CHAPTER-1
INTRODUCTION

1.1 Background

Ecological communities are the characteristics and properties of the assemblages of species populations (Koromondy 1989) or the group of population that occur together (Ricklefs 1990). Identification of patterns that characterise natural assemblages of species and factors responsible for them have been the two major priorities in community ecology studies. Being ecologically diverse and sensitive to various kinds of perturbations, avian community acts as a better predictor of the quality and health of the habitat than single species.

Approach in conservation has undergone great change during the last few decades. The shift in emphasis from single species to the community level has transformed the very trend of the traditional studies. Avian taxa have fortunately been receiving due attention, since the adoption of modern approach and a string of studies on avian communities have been undertaken recently. This trend received further boost after the publication of Robert MacArthur's classic paper on 'Bird Species Diversity'. Published in 1961, this study led to several studies aimed at investigating the relationship between bird species diversity and structural diversity of the habitat.

Considering the number of scientists following the trend and the magnitude of literature published, it becomes evident that bird community studies is the fastest growing
branch of ecology since 1960 and has significantly contributed to the advancement of field ecology. The outcome of these developments are the generation of new ideas, critical evaluation of the existing theories and models and even formulation of new theories, some of which are quite radical based on sound research and critical evaluation.

1.2 History

The beginning of the community ecology can be traced back to the trend setting conclusion drawn by Clements (1916) that communities are discrete assemblages which are closely integrated. This was contrary to Gleason (1917, 1926) who said communities lacked internal organisation. However except for studies by Lack (1933), Kendeigh (1934) and Odum (1950) this branch did not receive much attention of the biologist till Macarthur's work in 1950's.

The real boost to community ecology was given by MacArthur and MacArthur (1961) after the publication of their paper on "Bird Species Diversity" which established the view that bird species diversity is a function of foliage height diversity. This seminal work in fact revolutionised the thinking on the subject and a series of studies on the same lines followed.

Karr *et al.* (1982), Rice *et al.* (1983), Blake and Karr (1984), Holmes (1990) and Block and Brennan (1993) are some of the studies which followed the trend.

### 1.3 Pattern and Processes

Two types of avian community studies can be distinguished; the pattern based and the process recognition. There is a clear-cut dichotomy between the two type of studies. Detection of pattern and documentation of underlying process are conceptually separate and generally sequential (Wiens 1989).

Most of the above studies in fact, have been an attempt to explore the pattern in bird species diversity alpha, beta and gamma diversity; at a scale which varies from local, regional to panglobal (Karr 1971, 1976, 1976a, 1976b, 1980; James and Shugart 1970, Karr and Roth 1971, Terboh 1971, Pearson 1977, Bell 1982, Emlen 1986 and MacNally 1994).

Patterns in avian communities are based on some deterministic processes- a cause and effect relationship (MacArthur and Wilson 1967). Competition also plays an important role in community organisation and is responsible for the structuring of species along a resource-utilisation axes (Cody and Diamond 1975).

Pattern exploration studies are relatively simple, as the underlying patterns are often easily discernible and that has been the reason for more studies on pattern exploration than process recognition, though it is important to explain the patterns which are based on understanding of the processes (Wiens 1989). Thus the difficulty in studying the processes
such as interaction leading to competition, immigration, emigration and habitat selection has permitted only few studies (Cody 1975, 1985; Sherry and Holmes 1985, Terborgh 1985).

Some investigation of community patterns has revealed the relationship between bird species diversity and foliage height diversity (MacArthur and MacArthur 1961; MacArthur and Pianka 1966; Recher 1969, James 1971, Erdelen 1984) however some studies have failed to establish the same relationship in the tropical forest habitats (Pearson 1982, Wiens 1983).

Bird species diversity have also been found to be the function of certain features of habitat. Other than vertical layering in the foliage, such as total foliage volume (Karr and Roth 1971), vegetation cover (Karr 1968, Wilson 1974), total crown volume (Verner and Larson 1989), trophic level (Airola and Barett 1985), foraging strategies (Holmes 1979, Holmes and Robinson 1981, Sabo and Holmes 1983, Holmes and Recher 1986a 1986b, Poulin et al. 1994 and Cale 1994), aspects of physiognomy (Wiens 1973, Roth 1976, Holmes 1986, Brown and Stillman 1993), canopy cover (Wiens and Rotenberry 1981, James and Warner 1982) also are important variables which affect the BSD.

Food is one of the key factors in understanding the community patterns (Terbogh 1985). A substantial increase in tropical zone bird species over temperate zone in a similar habitat is due to substantially greater fruit availability (Cody 1985).
Various environmental factors also affect the communities such as rainfall, drought (MacArthur 1964, Karr 1976b, Holmes et al. 1986) and the climatic instability, which limits the opportunity for niche diversification (Wiens 1989).

Communities have a history and their attribute at any time bear the imprint of that history (Wiens 1989). The disturbance factors such as drought, human activities in the past also influences the composition of present day community in any area (Wiens 1977, 1989, Jarvinen and Halla 1984).

Bird species diversity and richness is also related to the size and extent of vegetation i.e patchiness (Beals 1964, Best and Stauffer 1980). Bird assemblages based on species composition, abundance, richness and diversity along with other attributes as rarity and endemism are frequently used for ornithological evaluations and assignment of conservation values to sites ( Fuller 1980, Fuller and Langslow 1986, Daniels et al. 1991). Birds are also considered to be a good indicator of environmental quality and are frequently being used to monitor environmental and ecosystem health (Jarvinen and Vaisanen 1979). Several current day studies are focussed on avian communities for environmental impact assessment (EIA).

Avian communities are also susceptible and responsive to changes in the land use pattern (Daniels et al. 1990). Habitat fragmentation as a consequence of clearance of large tracts of forests leads to changes in the avifaunal structure and composition. Species with narrow habitat ranges respond to such changes either by becoming locally extinct or show a decline, whereas some species adapt to habitat fragmentation (Arnold and Weeldenburg
Many species of Neotropical migrants have declined in small isolated woodlots (Lynch 1987, Wilcove and Robinson 1990).

1.4 Rationale

A review of the existing literature indicates that community studies have been mostly in the temperate region and relatively few in the tropics. Of the 60 odd papers reviewed for this section more than 60% pertain to studies in the temperate regions while about 40% are from studies in tropical forests. These nearly 40% studies have been mostly carried out in the Neotropics.

In India only few studies on the avian community were taken up before 1990's. Beehler et al. (1987), Katti (1989), Daniels 1989, Daniels et al. 1990, Daniels et al. 1991, Daniels et al. 1992, Price (1990), Price and Jamdar (1990), Sundarmoorthy (1991) and Johnsingh and Joshua (1994) are the only studies.

At the biogeographic level; only two studies have been conducted in the Himalayas, both in the North-western (Katti 1989, Price and Jamdar 1990) and two in semi-arid regions (Gaston 1983 and Sundarmoorthy 1991). All other studies have been conducted in the Western Ghats except for Beehler et al. (1987). There have been no studies in the Gangetic plain particularly and none in the terai region.

Lying in the Upper Gangetic plain biogeographic zone (Rodgers and Panwar 1988) the study site falls under a very important sub-region terai. This region has witnessed some of the
most drastic changes owing to the changed land used pattern and is ornithologically poorly known.

Earlier studies in Dudwa National Park had focussed on few single and threatened species such as Swamp deer, Bengal florican and the rhinoceros. Realising this and the current management practices in the Park the work on bird community in Dudwa National Park was envisaged. This study has been conceived to address certain questions regarding the avian community structure and to test whether the much discussed relationship between Bird Species Diversity (BSD) and Foliage Height Diversity (FHD) is applicable or not? Study has been designed to answer certain question and testing some hypotheses. Special attention has been paid on the affect of burning of grassland on the avifaunal composition, density and diversity.

With these perspectives in mind the plan to study bird communities of Dudwa has been envisaged. This research into the avian community structure of Dudwa can yield some valuable information on the avian community organisation in relation to habitat structure in general and overall functioning of the ecosystem in particular. Conservation organisations are increasingly using ornithological evaluation as component of wildlife assessment (Fuller and Langslow 1986). The base line data gathered on the effect of various management practices on the state of the flora and fauna can be helpful in outlining a conservation strategy for the better management of the Park.
1.5 Objectives

The avifaunal investigation of the area will be based on the following clearly defined objectives and the context in which they have been laid out. To achieve this, following questions will be put forth:

i) In what way the diversity of bird communities is related to the structural diversity of their habitat?

ii) What factors determine the limits to the similarity of the co-existing species?

iii) What are the important factor(s) which determines the species in its habitat?

To answer these questions following objectives are outlined:

1. To conduct bird community studies in moist deciduous terai forest of Dudwa National Park.
2. To evaluate bird species diversity (BSD), bird species richness (BSR), relative density and composition over a period of time.
3. To find out how the various habitat parameters affect the species diversity and density.
4. To investigate the effects of management activities for the maintenance of grasslands of the area on the avifaunal composition.

1.6 Hypotheses

The following hypotheses will be tested

1. Bird species diversity is greater in habitats of greater vegetational diversity.
2. Bird species diversity is a function of foliage height diversity (FHD) and cover values.
3. There are more "specialist" in grasslands than in any other habitat.
4. There is little difference in bird species composition in the tall and short grassland and mixed forest is more rich and diverse than specialised habitats of grasslands and Sal forest.

5. The greatest diversity is in the riparian habitat and a similar but disturbed habitat is poor in species composition with more generalists and opportunistic species.

1.7 Organization of thesis

The thesis starts with an introduction in Chapter 1, which includes an overview of the work done on the avian communities particularly explaining the trend in community studies. The chapter also discusses some of the studies carried out in India. Chapter 2 gives detail of the study area, with a description of the terai habitat its status and conservation problems.

Chapter 3 gives a fairly detailed account of vegetation where the transects were monitored. This was done for better understanding of bird habitat relationships. The Chapter 4 is an important chapter dealing with the avian densities in the selected habitats and interpretation of the variation in densities within and between habitats. This chapter also includes distribution pattern of birds in each habitat and models for distribution. This chapter along with the Chapter 6 on guilds and Chapter 5 on Bird-habitat relationships is the mainstay of this thesis.

Chapter 5 on bird guild structure is the first such attempt in India to classify and ordinate avian guild based on quantified data on foraging unlike the priori guild classification done in most of the other studies. The final part of the thesis (Chapter 6) gives a full account of bird-habitat relationship, including the testing of BSD vs. FHD relationship. The chapter also
provides three habitat models for relationship between bird species diversity and habitat features.