CHAPTER VII

SUMMARY AND CONCLUSIONS
The present study has looked into the avifaunal and floral composition of three major different habitats, the moist deciduous forest, the evergreen forest and the teak plantation of Parambikulam Wildlife Sanctuary, a biodiversity rich area of Western Ghats in Palghat district of Kerala.

The Sanctuary is noted for its diversified bird fauna. A total of 261 taxa of birds belonging to 59 Families under 17 Orders were recorded from here during the study period. Out of these, 229 were residents and 32 migrants. Highest number of birds observed come under the order, the Passeriformes followed by Falconiformes and Coraciformes. Among the various foraging guilds the insectivores were of highest occurrence followed by carnivores and aquatic feeders.

Out of 16 endemic species of birds known in the Western Ghats, 10 were observed in Parambikulam Wildlife Sanctuary. Of the 31 threatened bird species reported from Western Ghats, 10 species were noted in this Sanctuary.

**Vegetation Physiognomy**

33 species of trees, 25 species of shrubs and 15 species of herbs were recorded in the moist deciduous forest. 99 species of trees, 16 species of shrubs and 13 species of herbs were noted in the evergreen forest. In teak plantation, 19 species of trees, 20 species of shrubs and 18 species of herbs were recorded. In the moist deciduous forest *Grewia tillifolia* had the highest density followed by *Lagerstroemia microcarpa*, *Terminalia paniculata*. But in evergreen forest *Palaquium ellipticum*, represented with the highest density followed by *Vitex altissima*, *Mesua ferra* etc. Out of the 19 tree species recorded in plantation, *Pongamia pinnata* placed first in density followed by *Terminalia paniculata*. In moist deciduous forest the diversity index was highest for trees species followed by shrubs and herbs. In the case of evergreen forest the highest diversity was observed in trees followed by
shrubs and herbs. But in teak plantation highest diversity index was for shrub species followed by trees and herb species.

The diversity of tree species was high in evergreen forest followed by moist deciduous forest and teak plantation. The moist deciduous forest was dominated by short and small trees whereas the evergreen and plantations have taller and broader trees. The greater abundance of teak (*Tectona grandis*) is seen in most of the areas of the plantations. The foliage height diversity was higher in evergreen forest and lower in other habitats.

**Bird Communities**

The species richness was highest in the moist deciduous forest and lowest in teak plantation. A minimum of 1895 individuals were recorded in teak plantation and a maximum of 5002 individuals in moist deciduous forest. In moist deciduous forest the species richness was highest (169) in the month of December followed by November (163) and lowest (63) was in June. In the case of evergreen forest highest species richness was recorded (74) in the month of December followed by January (72) and lowest (30) was observed in July. In teak plantation the month of December marked the highest species richness (98) as in the case of other habitats, followed by February (89) and lowest was noted in July (42).

The highest number of birds was recorded in December (630) and lowest in June (220) in moist deciduous forest. Maximum number of birds recorded in November (322) and minimum in June (122) in the evergreen forest. In Plantation highest number of birds was recorded in December (230) and lowest in June (92).

In moist deciduous forest Red-vented Bulbul, Small Green Bee-eater and Yellow-browned Bulbul were the highest in dominance. In the the evergreen forest, Hill Myna is the most dominant bird species followed by Purple Sunbird and Copper
Smith Barbet. Common Myna, Small Green-billed Malkoha, Red-whiskered Bulbul were the highest in dominance in teak Plantation.

In moist deciduous forest highest diversity index was in December (3.95) and lowest in July (2.5). In evergreen forest January (3.13) marked the highest diversity index and June (2.08) the lowest. But in teak plantation maximum diversity index was in December (3.47) and minimum in July (2.32). Similarity indices of Jaccard and Sorenson showed high similarity between evergreen forest and teak plantation.

Season-wise observations revealed that the second year wet season-I held the minimum number of species (78) and the first year wet season-II the maximum number (128) in moist deciduous forest. Highest number of species (106) was recorded in the second year wet season-II and lowest in first year wet season-I (59) in evergreen forest. In the case of the teak plantation the second year wet season-II possessed the maximum number of species (106) and the first year wet season-I the minimum number (32).

A minimum number of individuals (1004) in the second year wet season-I and maximum of individuals (2668) in first year wet season-II were recorded in moist deciduous forest. But in evergreen forest highest number of individuals (1114) were in the first year wet season-II and lowest (708) in first year wet season-I were observed. With regards to teak plantation maximum number of individuals (892) was in the first year wet season-II and minimum (514) in the second year wet season-I.

Highest density was recorded in the first year wet season-II (1074 birds/sq. km) and lowest in the second year wet season-I (466 birds/sq. km) in the moist deciduous forest during the study period. But in evergreen forest a minimum density of birds was noted in the second year wet season-I (361 birds/sq. km) and maximum in first year wet season-II (502 birds/sq. km). Teak plantation was characterized by a maximum density of birds in the second year wet season-II (482 birds/sq. km) and
minimum in first year wet season-I (323 birds/sq. km). A significant negative
correlation was obtained between abundance of birds and rainfall.

839 species of insects belonging to 106 families under 13 orders were
collected from the Parambikulam Wildlife Sanctuary. Significant positive correlation
between bird diversity and insect diversity was obtained in evergreen forest, but the
same was not significantly correlated in moist deciduous forest and teak plantation.

The species richness and abundance of birds are higher during the wet
season-II in all habitats. The presence of locally moving birds and winter visitors are
one of the major factors responsible for the higher diversity in the wet season-II and
food availability also was higher during this season. There noted an emergence of
insects with the coming of rainy season in the Sanctuary and their abundance
increased as the rainy season progressed. Insectivore species such as Flycatchers
and Warblers were constantly increased in all the habitats with insect abundance. In
general, as the stability of food resources increases the diversity of the fauna
exploiting that resource also increases. This study indicates that rainfall influences
the tropical forest bird community.

**Foraging Behaviour**

Foraging records were collected at the study area during December 2002 to
November 2003. For each foraging attempt, microhabitat details such as the height
above ground level, the substrate of the prey and foraging method were noted.
Foraging attempts were observed for different height categories from ground level.

Foraging behavior of only common resident and migrant species in the
different habitats were studied. A total of 2905 observations were made on 29
species in the moist deciduous forest, 22 species in the evergreen forest and 28
species in teak plantation.
Various height categories were considered as foraging heights. In moist deciduous forest 5 species were found foraging mainly on the ground. Nine species resort to 0 - 2 m height. In the tree layer (>2m height) 15 foraging species were observed. They are of the three specializations, foraging method is the most prominent followed by foraging substrate and foraging height. Spotted Dove and Jungle Myna are specialists in foraging method and foraging substrate.

In the evergreen forest, 18 species were found to utilize 0-2 m height and in the tree layer (> 2 m) 18 species were observed. Four species, foraged mainly on the ground. Out of the three specializations, most prominent was foraging method followed by foraging substrate and foraging height in the evergreen forest. White-headed Babbler is a specialist in foraging height and foraging method.

Five species foraged mainly on the ground in teak plantation. 23 species were noted in the 0-2 m height. In the tree layer (>2 m) 26 species were found. Of the three specializations, most pronounced was foraging method followed by foraging substrate and foraging height in teak plantation. Spotted Dove, White-headed Babbler and Jungle Babbler are specialists in foraging height and foraging method.

The present study reveals that considering the food as a limiting resource, birds have evolved morphological features as adaptations suited to their foraging methods.

Among the bird species recorded in moist deciduous forest, evergreen forest and teak plantation, there are four major groups based on the food eating habit, viz., insectivores, nectarivores, granivores, and frugivores. There are four separate foraging environments in the different habitats at Parambikulam Wildlife Sanctuary (Forest floor, shrub, tree and air).

A total of nine foraging methods were used by birds in the selected habitats of Parambikulam Wildlife Sanctuary. All the birds in these habitats showed overlapping of their microhabitat and foraging method. The patterns of community changes are found to be due to the shifts in the number and composition of species.