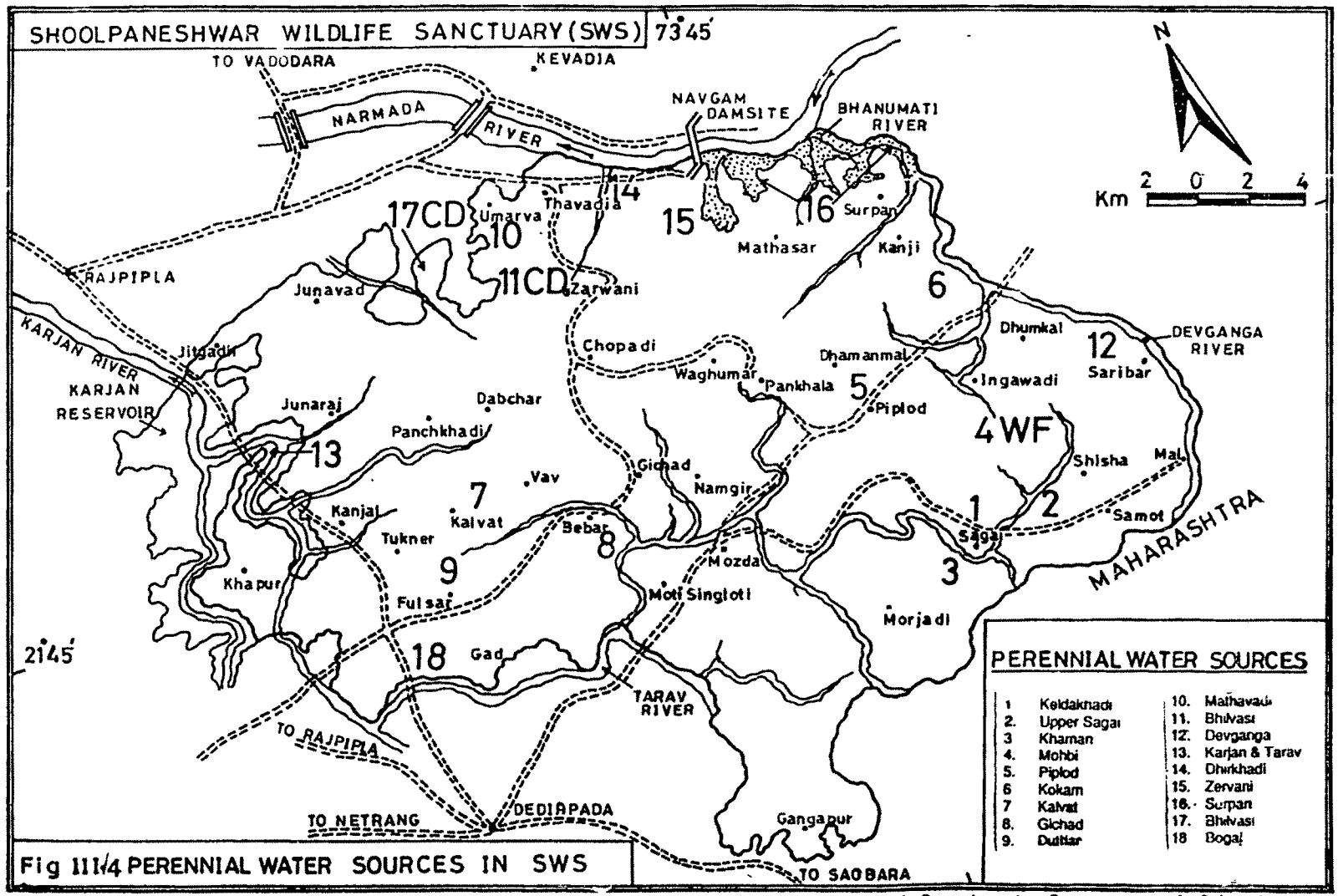


Fig III/4 PERENNIAL WATER SOURCES IN SWS

Source: Forest Department, Government of Gujarat.

pollinators. So if they feed upon pollinators (i.e. insects), they in turn carry out pollination and help the tree in return.

With its innumerable water courses, damp soil and wide variety of flowering plants, the sanctuary supports a vast and diverse insect population. Crawling, detritus feeding insects are necessary for several types of ground dwelling birds. Flying insects form food for large number of other insectivorous birds. Among them Honey bees, several species of Dipterans, Embiids, Waterstriders, Dragonflies, Butterflies, Crickets, Cockroaches, Bugs, Beetles and Neuropterans form major palatable food source for insect eating birds. Their food is also supplemented with earthworms, insect larvae, spiders and molluscs which are present abundantly in and around water bodies. Because of this luxuriant food supply, insectivores form the major group of birds in the sanctuary area. Several species of birds carry out foliage gleaning and bark gleaning activities to pick up caterpillars and insects. They also pick up those insects that invade flowers and fruits. However, nesting habitat is the major limiting factor which restricts the distribution of insectivores within the sanctuary. Wood Shrike, Blackheaded Cuckoo-shrike, Nightjar, Nuthatch, Grey Creeper, several species of Cuckoos, Woodpeckers, Drongos, Flycatchers and Warblers, that need good foliage cover for nesting and shelter are seen more in the better wooded areas of the sanctuary—core of the sanctuary. On the other hand, Swifts, Swallows, Bee-eaters, Rollers, Hoopoe, Pipits, Wagtails, Bulbuls and Robins which prefer forest clearings and open scrub jungle for feeding are scattered all along the periphery of the sanctuary.

FRUGIVORES

The rich flora of the thick interior forest is endowed with a number of tree species like *Ficus, Zizyphus, Bridelia, Butea. Erythrina, Bombax, Madhuca* and *Bauhinia*, bearing fleshy flowers and fruits. Frugivorous birds such as Yellowlegged Green Pigeon, Parakeets, Barbets, Orioles, Koel and Chloropsis, thus flourish well in this part of the sanctuary. These are the seed dispersers which play a vital role in the propagation of different tree species. Thus, frugivores are the main component for the survival of this forest ecosystem.

OMNIVORES

Birds like House Crow, Mynas, Common Babbler, Sparrow and Rosy Pastor are confined more around the villages that are located near the northern and southern boundaries of the sanctuary. These omnivores are the ones which usually do not get affected by decline in the quality of their habitat.

GRANIVORES

Cultivated land mainly bordering the sanctuary and also inside the forest areas attract a number of granivores, *viz.*, Blue Rock Pigeon, Redwinged Bush Lark, Ashycrowned Finch Lark, Rufoustailed Finch Lark and weaver bird. These are the passerines which are plenty in number. Since they have smaller body size, the sanctuary with plenty of food can support large number of these birds.

The study of the overall distribution of avifauna depending upon food preference, thus indicates that carnivores and frugivores prefer interiors of the sanctuary which is densely wooded, whereas omnivores and granivores prefer village vicinity and the surrounding crop fields as well as the scrub areas and, are therefore predominantly found in the peripheral areas of the sanctuary. Insectivorous birds are evenly distributed all over the sanctuary owing to their diverse food base availability.

Birds are not simply primary or secondary consumers in the usually thought of grazing food chain, but are much more completely linked to their energy sources (Holmes and Sturges, 1974). Although food is by far the most important element in the habitat which controls population density, it is by no means the only one. Nesting sites, nesting materials, the general vegetational appearance like vertical foliage height diversity, plant association and composition of the habitat and other subtler factors may also play a role in bird distribution. Some of the recent investigations suggest in general that the richer and more varied the plant food resources of an ecosystem, the denser its bird population (Cody, 1974, Holmes and Sturges, 1974)).

HABITAT PREFERENCE AND DISTRIBUTION

The loss of forest habitat has a bearing on abundance and distribution of the inhabiting organisms. It may cause some populations in the area to disappear and some may already have disappeared. The total loss of forest habitat will lead to the loss of all species confined to that habitat. Reduction in size of the forest is expected to lead to the loss of some species (MacArthur and Wilson, 1967; Whitcomb *et al*, 1981). Which species and how many, depends partially on the numbers restricted to the forest. To assess changes in the bird fauna it would be ideal to census birds from each habitat in widely separated areas (Terborgh, 1977) and to follow temporal changes in species diversity associated with habitat modification (Willson, 1974; Leck, 1979; Karr, 1982a, 1982b).

Denudation is largely due to the pressures of an expanding agricultural population and clearfelling of natural forests for replacement with teak and other economic species of timber (Price, 1979). The SWS is also not free from this ever increasing human need and greed for space and natural resources. Cattle grazing and primitive agricultural practice are observed at places far and wide along the sanctuary. There are about 108 villages inside the sanctuary area. The surroundings of human settlements are clearfelled and used for agriculture. Cropfields are therefore found honey combing the SWS. Apart from this, as a apart of afforestation programme, major patches or denuded forest are transformed into monoculture teak plantations. Areas on the way to Nani Singloti, Mathavali, Patavali, Sagai and Mozda (near river) as well as on the way to Kokati and Shisha are the examples of such plantations. Some are mature plantations whereas others are very recent plantations which are unable to support diverse birdlife. Due to all these above mentioned factors the forest is fragmented into patches. Typical thick forest is remaining in small pockets in the central part of the sanctuary as well as on the north western side, the reason is those areas of the sanctuary are comparatively less accessible and in turn experienced less human interference. Surrounding these areas of thick forest, few patches of forest land has experienced blows of the axe and have started thinning down. Although these patches are comparatively less disturbed than the ones which are towards the periphery where only the remnants of forest is seen, still further the denudation of small hillocks and surrounding plains has taken place and turned into scrubland or open areas without any marked vegetation structure (Figure III.3).

Bird community observed in the study area showed varied habitat preference, hence an attempt is also made to classify them into four groups according to Price (1990):

1. **Forest Species** - those species of birds that are virtually confined to the forest
2. **Forest-edge Species** - those bird species that are predominantly forest species but are also commonly found in areas of thick regenerating growth and also where there are fruiting and flowering trees
3. **Edge-forest Species** - those birds that are regularly found in regenerating growth away from the forest
4. **Scrub Species** - found in scrubland and regenerating growth but almost never in the forest.

There are 36 bird species which are totally confined to forest interiors (Table 1). They include larger birds like Crested Honey Buzzard, Sparrow Hawk, Bonelli's Eagle, Crested Hawk Eagle, Crested Serpent Eagle. Other birds which prefer better wooded areas are Grey Hornbill, Alexandrine Parakeet, Yellowlegged Green Pigeon, Hodgson's Frogmouth, Whitethroated Ground Thrush, Large Green Barbet, Racket Tailed Drongo, Blackbird, Velvetfronted Nuthatch apart from Cloropsis, Flowerpeckers, Woodpeckers, Flycatchers, Common Wood Shrike and Cuckoo Shrikes. Fifty six species of birds are representing forest-edge species (Table 1). They are those birds which are found majority of the times in the forest *viz.*, Red Spurfowl and Junglefowl, Brainfever bird, Plaintive Cuckoo, Common Peafowl, Greyheaded Fishing Eagle, Shikra, Indian Pitta, Golden Oriole, Indian Tree Pie, Lesser Whitethroat, White Eye along with Bulbuls, Flycatchers, Owls, Warblers, Sunbirds, Woodpeckers, Drongos, Parakeets, Tits, etc. Edge-forest species are 32 (Table 1) and are hardly found in forest such as Pariah Kite, Whit-eyed Buzzard Eagle, Shaheen Falcon, Green Bee-eater, Grey Partridge, Ring Dove, Large Grey Babbler, Magpie Robin, Indian Robin, Blue Rock Thrush, White Wagtail etc. Whereas 28 scrub species (Table 1) are present which are almost never found in forest and they are Blackwinged Kite, Pale Harrier, Marsh Harrier, Kestrel, Common quail, Common Bustard Quail, Indian Roller, Streaked Fantail and Orphean Warbler, Pied Bushchat, Black Redstart, Crested Bunting, Bush Lark and Finch Lark, Crested Lark and Munias.

Based on the results of this study, it was found that different areas of forest within the SWS had distinct avifaunal compositions. The plantations were found to have a different bird species composition as compared to the natural forests. Though the vegetation is thick in the plantations, typical forest species like Heartspotted Woodpecker, Barred Jungle Owlet, Grey Hornbill, Painted Partridge, Blackheaded Cuckoo Shrike, etc. are not harboured in these areas. The natural forests not only had a higher overall number of species than the plantations, but also had much higher numbers of forest and forest-edge species like Paradise Flycatcher, Large Cuckoo Shrike, Goldenfronted Chloropsis, Whitethroated Ground Thrush, Greyheaded Flycatcher, Yellowfronted Pied Woodpecker, Brown Crowned Pigmy Woodpecker, Whitebellied Drongo, Common Iora, Jungle Crow, Plaintive Cuckoo, Mottled Wood Owl. This shows that a change in forest structure and composition from a mature ecosystem with a diversity of tree species and age classes to a young forest dominated by a few species leads to a change in the avifauna. Birds requiring large trees to nest and/or forage, were absent or significantly less abundant in monoculture of Teak plantations. Similar observations are made by

Table 1. Distribution of birds according to vegetational structure

Forest Species	Forest-edge Species	Edge-forest Species	Scrub Species
Crested Honey Buzzard	Shikra	Pariah Kite	Blackwinged Kite
Sparrow-hawk	Greyheaded Fishing Eagle	White-eyed Buzzard Eagle	Pale Harrier
Crested Hawk-Eagle	Red-spurfowl	Shaheen Falcon	Marsh Harrier
Bonelli's Eagle	Red-junglefowl	Grey Partridge	Kestrel
Crested Serpent Eagle	Spotted Dove	Indian Ring Dove	Common/Grey Quail
Painted Partridge	Little Brown Dove	Roseringed Parakeet	Common Bustard Quail
Yellowlegged Green Pigeon	Roseringed Parakeet	Koel	Blue Rock Pigeon
Alexandrine Parakeet	Blossomheaded Parakeet	Crow-Pheasant	Indian Roller
Pied Crested Cuckoo	Brain Fever Bird	Spotted Owlet	Redwinged Bush Lark
Sirkeer Cuckoo	Plaintive Cuckoo	Green Bea-eater	Ashycrowned Finch Lark
Barred Jungle Owlet	Koel	Indian Roller	Rufoustailed Finch Lark
Hodgson's Frogmouth	Crow-Pheasant	Grey Shrike	Crested Lark
Grey Hornbill	Barn Owl	Rufousbacked Shrike	Baybacked Shrike
Large Green Barbet	Great Horned Owl	Black Drongo	Rosy Pastor
Little Scallybellied Green Woodpecker	Brown Hawk Owl	Rosy Pastor	Common Myna
Heartspotted Woodpecker	Spotted Owlet	Common Myna	House Crow
Blackbacked Woodpecker	Mottled Wood Owl	House Crow	Common Babbler
Larger Goldenbacked Woodpecker	Common Nightjar	Whitecheeked Bulbul	Streaked Fantail Warbler
Blackheaded Oriole	Coppersmith	Redvented Bulbul	Orphean Warbler
Greater Racket-tailed Drongo	Lesser Goldenbacked Woodpecker	Common Babbler	Bluethroat
Common Wood Shrike	Yellowfronted Pied Woodpecker	Large Grey Babbler	Black Redstart

Forest Species	Forest-edge Species	Edge-forest Species	Scrub Species
Large Cuckoo Shrike	Browncrowned Pigmy Woodpecker	Tailor Bird	Pied Bushchat
Blackheaded Cuckoo Shrike	Indian Pitta	Orphean Warbler	Paddyfield Pipit
Goldenfronted Chloropsis	Golden Oriole	Bluethroat	Baya
Goldmantled Chloropsis	Black Drongo	Magpie Robin	Streaked Weaver Bird
Whitebrowed Bulbul	Whitebellied Drongo	Indian Robin	Whitethroated Munia
Greyheaded Flycatcher	Brahminy Myna	Blue Rock Thrush	Spotted Munia
Whitespotted Fantail Flycatcher	Indian Tree Pie	White/Pied Wagtail	Crested Bunting
Paradise Flycatcher	Jungle Crow	Purple Sunbird	
Whitethroated Ground Thrush	Blackheaded Cuckoo Shrike	Tree Sparrow	
Blackbird	Small Minivet	Streaked Weaver Bird	
Velvetfronted Nuthatch	Common Iora	Baya	
Thickbilled Flowerpecker	Redwhiskered Bulbul		
Tickell's Flowerpecker	Whitecheeked Bulbul		
Yellowbacked Sunbird	Redvented Bulbul		
Yellowthroated Sparrow	Jungle Babbler		
	Redbreasted Flycatcher		
	Tickell's Blue Flycatcher		
	Verditer Flycatcher		
	Whitebrowed Fantail Flycatcher		
	Franklin's Wren Warbler		
	Ashy Wren-Warbler		
	Tailor Bird		
	Lesser Whitethroat		
	Magpie Robin		
	Grey Tit		

Forest Species	Forest-edge Species	Edge-forest Species	Scrub Species
	Spotted Grey Creeper		
	Large Pied Wagtail		
	Purple Sunbird		
	White-eye		
	Tree Sparrow		
	Hoopoe		
	Yellow-checked Tit		
	Common Peafowl		
	Purplerumped Sunbird		
	Loten's Sunbird		

Worah (1992) from Dangs forests. In order to support a larger number of bird species, a forest must have a high structural as well as floristic diversity, which is generally not found in monoculture plantations.

However, it was found that a plantation within a natural forest contains higher number of forest and forest-edge species (near Ninai Ghat, on the way to Kokam), than an isolated plantation which consists largely of edge-forest species (on the way to Patavali and near Andu). Even areas adjoining a small patch of natural forest showed a larger number of forest and forest-edge species than would have been expected in a plantation. Such sites are plenty near Sagai and on the way to Kokati. Therefore it appears that the negative effects of plantations, on forest and forest-edge species are, to some extent compensated for by the proximity of a patch of natural forest.

In addition to the effects of vegetational diversity, area and isolation also had an effect on bird species composition. Small and isolated patch of natural forest near Saribar had lost most of its forest and forest-edge species, which are highly area dependent. The natural forest with diverse habitat had the highest number of forest and forest edge species eg. near Chopadi and Junaraj. There are some species of birds which were sighted/reported from this area by earlier workers Ali (1956) and Monga and Naoroji (1984), but have not sighted during present course of study. They may be those birds which require specific habitation *viz.*, Jungle Bush Quail, Small Greenbilled Malkoha, Indian Banded Bay Cuckoo, Indian Cuckoo, Malabar Trogon and Booted Warbler. The loss in the number of habitat specialist species with decreasing forest size corroborates the findings of many other workers (Helliwell, 1976; Humphreys and Kitchener, 1982; Blake and Karr, 1984; 1987; Howe, 1984; Newmark, 1991).

Clearing of forest patches and subsequent replacement of these patches for agricultural practices has created more suitable habitat for birds preferring openlands and cropfields. There are few scrub species of birds which were not reported previously from this area but were sighted during the present study. Presence of granivorous birds like Redwinged Bush-lark, Crested Lark, Common Bustard Quail, Streaked Weaver Bird, Crested Bunting can be accredited to this habitat modification. Cropfields might have attracted many insects which are spread all over the study area. Birds like Verditer Flycatcher, Velvetfronted Nuthatch, Loten's Sunbird, Blackheaded Cuckoo-shrike, Indian Plaintive Cuckoo, Hodgson's Frogmouth all of which were not previously sighted from this area, might be thriving upon this rich insect population.

VERTICAL STRATIFICATION OF BIRDS

Because of their extreme vertical mobility, birds are especially sensitive to vertical stratification of vegetation and because of their size and activity, lend themselves well to observation (Holmes and Sturges, 1974).

Various studies of tropical ecology have included investigation of vertical stratification of both plants and animals, but only a few of these have made precise measurements of the vertical distribution of the organisms being studied. Stratification refers to the distribution of bird species in relation to the vertical distribution of the foliage (Holmes and Sturges, 1974).

A series of questions concerning the vertical distribution of birds should be answered.

- How is the vertical foliage distribution related to the distribution of bird species? What factors affect this relationship? How do this operate?
- Regarding the individual bird species, what differences in both foliage distribution and bird species make such zonation possible or mandatory?
- How stable over time and season is the observed vertical stratification?

A comparison of the vertical distribution profile of birds with that of the foliage in the study area reveals that middlestorey and understorey harbours 56 and 34 species of birds (Table 2) indicating a direct correlation between relative foliage density and the number of feeding individuals.

The canopy is made up of many large branches and therefore can support large species like birds of prey. Canopy preferring birds comprise of 48 species of birds (Table 2). The dense levels around middlestorey however, not only have smaller branches incapable of supporting such large species, but the density of the foliage may prevent larger birds from sallying or snatching prey on wing in this stratum which is why bird species like Owls, Parakeets, Orioles, Woodpeckers, Shrikes, Mynas, Flycatchers, Sunbirds, Flowerpeckers, etc. thrive in this stratum (Figure III.5).

Another reason for birds to occupy the canopy may be the rich resource supply. Leaves at the upper levels usually photosynthesize at maximum rate while the lower leaves most of the time operate close to the compensation point.

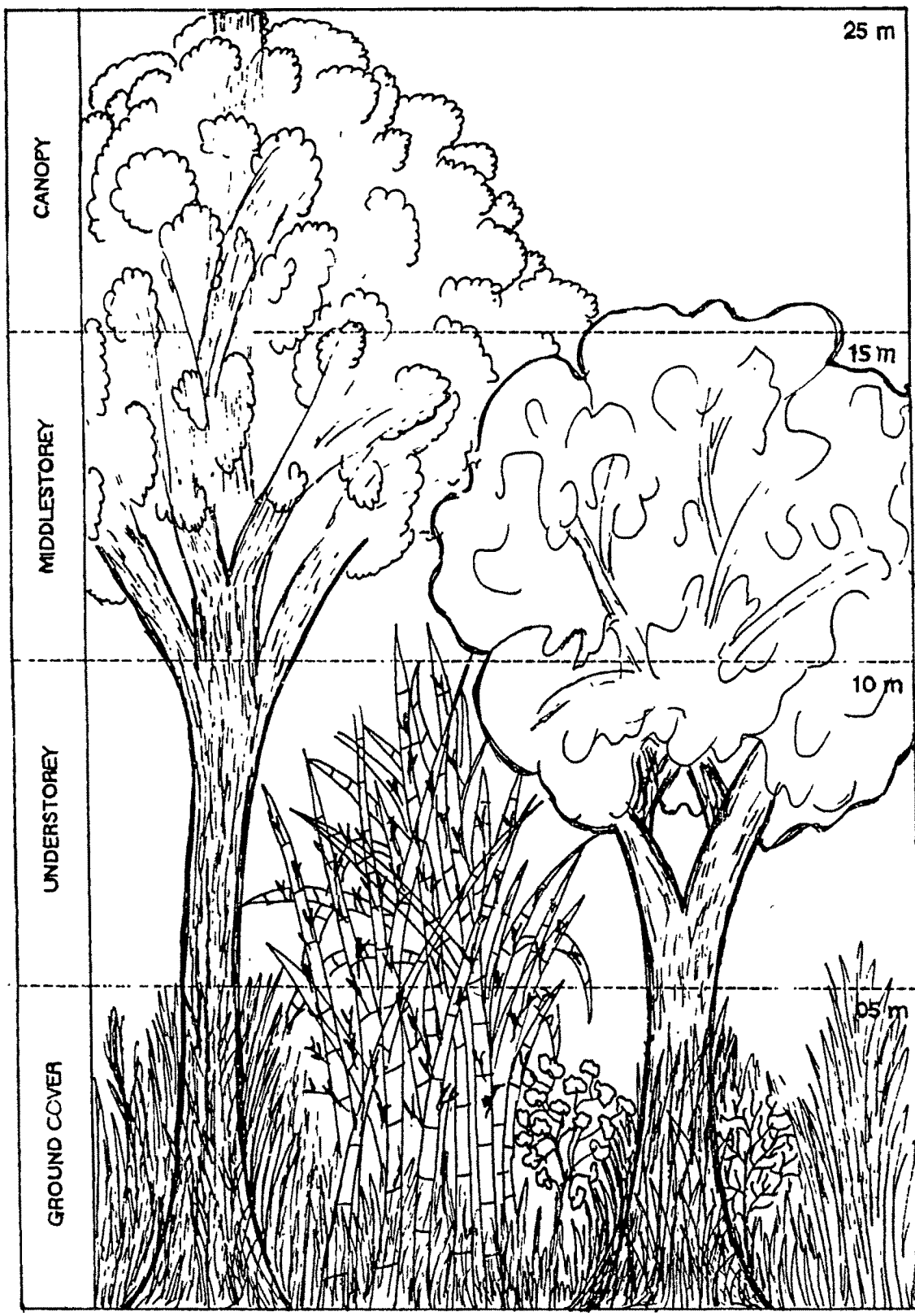
Table 2 . Distribution of birds according to vertical stratification

Canopy	Middlestorey	Understorey	Ground Cover
Crested Honey Buzzard	Shikra	Painted Partridge	Grey Partridge
Shikra	Black Drongo	Sirkeer Cuckoo	Red Spurfowl
Pied Crested Cuckoo	Crested Hawk Eagle	Crow-Pheasant	Red Junglefowl
Greyheaded Fishing Eagle	Bonelli's Eagle	Indian Tree Pie	Common Bustard Quail
Crested Serpent Eagle	Indian Ring Dove	Hodgson's Frogmouth	Little Brown Dove
Yellowlegged Green Pigeon	Roseringed Parakeet	Little Scallybellied Green Woodpecker	Sirkeer Cuckoo
Indian Ring Dove	Blossomheaded Parakeet	Rufousbacked Shrike	Crow-Pheasantl
Alexandrine Parakeet	Brainfever Bird	Common Myna	Indian Tree Pie
Roseringed Parakeet	Koel	Common Wood Shrike	Hodgson's Frogmouth
Blossomheaded Parakeet	Barred Jungle Owlet	Redwhiskered Bulbul	Common Indian Nightjar
Brain Fever Bird	Brown Hawk Owl	Whitecheeked Bulbul	Hoopoe
Koel	Spotted Owlet	Redvented Bulbul	Common Myna
Plaintive Cuckoo	Whitebellied Drongo	Whitebrowed Bulbul	Indian Pitta
Greathorned Owl	Little Scallybellied Green Woodpecker	Common Babbler	Bluethroat
Mottled Wood Owl	Lesser Goldenbacked Woodpecker	Large Grey Babbler	Rufousbacked Shrike
Grey Hornbill	Yellowfronted Pied Woodpecker	Jungle Babbler	Common Wood Shrike
Large Green Barbet	Browncrowned Pigmy Woodpecker	Redbreasted Flycatcher	Common Babbler
Coppersmith	Heartspotted Woodpecker	Tickell's Blue Flycatcher	Large Grey Babbler
Black Drongo	Blackbacked Woodpecker	Verditer Flycatcher	Jungle Babbler
Golden Oriole	Larger Goldenbacked Woodpecker	Whitebrowed Fantail Flycatcher	Franklin's Wren-warbler

Canopy	Middlestorey	Understorey	Ground Cover
Blackheaded Oriole	Golden Oriole	Yellowbacked Sunbird	Ashy Wren-warbler
Whitebellied Drongo	Blackheaded Oriole	White-eye	Magpie Robin
Greater Racket-tailed Drongo	Greater Racket-tailed Drongo	Franklin's Wren-warbler	Blackbird
Brahminy Myna	Brahminy Myna	Ashy Wren-warbler	Indian Robin
Rosy Pastor	Rosy Pastor	Tailor Bird	Whitethroated Ground Thrush
House Crow	House Crow	Orphean Warbler	Forest Wagtail
Common Myna	Bank Myna	Lesser Whitethroat	
Indian Tree Pie	Common Myna	Magpie Robin	
Large Cuckoo Shrike	Indian Tree Pie	Blackbird	
Blackheaded Cuckoo Shrike	Common Iora	Whitethroated Ground Thrush	
Small Minivet	Redwhiskered Bulbul	Grey Tit	
Goldenfronted Chloropsis	Whitecheeked Bulbul	Purple Sunbird	
Goldmantled Chloropsis	Redvented Bulbul	Spotted Grey Creeper	
Redwhiskered Bulbul	Redbreasted Flycatcher	Forest Wagtail	
Paradise Flycatcher	Tickell's Blue Flycatcher		
Tailor Bird	Verditer Flycatcher		
Grey Tit	Greyheaded Flycatcher		
Yellowcheeked Tit	Whitebrowed Fantail Flycatcher		
Velvetfronted Nuthatch	Whitespotted Fantail Flycatcher		
Spotted Grey Creeper	Paradise Flycatcher		
Thickbilled Flowerpecker	Franklin's Wren-warbler		
Tickell's Flowerpecker	Tailor Bird		
Purplerumped Sunbird	Grey Tit		
Yellowbacked Sunbird	Lesser Whitethroat		

Canopy	Middlestorey	Understorey	Ground Cover
Yellowthroated Sparrow	Velvetfronted Nuthatch		
	Spotted Grey Creeper		
	Thickbilled Flowerpecker		
	Tickell's Flowerpecker		
	Purplerumped Sunbird		
	Loten's Sunbird		
	Purple Sunbird		
	White-eye		
	Yellowbacked Sunbird		
	Yellowthroated Sparrow		
	Common Wood Shrike		
	Blackheaded Cuckoo Shrike		

Figure III.5 Vegetational cover at difierent strata in Shoolpaneshwar wildlife Sanctuary



The movement and activity of birds in various strata were oberved closely. Indian Tree pie and Common Myna were found in all the four vertical layers. Some of the birds were found exploring three layers or strata such as Common Wood Shrike, Redwhiskered Bulbul, Tailor Bird, Grey Tit, Spotted Grey Creeper, Franklin's Wren Warbler, Yellowbacked Sunbird, etc. Some of the birds were found moving between two strata either canopy and middlestorey or middlestorey and understorey for better resource exploitation. Those birds that have foliage and bark gleaning habits were mainly found in both middle and understoreys like Little Scalybellied Green Woodpecker, Spotted Grey Creeper, Coucal, Bulbuls, Flycatchers, etc. Rest of the birds were specific to one single layer of the forest. Birds which strictly preferred canopy were Crested Honey Buzzard, Greyheaded Fishing Eagle, Crested Serpent Eagle, Yellowlegged Green Pigeon, Alexandrine Parakeet, Plaintive Cuckoo, Great Horned Owl, Mottled Wood Owl, Grey Hornbill, Large Green Barbet, Large Cuckoo Shrike, Goldmantled and Goldenfronted Chloropsis, Yellowcheeked Tit, etc. Middlestorey preferring birds were Crested Hawk Eagle, Bonelli's Eagle, Barred Jungle Owlet, Brown Hawk Owl, Lesser Goldenbacked, Yellowfronted Pied, Bowncrowned Pigmy, Heartspotted, Blackbacked and Larger Goldenbacked Woodpeckers, Common Iora, Greyheaded Flycatcher, Whitespotted Fantail Flycatcher, etc. Those birds which prefer bushy areas and those which are skulking in nature were found preferring understorey. Such skulking species were Painted Partridge, Whitebrowed Bulbul and Orphean Warbler. Terrestrial species of birds are found to have greater weight as the ground can support heavy species and such species were Grey Partridge, Red Spurfowl, Red Junglefowl, Common Indian Nightjar. Apart from these species other ground dwelling species were Hoopoe, Indian Pitta, Bluethroat and Indian Robin (Table 2).

One group of birds in particular seemed not to show any stratification. These were the Scrub Species that were common in the forest clearings and around cropfields and human habitations (Table 1).

Most of the birds in mixed species feeding flocks were found foraging high only when the flock was in the immediate vicinity may be to provide protection from predators. Similar observations were also made by Pearson (1971). They were found moving downwards into the protection of dense lower foliage.

There may be shifts in the vertical movements of the avian community with the time of day. They were found moving downward during the middle of the day. The possible reasons for such a downward shift in stratification may be (1) the movement of food (insects) to lower levels (2) increased activity of insects making them more difficult to capture (3) moisture conservation (4) escape from mid-day heat stress (5) escape from the high degree of solar radiation.