V. DISCUSSION

5.1. Habitat-wise distribution of bird species

Results of the present study revealed that the species richness differed between habitats and same bird species are restricted to some habitats. For e.g., the number of habitat restricted species (found only in that habitat) was one in Dry Deciduous Forest and 10 in the Moist Deciduous Forest, 10 in the Scrub Jungle, 2 in the Scrub Jungle, 2 in the ecotone between Dry deciduous and Moist deciduous forests and 8 in the Riverine habitat. Thus it could be inferred that the Moist deciduous forest and Scrub jungle are more important from the avian diversity viewpoint.

Moist deciduous habitat is characterized by very high tree density and canopy volume, more fruit bearing trees and is also not affected by fire. So, species like the Bonelli’s Eagle, Oriental Hobby, Green Imperial Pigeon and Malabar Trogon which prefer only tall trees and closed canopy were found only in this habitat.

The Scrub forest serves as a habitat for a great bio-diversity of terrestrial birds and a larger population by more than one reason. There are many fruit bearing trees, climbers and shrubs for frugivorous birds like parakeets, barbets, bulbuls, cuckoos, etc., and many termite mounds for insectivores birds in this area. The bird species like Red Spurfowl, Yellow Wattled Lapwing and Oriental Turtle Dove which prefer open canopy were found only in the scrub jungle. Within a study period of 2 years time, it was found that out of 169 species sighted 115 were sighted in the scrub forest. This sowed that the notion that scrub forest covers have little value and can be dispensed with in favour of other kinds of land use can
not be sustained. The present study revealed that is an invaluable segment of this sanctuary and it should be preserved to support the diversity of avian fauna.

5.2. Seasonal variation in avian population characteristics

Significant seasonal variations were observed both with regard to population of individual bird species (Figs. 4.1 to 4.57) and various groups of birds (vide Tables 4.12 and 4.18, 4.20 and 4.22 Figures 4.58 to 4.114). Andrewartha and Birch (1954) also felt that climatic factors are the major ones influencing the size of animal populations. Seasonal variation in avian species composition and abundance had been well documented (Lack 1954; Leck, 1972; Winternitz, 1976; Gaston, 1978; Liversidge, 1980; Martin, 1980; Rice et al., 1980; Greenburg, 1981; Karr et al., 1982; Mahabal et al., 1990; Asokan, 1995). Moss et al. (1982) opined that weather can be important either by itself or through its effects on food supplies; animals seem to limit their own numbers below any threshold set by weather, food, disease, predation, parasites or places to live. Territoriality or food can limit populations during non-breeding seasons (van Balen 1980).

5.3. Major Factors Influencing Avian Diversity in Mudumalai Wildlife Sanctuary.

5.3.1. Vegetation characteristics and Avian Diversity

The multiple regression analysis showed that the vegetation characteristics such as canopy volume, the species richness and flowering tree density and diversity played an important role in influencing the avian diversity across the habitats studied (vide table 4.37). Relationship between vegetation characteristics avian diversity measures were reported earlier also (Mac Arthur and Mac Arthur, 1961; Mac Arthur et al., 1962; 1966; Karr, 1971; James and
Shuggart, 1973; Tomoff, 1974; Wilson, 1974; Terborgh, 1977). Gochfeld (1978) also found that *Mimus triurus* increased in density with vegetation height. The role of vegetation characteristics on bird occurrence had also been established by Sturman (1968) who found the chestnut-backed chickadees (*Parus rufescens*) were found to select taller coniferous vegetation and Black-capped chickadees (*P. atricapillus*) to select habitats where bushes and middle-storey trees were common. Vegetation density was reported to be an important factor in habitat segregation among thrushes by Fischer (1980). According to Cody (1985) birds distinguish habitats on the basis of vegetation structure and structural aspects of habitats can be used to predict bird diversity as the numbers of species that pack into a habitat are directly related to structural diversity and in turn structural diversity is related to either resource diversity or the number of ways in which resources can be partitioned.

5.3.2. Fire

Fire usually occurs in alternative years (if the fire is high in one year, in the immediate next year it usually will be less) due to various reasons. The prime reason is dry litter accumulation, which will stagnate in alternative years. Another reason is fire setters *i.e.*, the poachers and some horn collecting people, who set fire for ground clearance. The antler shedding will be in peak during November and December. If the forest is burned every year, the horn collection will be less and so they are setting fire every alternative years intensively. Fire seemed to have mainly depending upon the ground cover intensity, so that the tall grass and high weed areas are often getting burnt.

Fire occurrence were found to have a linear relationship with the overall density of birds (multiple regression analysis; vide table 4.37) indicating that some
bird species are attracted in large numbers to those areas. Bock and Lynch (1970) also found that burnt coniferous forests in the Sierra Nevada supported a few more species and larger species than unburned forests, presumably because of higher productivity of food supplies.

5.3.3. Cattle grazing

The cattle grazing was found to influence the bird species richness (vide table 4.37) in the habitat studies. Cattle grazing was found only in scrub jungle area. Results of the present study showed that the species richness was highest in the Scrub jungle (115 species). So, the positive linear relationship between the bird species richness and cattle grazing obtained might actually be a reflections of the habitat feature rather than anything directly with cattle grazing intensities. However, a rapid survey by Vijayan et al. (1989) in the Nilgiri Biosphere Reserve showed that bird abundance and species diversity were greatly reduced by human interference factors such as cattle grazing. So, long term studies are needed in future to understand fully the impacts of cattle grazing on avian diversities.

5.3.4. Weeds

5.3.4.1. Weed distributions

Elevation, habitat disturbance, rainfall and fire seemed to have major influence on the intensity and pattern of weed distribution.

At 900 – 950 m elevation, the weed distribution status was low; between 950 – 1000 m elevation the weed intensity was high; from 1000 – 1100 m elevation the weed distribution was sparse. Both Lantana sp. and Eupatorium sp. distribution follow the above pattern with regard to elevation.

Weed invasion was very high where the human interference was high. In Tourism zone comportments 1, 3 – 25, the weed intensity was high. These
comportments were altered for Tourism improvements such as provision of salt
licks, water holes, roads and watch towers, which attract visitors. Dry deciduous
high weed areas are also characterised by human settlements.

Rainfall might also have played a significant role in weed invasion as
lower (600 – 800mm) and higher (1800 – 2000mm) rainfall areas are affected with
low weed intensity and the medium (1000 – 1200mm). Rainfall areas are affected
severely by weed invasion.

Another factory that might have influenced weed distribution is fire; as
severely fire affected areas of previous years were highly invaded by weeds. In
previous years, the fire frequency was very high in Dry deciduous areas especially
Tourism zone, which is also having high weed intensity.

5.3.4.2. Avian diversity and weeds

Weed intensity was found to decrease the avian diversity (vide table 4.37).
But the bird species richness was more in high weed intensity areas (vide table
4.41). *Lantana* sp. is a major food plant for various Frugivorous birds and
omnivorous birds. These exotic plants especially *Lantana* sp. also helps the birds
to breed and hide. The common peafowl was previously (before more weed
invasion) distributed Mudumalai in very less numbers but now the population is
very high. In low weed areas the common peafowl distribution is very less and in
high weed intensity areas the peafowl distribution is also very high.

5.4 Avian Guilds

The cluster analysis (vide Figs 4.115 to 4.117) revealed that the six
habitats were better separated by their foraging guild composition suggesting that
the different kinds of food availability in different habitats determine their avian
species composition. Thus for a given forest type in the study area the avian
foraging guild assemblage tends to be more characteristic than bird species assemblage or nesting guild.

Discriminant analyses (vide tables 4.38 and 4.39) revealed significant difference between both the species and guild assemblages in the habitats. The result that the habitats could be delineated with high accuracy (99.5%) by species composition indicated that the habitat types studied have overall species composition that are characteristic of a given habitat. It was already mentioned in this text that the bird species composition differed between habitats.

Foraging guild composition was found to classify correctly 99.9% of the grouped cases; correct classification of 99.5% and 66.7% was achieved using species assemblage and nesting guild. This indicated that the habitats studied have dissimilar foraging guilds, especially guilds that are monotypic or rare ones are most discriminating. Vale et al. (1982) in a review of bird communities and vegetation studies across the United States also found foraging guilds to be useful in distinguishing broad ecoregions with characteristic bird communities. However, Landres and MacMahon (1980) stated that the use of guilds, since they are investigator-designed which, introduces circularity into their use in ecological analysis. Nevertheless, the potential utility of the guild concept to resource managers is great if species are arranged in guilds that accurately reflect their habitat/resource use (DeGraaf and Chadwick, 1984).

5. Management Recommendation

The following management recommendations are suggested for protecting avian diversity in the sanctuary.
1. Habitat-wise management strategies depending on the uniqueness of bird species of that habitat must be devised. Structural diversity with regard to vegetation in different habitats must be preserved.

2. Planting of fruit-bearing trees may be undertaken in the dry deciduous forest to increase avian diversity.

3. Fishing operations should be controlled in the riverine areas for the benefit of water birds which are found only in these areas of this sanctuary.

4. The exotic plant weeds plays a major negative role on habitat quality. These exotics will have to be eradicated from the ecosystem by some effective methods. There are two methods to destroy the exotic plants. One is chemical method, this method is not applicable in wildlife sanctuary areas; another one is physical method. This second one is biotic and non side effective. The exotic plants may be pulled out by physical method. The captive elephants may be utilized to pull out the exotic plants. This eradication program may be followed in July and August months because during this month only the exotic weeds occur in full growth and are in on fruiting. The pulled out plants will have to be dumped in one place. The above method can be followed to remove the Lantana sp. One disadvantage in this physical pullout is Eupatorium sp. is that its stump are slim and weak in strength. If we pull the plants, the stump breaks and the root portion will be cut off and remain in the soil. After some time coppice will grow and compensate the loss in intensity.

5. To control fire, the fire tracing unit will have to be strengthened and more staff will have to be engaged. Two centralized stations may be launched. One is in Upper Karugudi (other than MIC-6) and another one is in
Doddahalla. This should be equipped with wireless sets, and all the fire fighting equipments. Control burning is another way to prevent the fire. Frequently fire affected areas will have to be identified and extra fine lines may be laid.

6. Due to cattle trampling, the ground nesting birds’ broods are being destroyed. So, steps must be taken to stop this menace of cattle grazing in the sanctuary.

7. The collection of bird eggs by local villagers must be stopped.

8. Entry of domestic and feral dogs into the sanctuary area should be controlled to protect ground nesting bird species.

9. Ecotourism with emphasis on bird watching should be promoted as results of the present study clearly established the high degree of avian diversity of the sanctuary.

10. The Forest interpretation center at Theppakkadu should be provided with personnel to act as trained guides for bird watching, and field guides for the birds of this sanctuary sanctuary should be published.

11. Long term research and monitoring of bird populations should be undertaken to conserve avian diversity in this sanctuary.