BIRD COMMUNITY STRUCTURE IN A FEW SELECTED FOREST TYPES OF KERALA

THESIS

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By

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CERTIFICATE

This is to certify that this thesis entitled "**Bird Community structure in a few selected forest types of Kerala**" is an authentic record of the bonafide research work carried out by Sri. P.O. Nameer, from October 2000 to December 2004, under my supervision and guidance and that no report of this work has been presented before for any other degree or diploma. It is further certified that Sri. P.O. Nameer passed the Ph.D. qualifying examination held in December 2002 conducted by the University of Calicut.

Dr. M. NASSER

Calicut University (PO)
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Introduction

INTRODUCTION

1.1 Bird Community

At its simplest, the term community describes a group of populations and is the corner stone of natural resource conservation. Individual species cannot be protected effectively outside the biological context afforded by the community they occupy. Similarly, biological communities exist in the matrix of other communities that constitute an ecosystem. Communities will be substantially degraded if not maintained within the context of their encompassing ecosystems. Interchange among communities greatly enriches those communities, in terms of both species diversity and the biological interactions that drive the systems. Although this concept has become a *modus operandi* in conservation biology, ecosystem approach to conservation is still persistently ignored by government agencies as well as other conservation related organizations (Stotz, *et al.* 1996).

Compared to the temperate zone, elevated species diversity and pronounced local endemism characterize most tropical ecosystems. This makes it imperative that conservation in the tropics be approached from a community viewpoint rather than a focus on individual species. Except in a few noteworthy cases threatened species and endangered species in the tropics exist amid assemblages of less visible but also imperiled forms.

Certain organisms can play a key role in helping to identify integral biological communities in need of protection. Such indicator species share at least one of the following biological features: endemism, habitat specialisation, and rarity or sensitivity to habitat disturbance. Having one or more of these characteristics typically places an organism at higher risk of extinction. Areas with many such species contain vulnerable biological communities and should figure prominently in a list of priority sites for protection.

The operating hypothesis is that ornithological studies provide a means of assessing, quickly and accurately, the ecological characteristics and conservation status of most terrestrial communities. Many characteristics of birds make them ideal biological indicators. The characteristics include, conspicuous behaviour, rapid and reliable identification, ease of sampling, diversity and ecological specialisation and high sensitivity to disturbance.

1.2 Kerala context

The State of Kerala is located in the west coast of peninsular India between 8° 18' & 12° 48' N and 74° 40' 77° 50'. Kerala is remarkably well known for the luxuriant vegetation and rich biological diversity. The geographical isolation of this State - bordered in the west by the Arabian Sea and in the east by the Western Ghats - and its peculiar physiographic, edaphic and climatic gradients have

contributed significantly to the development of diverse types of ecosystems, each supporting a unique assemblages of biological communities with an impressive array of species and genetic diversity (Pushpangadan, *et al.*1997).

1.2.1 Forests of Kerala

Forests cover 24 per cent (9400 sq. km) of the total geographical area of Kerala (Anonymous, 1994). Classification and extent of major forest types in Kerala is given in Table 1.

Table 1. Classification and extent of major forest types in Kerala

Forest type	**Area (sq. km.)**
Tropical wet & semi evergreen forests	3449 (36.69%)
Tropical moist deciduous forests	4100 (43.62%)
Tropical dry deciduous forests	100 (1.06%)
Montane subtropical and temperate forests (sholas)	70 (0.75%)
Grasslands	130 (1.38%)
Forest plantations	1551(16.5%)
Total	**9400 (100%)**

1.2.2 Protected areas of Kerala

The protected areas of Kerala fall under four categories. A summary of information (after Basha, 1997), on the protected areas of Kerala is given in Table 2.

Table 2. Summary of information of the protected areas of Kerala

Name	Location (E long. & N lat.)	extent (km2)	Year	District	Major vegetation types
Wildlife Sanctuaries					
Aralam	11°53'N-11°59'N 75°46'E-75°56'E	55	1984	Kannur	EG, SEG & plantations
Chimmoni	10°22'N-10°29'N 76°25'E-76°34'E	75	1984	Thrissur	EG, SEG,MDF & reservoir
Chinnar	10°15'N-10°21'N 77°5'E-77°16'E	90.44	1984	Idukki	DDF, Scrub Jungle, dry bamboo break & GR-SH
Idukki	9° 53' & 76° 55'	70	1976	Idukki	EG, SEG,MDF, bamboo breaks & reservoir
Neyyar	8°30'N-8°37'N 77°8'E-77°17'E	128	1958	Thiruvanan-thapuram	EG, SEG,MDF,GR-SH, Reed breaks, plantations & reservoir
Parambi-kulam	10°20'N-10°32'N 76°35'E-76°51'E	285	1962	Palakkad	EG, SEG,MDF, DDF, bamboo break, reservoir & plantations
Peechi-Vazhani	10°28'N-10°40'N 76°17'E-76°29'E	125	1958	Thrissur	EG, SEG,MDF, bamboo break, reservoir & plantations
Peppara	8°34'N - 8°42'N 77°7'E -77°15'E	53	1983	Thiruvanan-thapuram	EG, SEG,MDF,GR-SH, Reed breaks, Myristica swamps, & reservoir
Shenduruni	8°48'N - 8°57'N 77°4'E -77°16'E	100.32	1984	Kollam	EG, SEG,MDF,GR-SH, Reed breaks, Myristica swamps, cane breaks & reservoir
Wayanad	10°21'-10°27' 76°02'-76°42'	344.44	1973	Wayanad	SEG,MDF, freshwater swamp, bamboo break & plantations
Bird Sanctuary					
Thattekkad	10°7'-11°2'	25.16	1983	Ernakulam	EG, SEG,MDF &

	76°1'- 77°1'				plantations
Tiger Reserve					
Periyar	9°16'N - 9°36'N 76°57'E -77°25'E	777	1978	Idukki	EG, SEG,MDF, Savannah & reservoir
National Parks					
Eravikulam	10°8'N - 10°19'N 77°0'E -77°8'E	97	1978	Idukki	GR-SH
Silent Valley	11°4'N - 11°13'N 76°24'E -76°29'E	89.52	1984	Palakkad	EG, SEG, GR-SH, Reed breaks, & Cane breaks

(Legend - EG - evergreen, SEG - semi-evergreen, MDF - moist deciduous, DDF - dry deciduous, GR - SH - grassland shola)

1.3 Scope of the study

A balanced ecosystem, in which all the components are in a state of dynamic equilibrium, is a must for the survival of any living system. The information about the floral and faunal status and their interaction would be beneficial for the management of different ecosystems. The information gathered in such a way would be of immense value to the forest and sanctuary managers for arriving at appropriate management decisions ensuring the long-term conservation of forest dependant bird communities in the different forest types. Unfortunately a very few studies have been conducted on the bird community structure of the various forest types of Kerala, as is evidenced by the published literature. Hence, this study is intended to give some insight into the birds of the few selected forest types of Kerala.

1.4 Objectives of the study

Very little information is available about the bird communities of the various forest types in Kerala. Hence the broad objectives of the present study were to find out the bird community structure of a few selected forest types of Kerala such as evergreen forests, moist deciduous forests, dry deciduous forests and shola forests. These four forest types were chosen because of the fact that these are the major forest types in Kerala. While the specific objectives of the study were,

1. To study the bird community structure including the species composition, diversity, abundance, status and feeding guild of birds of evergreen forests, moist deciduous forests, dry deciduous forests and the shola forests

2. To study bird species richness and diversity in relation to plant species richness and diversity and other vegetation parameters

3. To study the density of the birds of shola forests

REVIEW OF LITERATURE

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Review of Literature

REVIEW OF LITERATURE

2.1 The Community: introduction and definitions

The term community describes a group of species populations occurring together, as in a pond or woodland. However, many workers will refer to communities of birds, insects or plants for example, which cause confusion over the scale and true ecological meaning of the community. The term assemblage is a more appropriate description for such a group of similar species populations occurring together (i.e. an assemblage of birds, insects or plants). A community of organisms should be viewed more as an organized whole, and any definition should encompass interactions among constituent populations, i.e. an association of interacting populations of all trophic levels occurring in a given habitat (Menge and Sutherland, 1976). Species do adapt to the presence of other species, so, just as populations have properties over and above those of the individuals comprising them, the community is more than the sum of the individual populations and their interactions (Harper, 1980). Whittaker's (1975) definition is the most precise to date, describing a community as a combination of plant, animal, and bacterial populations, interacting with one another within an environment, thus forming a distinctive living system with its own composition, structure, environmental relations, development and function. Despite this precision, it is difficult to say what a natural community is and how one recognizes it, so the concept of a community is often an abstraction. Communities

are, in reality, open, generally intergrading continuously along environmental gradients rather than forming clearly separated zones as envisaged by early thinkers (Harper, 1980). Similar difficulties in identification have been faced by population biologists. The same criteria are used by the community ecologist. For example, some theoreticians simply specify an arbitrary set of species (Vandermeer, 1972). Another technique delimits communities objectively, using what is known as a species-area curve. The minimal area that includes the community's representative species combination is given where the curve reaches its asymptote. Lake and woodland communities are somewhat easier to delimit, although one often arbitrarily considers only a part of such systems. Despite difficulties of definition, the study of the community is an important step in our study of the natural world as a whole.

2.2 Community structure

It is generally believed that communities, as living systems of interacting species populations, are organized in some way, and that the role of the community ecologist is to unravel and explain that organisation.

A possible method of investigating community organization is at the individualistic level, where the behaviour and population dynamics of individual species are examined in terms of interactions between and within the populations

(May, 1981). While guild is an assemblage of species utilizing a particular resource or group of resources in a functionally similar manner (Miller, 1980).

2.2.1 Definition

Krebs (1985) defined community as a group of populations of plant and animals in a given place, while Begon *et al.* (1986) it as an assemblage of species populations which occur together in space and time. Southwood (1988) sees community as an organized body of individuals in a specified location. Community is made up of group of interacting organisms.

Whittaker (1977) distinguishes four levels of inventory diversity. On the smallest scale is point diversity, the diversity of a micro-habitat or sample taken from within a homogeneous habitat. The diversity of this homogeneous habitat, the second of Whittaker's categories, is termed *alpha* diversity, and is directly equivalent to MacArthur's (1965) idea of within-habitat diversity. The next scale of inventory diversity is *gamma* diversity, the diversity of a larger unit such as an island or landscape. As gamma diversity is defined to be the overall diversity of a group of areas of alpha diversity, the fourth category, is the total diversity of a group of areas of gamma diversity. Whittaker envisages epsilon diversity applying to large biogeographic areas.

Community structure embodies different ways in which individual members of the community interact with one another. This includes the patterns of resource allocation and spatial and temporal abundance of species of the community. It also include the community level properties arising from these relations, such as, trophic levels, succession, rates and efficiencies of energy fixation and flow, nutrient cycling etc. However one can examine the structure of communities by concentrating on two important indices of community organization, namely the number of species and their relative abundance (Ricklefs, 1980).

2.3 Species diversity

Species diversity is often used as a more representative measure of community richness, as it incorporates both species number and relative abundance. The choice of index, from the bewildering variety available, depends on such factors as the difficulty in appraisal of species abundance and success in sampling and identifying all species present. For many purposes, the number of species present is the simplest and most useful measure of local or regional diversity (Whittaker, 1972).

2.4 Trends in species richness

2.4.1 Latitudinal gradients

One method of estimating the number of species occurring within different regions is to partition maps of large land areas into equal sized quadrats, on which range maps of individual species are superimposed (Pianka, 1966; Schall and Pianka, 1978). These and other studies have revealed the well-known latitudinal gradients of species richness, where, in most groups of organisms, the number of species increases markedly towards the equator. Nesting birds show a typical latitudinal gradient and Fischer (1960) describes similar gradients for ants, corals, tunicates, amphipods, nudibranchs and gastropod molluscs. More recent examples include American insectivorous birds (Rabenold, 1979), lizards (Schall and Pianka, 1978) and Australian endemic Drosophila (Parsons and Bock, 1979). Another is that there is a greater diversity of habitats in low latitudes (e.g. ranging from tropical to boreal with altitude) than in higher latitudes, so it is not surprising that on this gross scale, more species are found in the tropics. Nevertheless, a comparison of similar habitats still reveals greater species richness in the tropics (Pianka, 1978).

2.4.2 Habitat gradients

Smaller scale studies compare species richness across many different habitats within latitudinal belts. These usually reveal differences between adjacent

habitats, even though there are no physical barriers preventing species from one habitat invading another. In addition, consistent trends in species numbers involving altitude, topographic relief, island size and location, peninsular effects and proximity to oceans have been documented (Fischer, 1960).

2.4.3 Exceptions to the rule

Latitudinal trends are not universal. The gradients are not shown by burrowing marine invertebrate groups like Ophiuroids and Holothuroids which show little diversity anywhere. Similarly, the prosobranch mollusc family Naticidae, a soft bottom dweller, shows no trends, whereas the epifaunal prosobranchs show good latitudinal gradients (Fischer, 1960). Latitudinal trends are virtually non-existent among Australian vertebrate taxa (Schall and Pianka, 1978), and are often not very clear in plant assemblages apart from forests (Richards, 1952). The prevalent trend is also occasionally reversed, often by small specialized taxonomic groups. For example, sandpipers and plovers are more diverse in the Arctic (Ricklefs, 1980), a greater diversity of breeding birds is found at higher latitudes in Eastern deciduous forests of the USA (Rabenold, 1979), and marsupials appear to be more diverse in temperate regions than the tropics (Schall and Pianka, 1978). Red algae and kelps also show greater diversity in temperate regions (Fischer, 1960). These exceptions to the rule are, nevertheless, worthy of further investigation.

2.5 Studies on birds of Kerala

2.5.1 Studies on forest birds of Kerala

Hume (1876, a and b) initiated the studies on birds in Kerala and published the list of birds of the Travancore Hills. This was followed by Bourdillon (1880), Ferguson and Bourdillon (1903) and Ferguson (1904a, 1904b, 1904c). The papers by Rose (1904) on birds in the Nilgiris and Wynaad and Wall (1904) and Baker (1911) on birds in Kannur extended the observations further north, while Kinloch (1928 & 1929) on the birds of Nelliampathies.

The golden era of ornithology in Kerala started with the ornithological survey of Travancore and Cochin by Salim Ali. He along with Hugh Whistler published the results of the survey in eight volumes (Ali and Whistler, 1935a, 1935b, 1935c, 1936a, 1936b, 1936c, 1937a and 1937b). This was later supplemented by Rose (1938) with observations from Munnar. The "Birds of Kerala" published first in 1969 by Salim Ali is still the authentic record on birds in the State. During the fifties, Neelakantan initiated studies on the birds of Kerala and published the book in Malayalam entitled "*KeralathiIae Pakshikal*" (Neelakantan, 1958a). During his career spanning around 40 years, he published several papers on various aspects of birds' biology particularly on bird behaviour. (Neelakantan, 1958b, 1960, 1968, 1969a, 1969b, 1969c, 1970, 1981, 1982, 1983, 1990, 1991a, 1991b, Neelakantan and Sureshkumar, 1980 and Neelakantan *et al* 1980). Neelakantan *et al.,* (1993) also

authored the book entitled "*A Book of Kerala Birds*". This book listed 488 species of birds as occurring in Kerala.

Jackson (1954a, 1954b) published many new records of the birds in Kerala, while Pillai (1960) and Khan (1960, 1967, 1971) published the ecological aspects of leaf warblers and the general problems of the birds of Kerala. Some of the autecological studies on the birds of Kerala and adjacent forests include, Vijayan (1975) on bulbuls, Khan (1977) on Black and Orange Flycatcher, Zacharias (1978) on babblers, Shukkur and Joseph (1980) on black drongo, Yahya (1980) on barbets, Vijayan (1984) on drongo, Islam (1985) on laughingthrushes, Santhanakrishnan (1988) on Barn Owls, Zacharias and Mathew (1988) on babblers, Venugopal (1991) on Red-wattled Lapwing, Yahya (1988) examined the breeding biology of Barbet and Vijayan (1992) reported the breeding biology of Malabar Wood shrike, Santharam (1993), studied the ecology of sympatric species of Woodpeckers, and Kannan (1994) studied the ecology of Great Pied Hornbills.

During the nineties, many workers initiated studies on the birds of Kerala and this resulted in a large number of new records from Kerala and listing of birds from more areas. Nair (1994, 1995 and 1996) published behavioural aspects of Golden-backed Woodpecker, sunbird and pipit. In the same period Nameer (1992a) added information to the bird fauna in Kerala. Sashikumar (1989, 1990, 1991 and

1994) and Sashikumar *et al.* (1991 and 1995) reported the occurrence of many new species.

2.5.2 Studies on the water birds of Kerala

The ornithological studies of Kerala wetlands commenced after Neelakantan's extensive explorations on the water bodies in the State, which were greatly rewarding (Neelakantan, 1969a & 1969b; 1970; 1981; 1982; Neelakantan *et al.,* 1980; Neelakantan and Sureshkumar, 1980). Uthaman and Namassivayan (1991) had carried out an intensive study on the birdlife at Kadalundi estuary. That study also had come out with many interesting observations (Namassivayan *et al.,* 1989; Namassivayan and Venugopal, 1989; Uthaman, 1990; Uthaman and Namassivayan (1992). Recently couple of detailed ecological studies on the birds of wetlands of the state was carried out at Bharatapuzha estuary and Malabar coast (Kurup, 1987, 1990 and 1991, 1996) and at Kole wetlands (Jayson and Sivaperuman, 1999 and Jayson, 2002), and Jayson and Easa (2000).

The studies on the waterfowl of the State got an impetus after the inception of the Asian Waterfowl Census (AWC) in 1987. The Kole Wetlands and Vembanad Lake (now Ramsar sites, since 2002) were practically unknown to the birdwatchers before the inception of Asian Waterfowl Census. Comprehensive bird surveys were carried out as part of the AWC at Kole wetlands for three consecutive

years from 1992 to 1994 (Nameer, 1992b; 1993a, 1993b, 1994a, 2002a and 2002b) and at Vembanad lake during 1993 (Nameer, 1993c) then from 2001 to 2004 (Sreekumar, 2001, 2002, 2003 and 2004).

2.6 Studies on the birds of protected areas of India

There are quite a few studies on the birds of the protected areas (wildlife sanctuaries and national parks) of the country. The following are some of the examples.

2.6.1 Studies on the birds of protected areas before 1980's

Donahue, (1964) on the birds of the Keoladeo Ghana Sanctuary, Futehally, (1968) on the birds of the Gir Sanctuary, Neginhal, (1971) on the birds of Dandeli Sanctuary, Neginhal, (1976) on the birds of Ranganathittu Bird Sanctuary, Khacher (1978) on the birds of Nanda Devi Sanctuary, Vijayan (1978) on the birds of Parambikulam Wildlife Sanctuary, Kerala, and Reed (1979) on the birds of Rishi Ganga Valley and the Nanda Devi Sanctuary.

2.6.2 Studies on the birds of protected areas between 1980 to 1990

Abdulali (1981) on the birds of Borivli National Park, Mumbai, Aitken (1981) on the birds of Nanda Devi Sanctuary, Sugathan (1982) on the birds of Point Calimere Sanctuary, Tamil Nadu, Pittie (1983) on the birds of Eturnagaram Wildlife Sanctuary, Green (1986) on the birds of the Kedarnath Sanctuary, Uttar Pradesh, Santharam (1986) on the birds of Guindy National Park, Ara (1987) on the birds of Mula-Mutha Sanctuary, Poona, Katti, (1989) on the birds of Dachigam National Park, Manakadan and Rahmani (1989) on the birds of Rollapadu Wildlife Sanctuary, Pandey, (1989) on the birds of Pong Dam Lake Bird Sanctuary, Tyabji (1990) on the birds of Bandhavgarh National Park.

2.6.3 Studies on the birds of protected areas between 1990 to 2000

Easa, (1991) on the birds of Peechi Vazhani Wildlife Sanctuary, Kerala, Nameer and George (1991) on the birds of Chinnar Wildlife Sanctuary, Rahmani (1991) on the birds of the Karera Bustard Sanctuary, Madhya Pradesh, Kar, (1991) on the birds of Bhitarkanika Wildlife Sanctuary, Orissa, Nameer (1992c) on the birds of Chimmoni Wildlife Sanctuary, Kerala, Manakadan (1992) on the birds of Point Calimere Sanctuary, Robertson and Jackson (1992) on the birds of Periyar Tiger reserve, Bashir and Nameer (1993) on the birds of Silent Valley National Park, Kerala, Gaston, *et al.* (1993) on the birds of Great Himalayan National Park,

Himachal Pradesh, Ghosh, *et al.* (1993): on the birds of Udhuwa Lake Bird Sanctuary, Bihar, Karthikeyan, *et al.* (1993) on the birds of Dandeli Wildlife Sanctuary, Mahabal and Sharma (1993) on the birds of Nainadevi Wildlife Sanctuary, Nair (1993) on the birds of Neyyar Wildlife Sanctuary, Kerala, Raj (1993) on the birds of Orang Wildlife Sanctuary, Rao and Mohapatra (1993) on the birds of Pulicat Bird Sanctuary, South India, Pramod *et al,* (1993) on the birds of Pulicat Bird Sanctuary, Shrivastava *et al.* (1993) on the birds of Periyar Tiger reserve, Uthaman (1993) on the birds of Wayanad Wildlife Sanctuary, Vasanth (1993) on the birds of Kalakad Wildlife Sanctuary, Tamil Nadu, Sangha (1994) on the birds of Desert National Park, Sankaran (1994) on the birds of Nanda Devi National Park, Choudhury (1994) on the birds of Dibru-Saikhowa Wildlife Sanctuary, Gupta and Gupta (1994) on the birds of Sepahijala Wildlife Sanctuary, Tripura, Kumar, (1994) on the birds of Manjira Wildlife Sanctuary, Nameer (1994) on the birds of Parambikulam Wildlife sanctuary, Pandey *et al,* (1994) on the birds of Rajaji National Park, Kailash and Rajan (1994) on the birds of Mount Harriett National Park, South Andaman, Tyabji (1994) on the birds of Bandhavgarh National Park, Madhya Pradesh, Kerala, Kasinathan *et al,* (1995) on the birds of Grizzled Giant Sqirrel Wildlife Sanctuary, Tamil Nadu. Katju (1995) on the birds of Amravathi area and Chinnar Wildlife Sanctuary, Choudhury, (1995) on the birds of Dibru-Saikhowa Wildlife Sanctuary, Balachandran (1995) on the Shore birds of the Marine National Park in the Gulf of Mannar, Tamil Nadu, Barua (1995) on the birds from Chakrashila Wildlife Sanctuary, Nameer (1995) on the birds of Silent Valley National Park,

Kerala, Pittie (1995) on the birds of Rollapadu Bustard Sanctuary, Andhra Pradesh, Shah *et al.* (1995) on the birds of Wild Ass Sanctuary, Gujarat, Sugathan and Varghese (1996) on the birds of Thattekkad Bird Sanctuary, Kerala, Nameer (1996) on the birds of Chinnar Wildlife sanctuary, Ahmed (1996) on the birds of Shendurney Wildlife Sanctuary, Kerala, Alagar (1996) on the avifauna of the Tropical Dry Evergreen Forest of Point Calimere Wildlife Sanctuary, Tamil Nadu, Chandra and Rajan (1996) on the birds Mount Harriett National Park, South Andaman, Susanthkumar (1997) on the birds of Shendurney Wildlife Sanctuary, Kerala, Bhattacharjee (1997) on the birds of Kaziranga National Park, Choudhury (1997) on the birds of Dibru-Saikhowa Sanctuary, Assam, Gokula and Vijayan (1997) on the birds of Mudumalai Wildlife Sanctuary, Kazmierczak and Allen (1997) on the birds of Dibru-Saikhowa Wildlife Sanctuary, Mishra (1997) on the birds of Majhatal Harsang Wildlife Sanctuary, Himachal Pradesh, Pandav (1997) on the birds of Bhitarkanika mangroves, eastern India, Allen *et al.* on the birds of Buxa Tiger reserve, Choudhury (1998a), on the birds of Nongkyllem Wildlife Sanctuary, Meghalaya, Choudhury (1998b), on the birds of Mehao Wildlife Sanctuary, Arunachal Pradesh, Javed and Rahmani (1998) on the birds of Dudwa National Park, Kalsi (1998), on the birds of Kalesar Wildlife Sanctuary, Haryana, Kumar (1998) on the birds of Jaldapara Wildlife Sanctuary, Relton (1998) on the birds of Karaivetti Bird Sanctuary, Tamil Nadu, Kazmierczak *et al.* (1998) on the birds of Harike Bird Sanctuary, Punjab, Uthaman (1998) on the birds of Birds of the Eravikulam National Park, Kerala, Barua and Sharma (1999) on the birds of Kaziranga National Park,

Datta *et al.* (1999) on the birds of Pakhui Wildlife Sanctuary in western Arunachal Pradesh, Ahmad (1999) on the birds in Dachigam National Park, Jammu & Kashmir. Ahmed (1999) on the birds of Maenam Wildlife Sanctuary, Sikkim, Andheria (1999a) on the birds of Mudumalai National Park, Tamil Nadu, Andheria (1999b) on the birds of Nagarhole National Park, Karnataka, Lahkar (1999) on the birds of Pobitora Wildlife Sanctuary.

2.6.3 Studies on the birds of protected areas after 2000

Mahabal (2000) on the birds of Talra Wildlife Sanctuary in lower western Himalaya, Datta (2000) on the birds of Chakrashila Wildlife Sanctuary, Nameer (2000) on the birds of Idukki Wildlife sanctuary, Aravind *et al.* (2001) on the birds of Biligiri Rangaswamy Temple Wildlife Sanctuary, Western Ghats, Nameer (2003)on the birds of Idukki Wildlife sanctuary, Andheria (2000) on the birds of Ranthambhore National Park, Rajasthan, Mohan (2000) on the birds of Sri Venkateshwara Wildlife Sanctuary, Andhra Pradesh, Sashikumar *et al.* (2000) on the birds of Aralam Wildlife Sanctuary, Kerala, Saikia and Kakati (2001) on the birds of Nameri National Park. Choudhury (2002) on the birds of Nagaland, Choudhury (2003) on the birds of Eaglenest Wildlife Sanctuary and Sessa Orchid sanctuary, Arunachal Pradesh, Urfi (2003) on the birds of Okhla barrage bird sanctuary, Delhi, Birand and Pawar (2004) on the birds of north-east India.

2.7 Studies on bird communities

2.7.1 Studies on bird communities - outside India

Kwok and Corlett (1999) reported 71 bird species from the natural secondary forest at Tai Po Kau Nature Reserve in Hong Kong, China. However, three resident habitat-generalists, such as the great tit *Parus major*, light-vented bulbul *Pycnonotus sinensis* and Japanese white-eye *Zosterops japonicus*, accounted for 65% of the mean total bird density of 38 per hectare. Insectivores and insectivore-frugivores accounted for 80% of the species and 98% of the total bird density. Robinson (1999) observed that small tropical forest reserves such as Barro Colorado Island (1600 ha) may not preserve high levels of regional avian diversity over long periods of time. He also noted that the chances of extinction of forest-interior species of birds are extremely persistent in small patches of forests. Dale *et al.* (2000) studied the edge effects on the understory bird community in a logged forest in Uganda and found that commoner species were found near the edge, whereas the interior of the forest had less common species. Guild composition also changed with distance from the edge. Frugivore-insectivores and nectarivores were most common close to the edge. Among insectivores, ground foragers, bark-gleaners, and leaf-gleaners were most common in the interior of the forest, whereas sallying insectivores favored the edge. Graminivores were unaffected by the edge. Ribon *et al.* (2003) studied the conservation status of Atlantic forest birds in 43 forest fragments ranging in size from

1 to 384 ha in the Vicosa region of southeastern Brazil. They observed that 28 bird species had become locally extinct, 43 were critically endangered, and 25 were vulnerable, representing 60.7% of the original forest bird community known to exist in the region. Vulnerability to fragmentation differed among guilds, forest strata, and endemicity status. Birds that feed on fruit and seeds, and those that feed on insects, were more threatened than omnivores and carnivores. Nectarivorous species were less threatened than other guilds. Marsden and Whiffin (2003) who studied the relationship between population density, habitat position and habitat breadth within a neotropical forest bird community in a large Atlantic forest reserve in Espirito Santo, Brazil noted that amongst the 31 species for which density estimation was possible, there were no correlations between local abundance and breadth of habitat use on any of the habitat axes. Robinson *et al.* (2004) studied the bird diversity in a vulnerable neotropical landscape, Soberania National Park, and found that the park contains 92% of the region's forest-dwelling species. Donatelli *et al.* (2004) recorded 216 species, from Fazenda Rio Claro, Lencois Paulista, Sao Paulo, Brazil, 82 of which were non-Passeriformes and 134 Passeriformes. Insectivores accounted for almost half the total number of species recorded in the quantitative survey (44%), followed by frugivores (24.9%), omnivores (16.4%), carnivores (8.5%), detritivores (1.4%), and a small proportion of nectarivores.

2.7.2 Studies on bird communities - within India

Studies on the bird communities of the Indian region are few and far between. Toor *et al.* (1986) studied the community structure and feeding ecology of birds at a grain store in Punjab. Khan *et al.* (1993) studied the community ecology of birds of Aligarh. Thiollay (1993) studied the raptor community response to shrinking area of tropical rain forests. Javed (1996) and Shafiq *et al.* (1997) studied the bird community structure of Kumaon Himalayas. Raman *et al.* (1998) who investigated the recovery of rainforest bird community structure and composition in relation to forest succession after slash-and-burn shifting cultivation, observed that the number of bird species in guilds associated with forest development and woody plants (canopy insectivores, frugivores, bark feeders) was correlated with PC1 scores of the sites. Species in other guilds (e.g. granivores, understorey insectivores) appeared to dominate during early and mid-succession. It is suggested that the non-linear relationships imply that fallow periods less than a threshold of 25 years for birds, and about 50-75 years for woody plants, may cause substantial community alteration. As 5-10-year rotation cycles prevail in many parts of north-east India, it is concluded that there is a need to protect and conserve tracts of late-successional and primary forest. Chettri *et al* (2001) reports that bird species richness and diversity were higher at the open canopy conditions compared with closed canopy in Sikkim Himalayas.

2.7.3 Studies on bird communities - within Kerala

Community ecological studies on the birds of Kerala and nearby areas are very few. They include the studies done by Palat (1983), Gandhi (1986), Johnsingh (1987), Daniels (1989), Jayson (1990 and 1994) and Pramod (1995), Pramod *et al.* (1997a and 1997b) and Pramod (1999) and Raman (2001) on the various synecologocal aspects of birds of Kerala and nearby areas. Zacharias and Gaston (1999) gave details of the distribution and status of the endemic species of birds of forests of Kerala.

On a perusal of the literature it is evident that very little information is available about the bird communities of the various forest types in Kerala. Hence the main objective of the present study is to understand the bird community structure in the few selected major forest types of Kerala, such as evergreen forests, moist deciduous forests, dry deciduous forests and shola forests.

STUDY AREA AND METHODS

Nameer P.O"Bird community structure in a few selected forest types of Kerala" Thesis. Department of Zoology, University of Calicut, 2005

Study Area and Methods

STUDY AREA AND METHODS

3.1 Study Area

The study was done at four protected areas of Kerala. They are Silent Valley and Mannavan Shola National Parks and Chinnar and Idukki Wildlife Sanctuaries.

3.1.1 Evergreen forests (Silent Valley National Park)

Silent Valley National Park is located between 11° 4'N - 11° 13'N and 76° 24'E - 76° 29'E, in Palakkad district (Fig. 1). It was declared as a National Park in 1984 and covers an area of 89.52 sq. km. The major vegetation types include Tropical evergreen and semi-evergreen forests (Plate 1). There are also some patches of reed (*Ochlandra*) and cane (*Calamus*) breaks. The altitude ranges between 900 - 2300 m above msl (Nair, 1991).

There were five base camps or sites at Silent Valley from where the birds were studied. The sites are, Sairandri, Neelikkal, Poochipara, Poovanchola and Walakkad. The habitats of all the sites surveyed were relatively undisturbed evergreen forests. However, the forests at Sairandri and Poochipara have some degraded evergreen patches and secondary grasslands owing to fire. The site,

Fig. 1 Map of Kerala State indicating the study locations

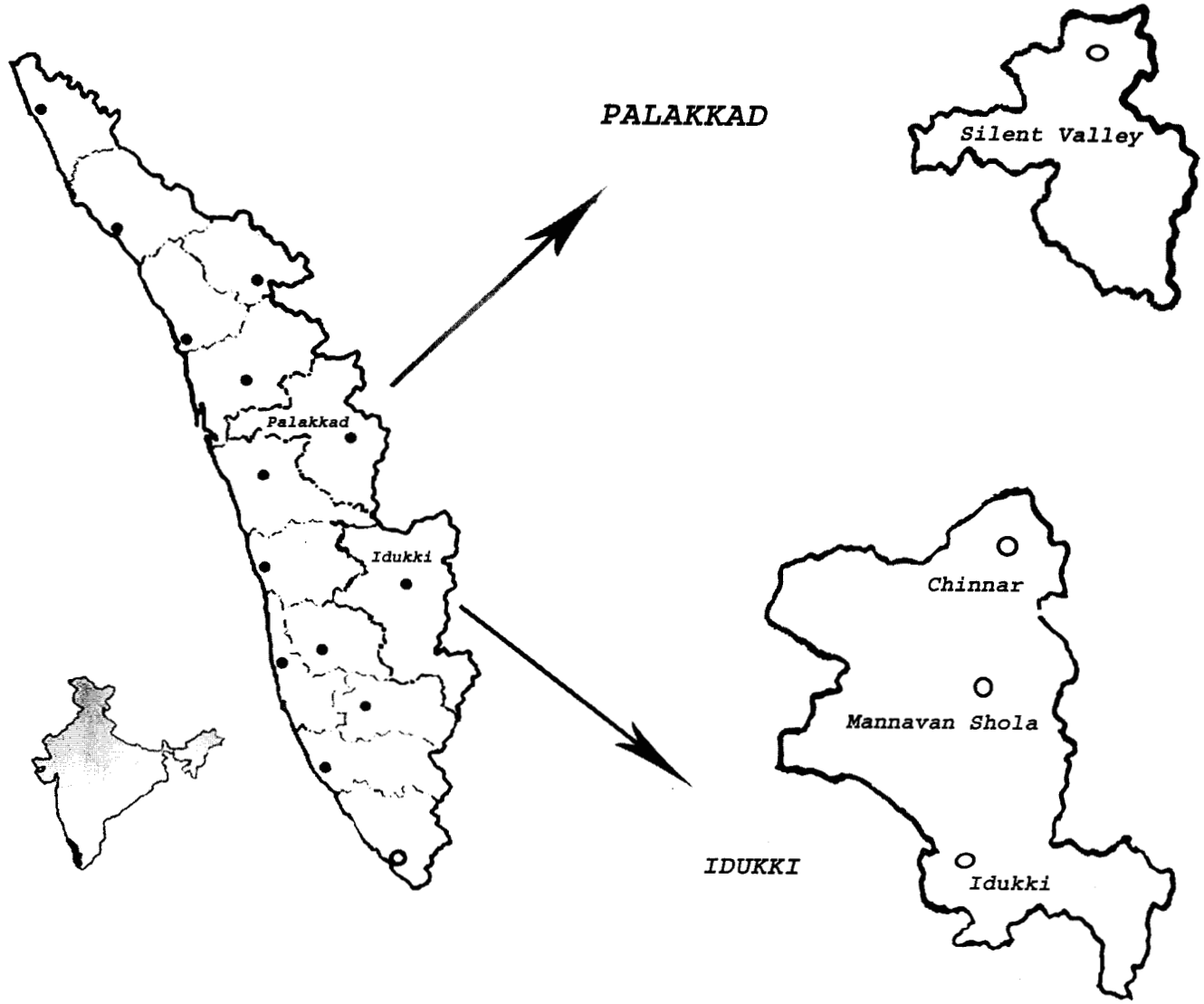


Plate 1 Evergreen forests of Silent Valley

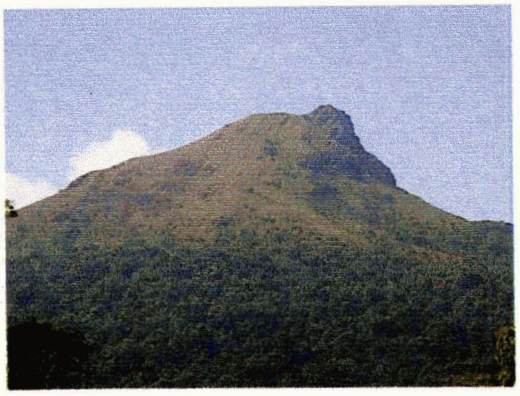
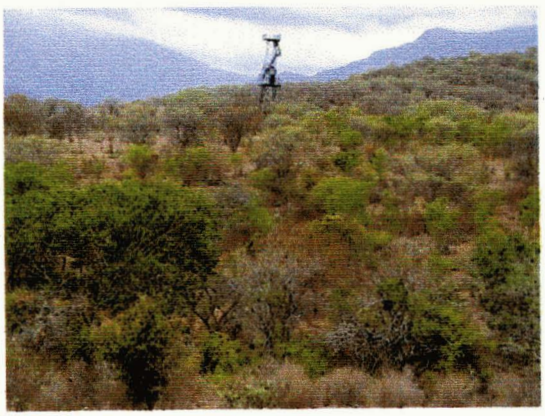


Plate 2 Dry deciduous forests of Chinnar



Neelikkal, is towards the south-western border of the National Park, which is contiguous with the Mannarkkad reserve forests, the latter of which is predominantly moist deciduous.

3.1.2 Dry-deciduous forests (Chinnar Wildlife Sanctuary)

Chinnar Wildlife Sanctuary is located between 10° 15'N - 10° 21'N and 77° 5'E - 77° 16'E in Idukki district (Fig. 1). It was also declared as a Sanctuary in 1984, has a total area of 90.44 sq. km. The major vegetation types include Tropical dry-deciduous forest, thorny scrub jungle (Plate 2), dry bamboo forests and towards the north-eastern part, the sanctuary merges with the grassland-shola forest of Eravikulam National Park. The altitude ranges between 400 - 2000m above msl (Nair, 1991). This is the only protected area in the State that protects dry-deciduous forest and thorny scrub jungle.

At Chinnar, the transects were selected at, Koottar and Churulapetti. At the first two base camps the habitat was thorny scrub jungle and dry deciduous. At Koottar, one transect was selected on the riverside, to cover the riverine forest tract along the banks of Chinnar river. At Chinnar also there were no transects in Shola - grassland ecosystem.

3.1.3 Moist-deciduous forest (Idukki Wildlife Sanctuary)

Idukki Wildlife Sanctuary is located between 76° 55' E & 9° 53' N, in Idukki district (Fig. 1). Idukki was declared as a Wildlife sanctuary in 1976, immediately after the commissioning of the Idukki hydroelectric project. The sanctuary is actually the catchment of the Idukki dam. If one looks at the history of most of the sanctuaries of Kerala it can be seen that most of them form the catchment area of the dams that are constructed either for making hydroelectric energy or for irrigation purpose. Neyyar, Peppara, Shenduruni, Idukki, Periyar, Chimmoni, Peechi -Vazhani, and Parambikulam for example. The Idukki sanctuary has an extent of 70 sq. km., about half of which is water spread area of the reservoir. The major vegetation includes disturbed semi-evergreen and moist-deciduous forest (Plate 3) (Nair, 1991). There were five base camps in Idukki viz. Kettuchira, Kizhakanam, Murukoli, Vakavanom and Chembakassery.

3.1.4 Shola forests (Mannavan Shola)

Mannavan Shola is located between the 77° 5' E & 10° 15' N in Idukki district (Fig. 1). Mannavan Shola was recently declared as a National Park and is a large shola patch (Plate 4), extending to about 10 sq.km. The grasslands around this shola patch have been converted into wattle plantations some 100 years back. The altitude here varies from 1400-2100 m (Swarupanandan *et al.* 1998).

Plate 3 Moist deciduous forest of Idukki

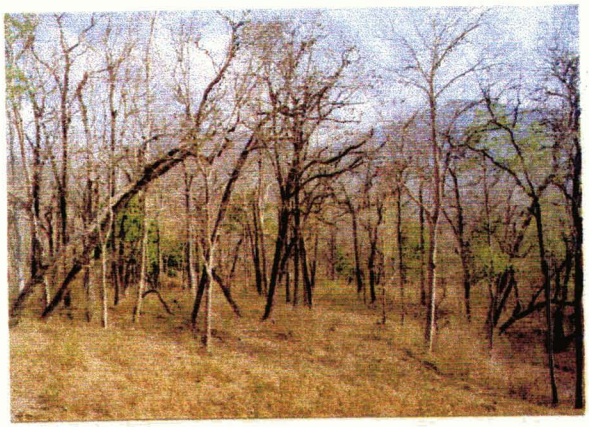
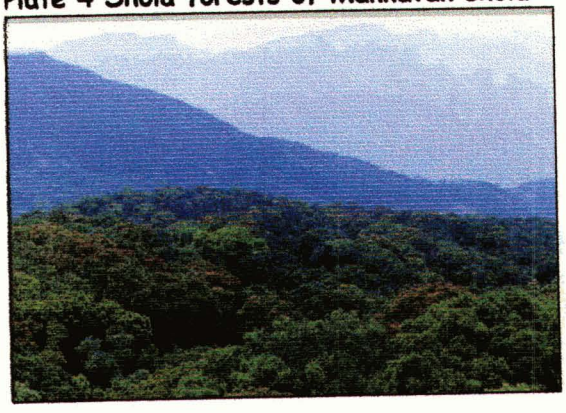


Plate 4 Shola forests of Mannavan shola



There were three base camps in Mannavan Shola, two were shola patches at two elevations and one transect was through a wattle plantation, that is located between these shola patches at an intermediate altitude.

These four sites have been chosen as they represent four major types of habitats such as pristine tropical evergreen forests (Silent Valley), moist-deciduous forests (Idukki), dry-deciduous forests (Chinnar) and shola forests (Mannavan).

3.2 Methods

Strip transects were used to study the community organisation, bird richness, diversity and abundance of the birds in the study areas, except Mannavan Shola, where point sampling was done.

3.2.1 Strip transects for birds

Strip transects was preferred due to the realized impracticability of obtaining accurate perpendicular distance from the line (which is demanded by line transect), while sampling highly mobile organisms such as birds (Daniels, 1989). Strip transects with 1000 m length were selected in the study sites. The outer limits of the strip transects were fixed depending upon the visibility. In Silent Valley 50m

(25m on either side) strips were used, while in Idukki 80m (40m on either side) and in Chinnar 100m (50m on either side) were chosen. This width was much more than the usual 25-50m (Verner, 1985). The assumptions are a)all birds within the strip are detected, b) all birds are correctly identified, c) no bird moves into or out of the strip in response to observer movement, d) no bird is counted more than once and e) no error are made in determining whether a bird is within the strip. Care was also taken to avoid counting a bird repeatedly by moving progressively forward on the strip and recording the birds encountered only within the half-circle immediately ahead. Depending upon the steepness of the terrain 10 to 14 normal paces covered 10m on the ground. A 'halt-and-proceed' strategy (after Daniels, 1989) was used to maintain time. Two minutes halt at every 10m made it possible to cover the entire 1000m in 2 to 2½ hrs. The transects were covered in the morning (08.00 – 11.00 hrs) and in the afternoon (15.00-18.00 hrs).The observations recorded include species of bird sighted, number of birds sighted, time of sighting, habitat and breeding records of any. Apart from this, date and general weather conditions were also recorded. The bird species where then assigned to various status levels such as resident (R), migratory (M) and endemic to Western Ghats (EN), after Ali & Ripley (1983) and to various feeding guilds such as aerial (AER), aquatic (AQ), bark surface feeders (BAR), canopy insectivores (CAN), carnivorous (CAR), frugivores (FRU), nectarivore – insectivore (NEC), omnivore (OMN), parasitic cuckoos (PAR), piscivores (PIS), terrestrial insectivores (TER), understorey insectivores (UND), modified after Raman *et al.* (1998). The birds were identified using

binoculars (10X50) and field guides of Ali and Ripley (1983), Grimmett *et al.* (1998) and Kazmierczak (2000).

3.2.2 Point sampling for birds

At Mannavan Shola, distance-sampling method was used to study the distribution and abundance of birds (Buckland *et al*, 1992). The distance sampling method work on the assumptions such as: a) Objects directly on the line or point are always detected. b) Objects are detected at their initial location, prior to any movement in response to the observer. c) Distances are measured accurately or objects are correctly counted in the proper distance.

Point transect survey was adopted for the distance sampling. The points are selected at intervals along the line transect. The distance of each detected bird from the point is recorded.

Point transect sampling is advantageous at Mannavan, as the terrain make it nearly impossible to traverse a straight line and record data pertaining to birds. Point transect is useful in a patchy forest cover like shola, where it is desirable to estimate density within each habitat type like shola and plantation. (Buckland *et al*, 1992).

In each transect the point transect sampling method was followed (Buckland *et al*, 1992). In a 1000 m long transect 10 points were identified at 100 m apart. This is to avoid the overlapping effect. These points were covered by foot. On reaching each point a period of 2 minutes was spent before recording the data. This was to allow the birds to regain their normal behaviour, as they may be disturbed due the arrival of the observer. The survey was conducted for a period of 8 min. and the data were recorded.

3.2.2.1 Point identification number

This number denotes the specific point that was surveyed and the point was marked to repeat the observation.

3.2.2.2 Species

Each detected bird was identified to the species level and recorded as per the detection order in the data sheet. Even if the same species of bird was detected again the data entry was made as a new one with the same point identification number.

3.2.2.3 Group size

The number of the birds in a flock of the same species in a single encounter was entered as the group size. If no bird was detected the group size was entered as zero.

3.2.2.4 Radial distance

The distance from the observer to the bird is the radial distance. It was measured in meters. The radial distance was measured by ocular method (Buckland *et al*, 1992). If there was no encounter made in a point, the point identification number was entered and the species recorded as none. All other data were entered as 'zero'.

The birds were identified using binoculars (10 X 50) and field guides of Ali and Ripley (1983), Grimmett *et al.* (1998) and Kazmierczak (2000).

3.2.3 Vegetation

Each vegetation type has a characteristic structure i.e., floristic composition, density of plant species, extent of canopy and vertical stratification.

3.2.3.1 Floristic composition and density of trees

The trees of the shola and plantation were surveyed using point centered quarter method. In this four distances are measured at each sampling point. Four quarters were established at the sampling point through a cross formed by two lines. One line is in the direction of the transect and the second line running perpendicular through the sampling point. The distance to the midpoint of the nearest tree from the sampling point was measured in each quarter. Each tree was identified to the species level and the girth of each tree was measured with a tape at breast height (GBH) level (1.37 m). The height of the trees was measured using a graduated pole of length 15m. The pole was held near the tree and height was recorded in meters. The canopy height also was measured using the same pole. The height from the point where the first green branch appears to the apex of the tree was treated as the canopy height.

3.2.3.2 Extent of canopy

The extent of canopy at each sampling point was measured using a 35 mm. SLR camera with 135 mm zoom lens. The camera was focused down through the canopy. By using a grid marked on acetate film placed over the view finder of the camera, the percentage of canopy cover was assessed counting the number of grids filled with foliage image. These percentage values were converted

to grades as 0-25% to 1, 26-50% to 2, 51-75% to 3 and 76-100% to 4 (Daniels, 1989).

3.2.3.3 Vertical stratification

To understand vertical stratification at every 100 m point of the 1000m transect, 2.5m horizontal lines perpendicular to the transect was laid out on either side of the transect. The plants that falling on the horizontal lines were recorded. The name and the height of the plants were entered in to the data sheet. The heights of plants were classified in to height classes as 0-1, 1-2, 2-4, 4-8, 8-16, 16-32.

3.2.3.4 Herbs and shrubs

At every 100m point of the transects 2 X 2 m plots were laid out on the either side of the transect. The plant species inside the plot were enumerated and identified up to species level. To get the foliage cover of the herbs and shrubs the foliage cover of each plant in the plot was traced on a graph paper in a scale 1: 50. From the graph by counting the filled grids the percentage of ground cover was found out.

3.3 Data analysis

To study community ecology, the data collected were analysed for understanding species diversity, richness, evenness, different dominance such as density, frequency, basal area, species-area relations in the vegetation type and importance values. The bird data were analysed using the programme STATECOL (Ludwig and Reynolds, 1988) and BIODIVERSITY PRO Version2 (McAleece, 1997), while the vegetation data the programme POINT was used (Rao and Javed, 1999).

Species diversity may be thought of consisting of two components. The first is the number of species in the community, which ecologist often refers to as species richness, and the second component is species diversity. Over the years, a number of indices have been proposed for characterising species richness and diversity. Such indices are termed richness indices and diversity indices. Diversity indices actually combine species richness with species evenness into a single value (Ludwig and Reynolds, 1988).

3.3.1 Richness indices

3.3.1.1 Margalef index

$$D_{Mg} = S\text{-}1/\ln (n)$$

3.3.1.2 Menhinick index

$$D_{Mn} = S/\sqrt{n}$$

where 'S' is the total number of species in a community and 'n' is the total number of individuals observed (Magurran, 1988).

3.3.2 Diversity indices

3.3.2.1 Simpson's index, λ

Simpson (1949) proposed the first diversity index used in ecology as,

$$\lambda = \sum_{i=1}^{S} p_i^2$$

where 'p_i' is the proportional abundance of the 'i^{th}' species, given by

$$p_i = \frac{n_i}{N}$$

i = 1,2,3,4,.....S,

where 'n_i' is the number of individual of the 'i^{th}' species and 'N' is the known total number of individuals for all 'S' species in the population. Simpson index, which varies from 0-1, gives the probability that two individuals drawn at random from a population belong to the same species. Simply stated if the probability is

high that both individuals belong to the same species, then the diversity of the community sample is low (Ludwig and Reynolds, 1988).

3.3.2.2 Shannon's index, H'

The Shannon index (Shannon and Wiener, 1949) is a measure of the average degree of "uncertainty" in predicting to what species an individual chosen at random from a collection of S species and N individuals will belong. This average uncertainty increases as the number of species increases and as the distribution of individuals among the species becomes even. Thus, H' has two properties that have made it a popular measure of species diversity: (1)H'=0 if and only if there is one species in the sample, and (2) H' is maximum only when all S species are represented by the same number of individuals, that is, a perfect even distribution of abundances (Ludwig and Reynolds, 1988).

The equation for the Shannon function, which uses natural logarithms (ln), is

$$\mathbf{H' = -} \sum_{i=1}^{S} (\mathbf{p_i \ln p_i})$$

where H' is the average uncertainty per species in the infinite community made up of 'S' species with known proportional abundances $p_1, p_2, p_3, \ldots\ldots p_s$.

3.3.3 Dominance index

The dominance index gives the relative dominance of the species (Jayson, 1994). The same is calculated using the formula,

$$\mathbf{D = ni \ x \ (100/N)}$$

where ni = the number of individuals in species "i" and

N = total number of individuals of all the species

3.3.4 Similarity indices

The similarity of the birds between the three study sites were worked out using Jaccard's and Sorensen's indices (Smith, 1983) and Bray-Curtis Cluster analysis of similarity using BIODIVERSITY PRO Version2 (McAleece, 1997).

3.3.4.1 Jaccard's index

$$\mathbf{S_j = a / (a + b + c)}$$

3.3.4.2 Sorensen's index

$$\mathbf{S_s = 2a / (2a + b + c)}$$

where, a = number of species common in both sites 1 and 2, b = number of species in site 1 but not in site 2, and c = number of species in site 2 but not in site 1

Apart from the above ecological parameters the bird data were subjected to analysis using the computer programme DISTANCE (Thomas *et al.*, 1998). Using the programme the major parameters extracted were survey effort, sample size, detection rate, number of individual birds, density of clusters and density of individual bird species.

Vegetation data were analysed for different dominance such as density, frequency, basal area and importance values (Mueller-Dombois and Ellenburg, 1974 and Pascal, 1988). The correlation between the birds and vegetation was worked out after Verner (1985).

RESULTS

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Thesis. Department of Zoology, University of Calicut, 2005

Results

RESULTS

4.1 Bird species richness, abundance and diversity

4.1.1 Bird species richness and abundance

The mean bird species richness, which is the average number of species sighted in the various study area, was maximum at moist-deciduous forest (118) followed by evergreen forest (115) and was the lowest for shola forest (33) (Table 3). The bird abundance, which is the number of individuals at each location also followed a similar pattern of maximum abundance at moist-deciduous forest (1655) followed by evergreen forest (1358) and was the lowest for shola forest (630). The bird species richness indices such as Margalef (D_{Mg}) and Menhinick indices (D_{Mn}) also followed a similar pattern. The species richness indices value for the shola forest was the lowest, when compared to the other types of forest.

Table 3. Species richness and abundance of the birds at different forest types of Kerala

Forest types	Number of species	Number of individuals	Margalef index (D_{Mg})	Menhinick index (D_{Mn})
Moist-deciduous forest	118	1655	16.49	3.70
Evergreen forest	115	1358	15.79	2.90
Dry-deciduous forest	109	947	14.83	2.93
Shola forest	49	630	7.45	1.95

4.1.2 Bird species diversity

The species diversity was the highest at dry-deciduous forest (Shannon-Weiner index of 3.65 and Simpson's index of 0.96), closely followed by moist-deciduous forest (Shannon-Weiner index of 3.50 and Simpson's index of 0.96). The species diversity was the lowest for shola forest (Shannon-Weiner index of 2.69 and Simpson's index of 0.90) (Table 4).

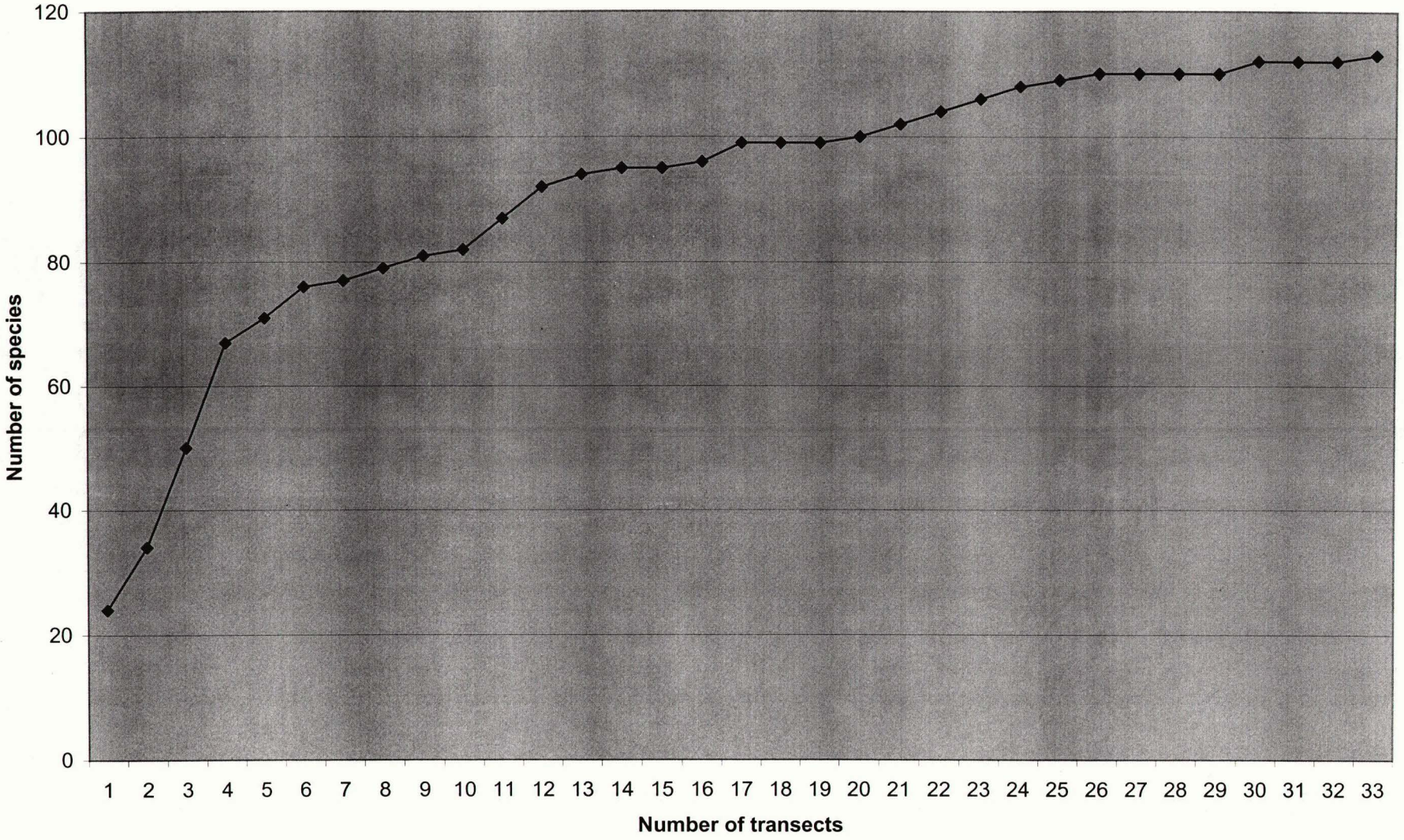
Table 4. The mean bird diversities at various forest types of Kerala

Location	Shannon	Simpson
Dry-deciduous forest	3.65	0.96
Moist-deciduous forest	3.50	0.96
Evergreen forest	3.37	0.95
Shola forest	2.69	0.90

4.2 Species area curve

Species area curve, the number of additional species added over the transects, is another indication of the species richness in an area. Species area curve increases with sample size. However, the curve plateaus at certain level after which the growth of the curve slows down. The species area curve at evergreen forest (Fig. 2), more or less plateaus at 21st transect. While that of dry-deciduous forest at 20th

Fig. 2 Species area curve for birds of evergreen forests



transect (Fig. 3), moist-deciduous forest and shola forest at 18 transects each (Fig. 4 and 5).

4.3 Bird community structure

4.3.1 Species composition at various forest types

4.3.1.1 Species composition at evergreen forest

Summary statistics of the bird species abundance, richness and diversity of the birds of evergreen forest is given in Table 5. The five study sites at the evergreen forest habitat were Sairandri, Neelikkal, Poochipara, Poovanchola and Walakkad. Among the five sites the species richness, diversity and abundance were maximum at Sairandri and Neelikkal.

Table 5. Summary statistics of the bird species abundance, richness and diversity of birds of evergreen forest

Sites	Number of individuals	Number of species	Shannon index	Simpson index
Neelikkal	99	26	2.75	0.91
Sairandri	96	24	2.76	0.91
Walakkad	86	20	2.46	0.88
Poochipara	79	23	2.56	0.87
Poovanchola	77	20	2.65	0.91

During the present study, 168 species of birds in 31 families were recorded from evergreen forest (Appendix 1). These were the birds that were actually

Fig. 3 Species area curve for the birds of dry deciduous forests

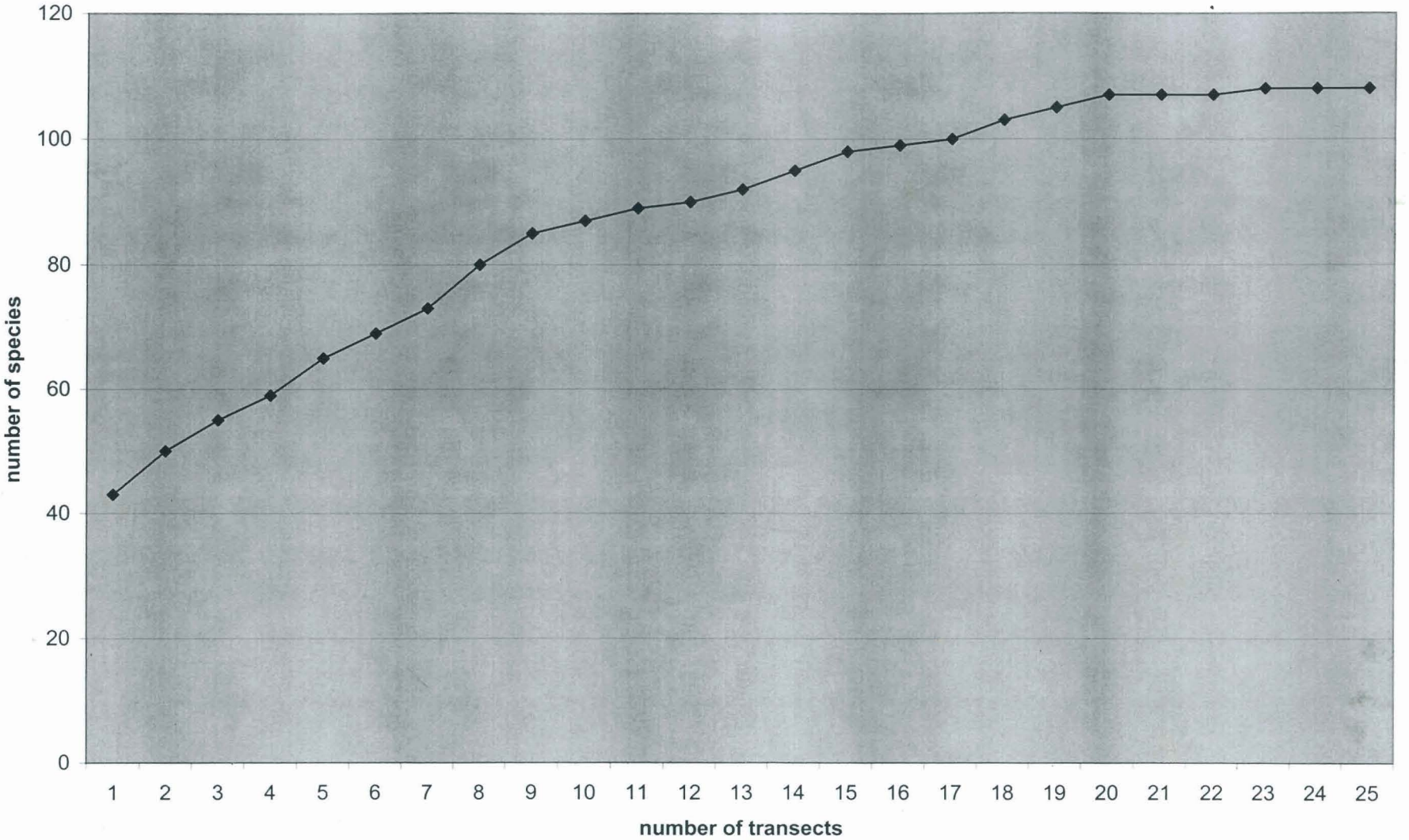


Fig. 4 Species area curve for the birds of moist-deciduous forests

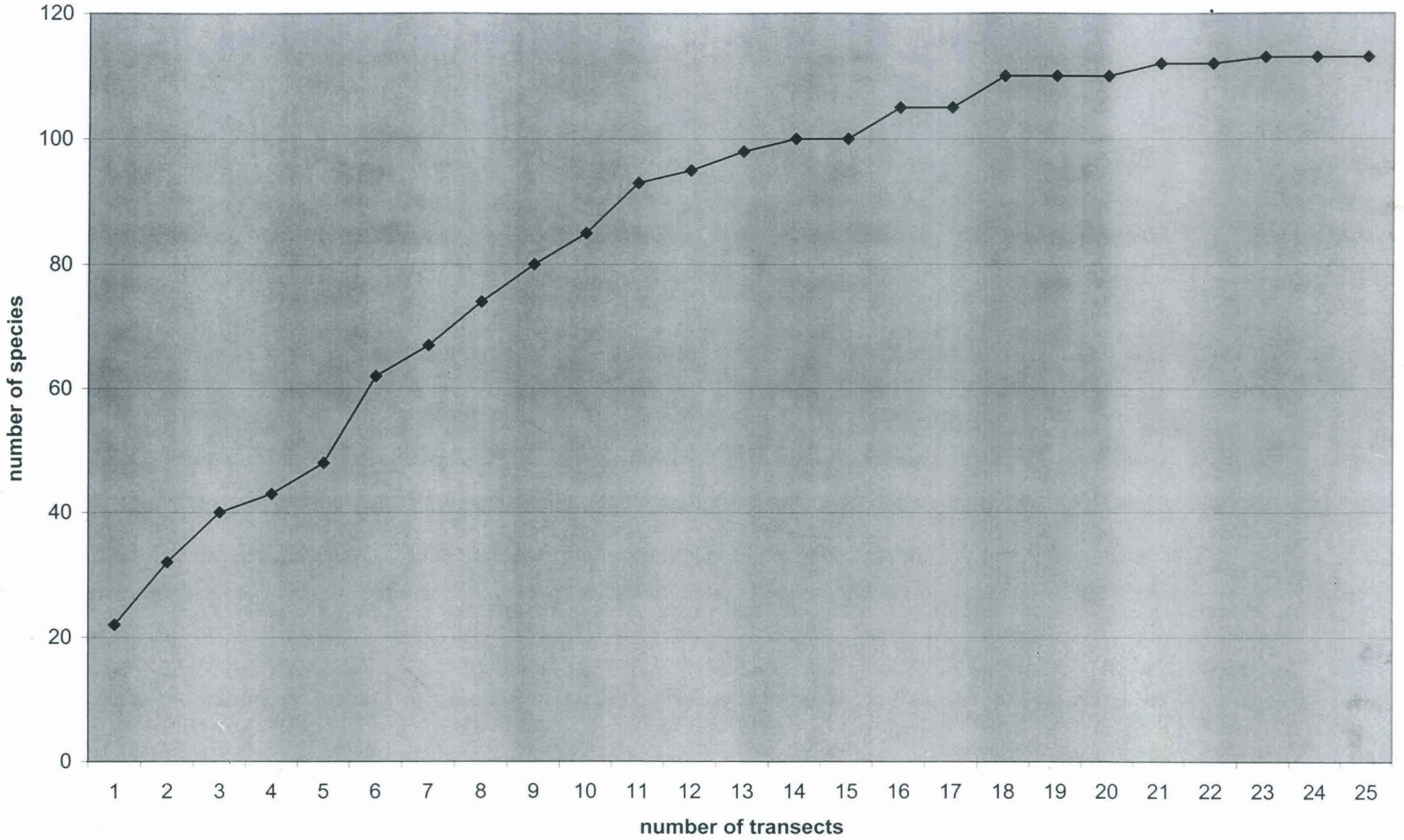
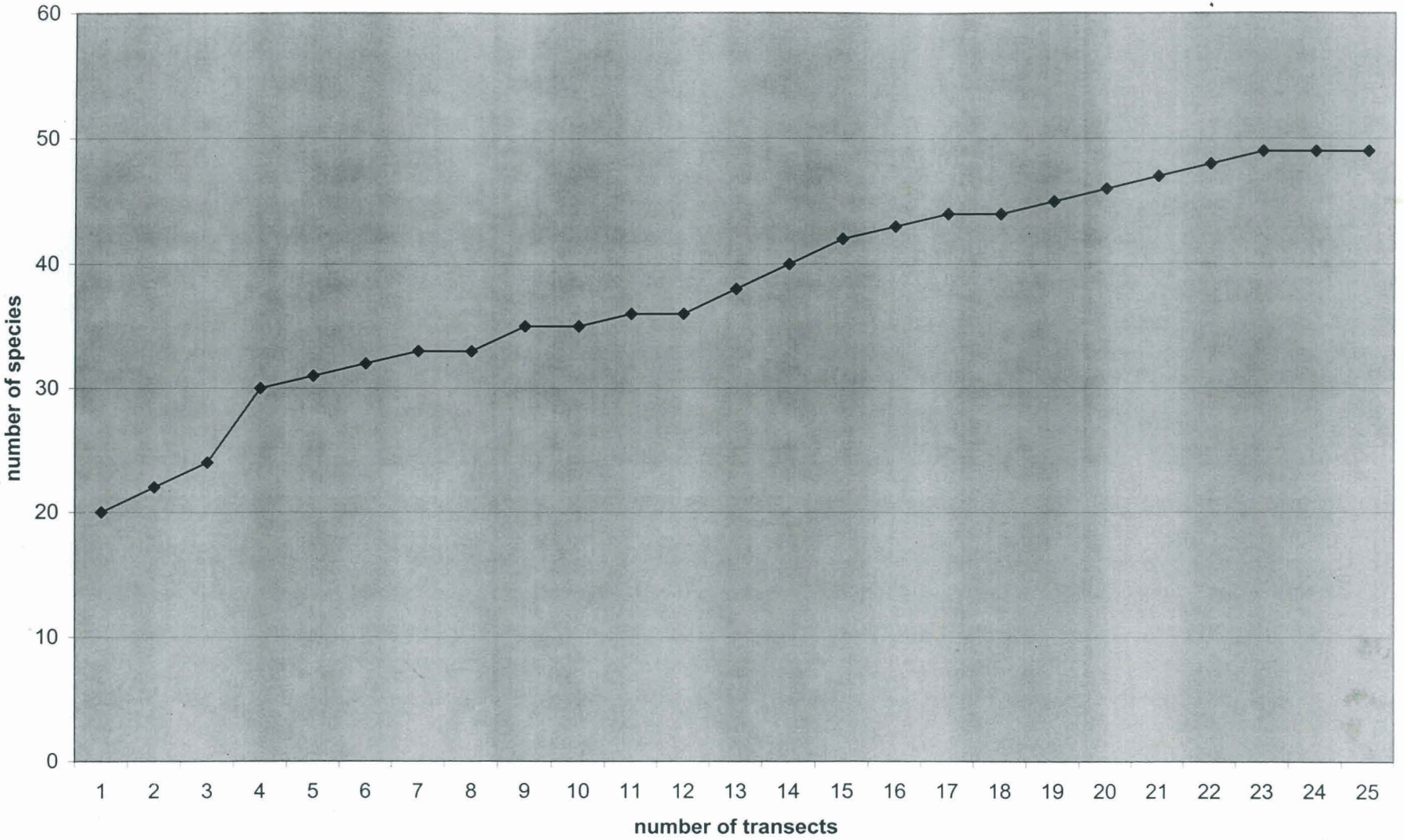


Fig. 5 Species area curve for the birds of shola forests



sighted on the various transects as well as the birds that were opportunistically reported outside the transect. The frequency and the dominance index of the birds of evergreen forest are given in Table 6. Small Sunbird (*Nectarinia minima*), Yellow-browed Bulbul (*Iole indica*), Small Green Barbet (*Megalaima viridis*), Malabar Whistling Thrush (*Myiophonus horsfieldii*), Jerdon's Imperial Pigeon (*Ducula badia*), Black Bulbul (*Hypsipetes leucocephalus*), Quaker Babbler (*Alcippe poioicephala*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Lorikeet (*Loriculus vernalis*) and Blyth's Reed Warbler (*Acrocephalus dumetorum*) were the ten common species of birds showing the maximum dominance index at evergreen forest. These ten common birds also show an encounter rate of more than 40 times during the study period, while the remaining 108 species had an encounter rate of less than 40, with 76 of them were encountered less than ten times. The dominance index at evergreen forest varied between 7.92 and 0.12. Pictures of a few birds typical of evergreen forest are given in Plate 5.

The dominant bird families of evergreen forest are Nectarinidae (sunbirds), Pycnobnotidae (bulbuls), Capitonidae (barbets), Turdinae (thrushes and babblers), Columbidae (pigeons), Sylvinae (warblers), Psittacidae (parakeets), Dicruridae (drongos), Muscicapinae (flycatchers), Motacillidae (pipits and wagtails), Oriolidae (orioles), Apodidae (swifts), Strunidae (mynas), Hirundinidae (swallows), Meropodidae (bee-eaters).

Plate 5. Pictures of a few birds typical of evergreen habitat

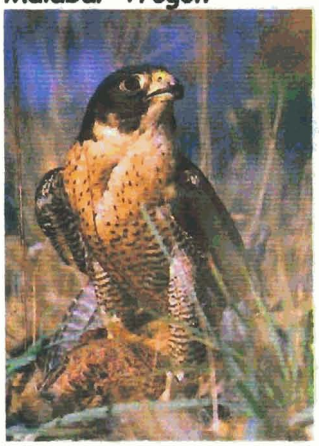
Blue-eared Kingfisher

Rufous-bellied Shortwing

Great Pied Hornbill

Malabar Trogon

Nilgiri Laughingthrush



Shahin Falcon

Table 6. Frequency and the dominance index of birds of evergreen forest

Species	Encounter rate	Dominance index
1. Small Sunbird	128	7.92
2. Yellow-browed Bulbul	80	4.89
3. Small Green Barbet	66	4.23
4. Malabar Whistling Thrush	64	3.93
5. Jerdon's Imperial Pigeon	61	3.75
6. Black Bulbul	55	3.63
7. Quaker Babbler	51	3.14
8. Greenish Leaf Warbler	49	3.02
9. Lorikeet	48	2.96
10. Blyth's Reed Warbler	44	2.90
11. Large-crowned Leaf Warbler	28	1.99
12. Red-whiskered Bulbul	25	1.99
13. Ashy Drongo	25	1.75
14. Emerald Dove	24	1.57
15. Paradise Flycatcher	24	1.57
16. Black-capped Babbler	24	1.51
17. White-throated Ground Thrush	23	1.51
18. Grey Wagtail	22	1.45
19. Scimitar Babbler	20	1.39
20. Golden Oriole	20	1.27
21. Edible-nest Swiftlet	19	1.27
22. Blue Chat	18	1.27
23. Hill Myna	18	1.15
24. Red-rumped Swallow	16	1.15
25. Chestnut-headed Bee-eater	16	1.15
26. Racket-tailed Drongo	15	1.15
27. White Eye	15	1.09
28. Three-toed Woodpecker	15	1.03
29. Nilgiri Flowerpecker	14	0.97
30. Black-winged Kite	13	0.97
31. White-bellied Blue Flycatcher	13	0.97
32. Brown Flycatcher	13	0.91
33. Rufous-tailed Flycatcher	13	0.85
34. Spiderhunter	13	0.85
35. Large-billed Leaf Warbler	12	0.85
36. Verditer Flycatcher	11	0.85
37. Blue-headed Rock Thrush	11	0.85
38. Spotted Babbler	10	0.79
39. Black Drongo	10	0.73
40. Blue-winged Parakeet	10	0.73
41. Nilgiri Flycatcher	10	0.66
42. Grey Jungle Fowl	9	0.66
43. Grey-headed Flycatcher	9	0.66

44. Orange Minivet	9	0.66
45. Rosefinch	9	0.66
46. Brown-breasted Flycatcher	8	0.60
47. Malabar Grey Hornbill	8	0.60
48. Tickell's Leaf Warbler	8	0.60
49. Yellow-cheeked Tit	7	0.60
50. Grey-headed Bulbul	7	0.60
51. Blossom-headed Parakeet	7	0.54
52. Velvet-fronted Nuthatch	6	0.54
53. Crested Serpent Eagle	6	0.54
54. Brown Shrike	6	0.54
55. Black-naped Blue Flycatcher	5	0.54
56. Fairy Bluebird	5	0.54
57. Black Eagle	5	0.48
58. Grey-breasted Prinia	5	0.48
59. Rufous-bellied Munia	5	0.48
60. Nilgiri House Swallow	4	0.42
61. Rufous Babbler	4	0.42
62. Black-headed Cuckoo Shrike	4	0.42
63. Heart-spotted Woodpecker	4	0.36
64. Black Woodpecker	4	0.36
65. Bronzed Drongo	4	0.36
66. Iora	4	0.36
67. Crimson-throated Barbet	3	0.36
68. Yellow-naped Green Woodpecker	3	0.36
69. Southern Treepie	3	0.30
70. Purple Sunbird	3	0.30
71. Malabar Wood Shrike	3	0.30
72. Black Bird	3	0.30
73. Painted Bush Quail	3	0.30
74. Black-capped Kingfisher	3	0.30
75. White-breasted Kingfisher	3	0.30
76. Malabar Trogon	2	0.30
77. Booted Warbler	2	0.30
78. Purple-rumped Sunbird	2	0.30
79. Grey-fronted Green Pigeon	2	0.30
80. Tickell's Flowerpecker	2	0.24
81. Speckled Piculet	2	0.24
82. Plain Wren Warbler	2	0.24
83. Forest Wagtail	2	0.24
84. Black & Orange Flycatcher	2	0.24
85. White-rumped Spinetail Swift	2	0.24
86. Thick-billed Flowerpecker	2	0.24
87. Pond Heron	2	0.18
88. Larger Golden-backed Woodpecker	2	0.18
89. Crested Hawk Eagle	2	0.18

90. Blue-eared Kingfisher	2	0.18
91. Indian Scops Owl	1	0.18
92. Spotted Dove	1	0.18
93. Booted Eagle	1	0.18
94. Alpine Swift	1	0.18
95. Grey Tit	1	0.18
96. Loten's Sunbird	1	0.18
97. Tailor Bird	1	0.18
98. White-backed Munia	1	0.18
99. Gold-fronted Chloropsis	1	0.12
100.Crested Honey Buzzard	1	0.12
101.Broad-tailed Grass Warbler	1	0.12
102.Pied Flycatcher Shrike	1	0.12
103.Red Spurfowl	1	0.12
104.Dusky Crag Martin	1	0.12
105.Shahin Falcon	1	0.12
106.Jungle Crow	1	0.12
107.Great Reed Warbler	1	0.12
108.Ashy Wren-Warbler	1	0.12
109.Cattle Egret	1	0.12
110.Chestnut Bittern	1	0.12
111.Little Green Heron	1	0.12
112.Stork-billed Kingfisher	1	0.12
113.Rufous-bellied Hawk Eagle	1	0.12
114.Pitta	1	0.12
115.Nilgiri Thrush	1	0.12

The red data book (RDB) species found in evergreen forest are Rufous-breasted Laughingthrush (*Garrulax cachinnans*), Nilgiri Wood-pigeon (*Columba elphinstonii*), White-bellied Shortwing (*Brachypteryx major*), Broad-tailed Grassbird (*Schoenicola platyura*), Great Hornbill (*Buceros bicornis*), Nilgiri Pipit (*Anthus nilghiriensis*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*) and Nilgiri Flycatcher (*Eumyias albicaudata*). Pictures of a few threatened birds of the different study locations are given in Plate 6.

Plate 6. Pictures of a few birds typical of dry deciduous habitat

Ring Dove

Brown Dove

Yellow-eyed Babbler

Bay-backed Shrike

White-bellied Drongo

Yellow-throated Bulbul

4.3.1.2 Species composition at dry-deciduous forest

Summary statistics of the bird species abundance, richness and diversity of birds at dry-deciduous forest is given in Table 7. The three study sites at dry-deciduous forest were Koottar-scrub, Churulapetti and Koottar-riverine. Among the three sites the species abundance was maximum at Koottar-scrub, while the species richness as well as the species diversity was maximum at the riverine site at Koottar.

Table 7. Summary statistics of the bird species abundance, richness and diversity of birds at dry-deciduous forest

Site	Number of individuals	Number of species	Shannon	Simpson
Koottar-riverine	178	43	3.29	0.95
Churulapetti	156	38	3.03	0.92
Koottar-scrub	203	36	2.98	0.92

195 species in 49 families were recorded from dry-deciduous forest (Appendix 2). The common ten birds, based on the dominance index, of dry-deciduous forest are Spotted Dove (*Streptopelia chinensis*), Red-vented Bulbul (*Pycnonotus cafer*), Ashy Drongo (*Dicrurus leucophaeus*), Purple-rumped Sunbird (*Nectarinia zeylonica*), Indian Robin (*Saxicoloides fulicata*), White-headed Babbler (*Turdoides affinis*), Common Bee-eater (*Merops orientalis*), Ring Dove (*Streptopelia*

decaocto), Purple Sunbird (*Nectarinia asiatica*) and Paradise Flycatcher (*Terpsiphone paradisi*).

The frequency and the dominance index of the birds of dry-deciduous forest are given in Table 8. Only four species such as Spotted Dove (*Streptopelia chinensis*), Red-vented Bulbul (*Pycnonotus cafer*), Ashy Drongo (*Dicrurus leucophaeus*) and Purple-rumped Sunbird (*Nectarinia zeylonica*), had an encounter rate of more than 40, while the remaining 104 species had an encounter rate of less than 40, with 71 of them were encountered less than ten times. The dominance index at the dry-deciduous forest varied between 5.82 and 0.15. Pictures of a few birds typical of dry-deciduous forest are given in Plate 7.

Table 8. Frequency and the dominance index of birds of dry-deciduous forest

Species	Encounter rate	Dominance index
1. Spotted Dove	78	5.82
2. Red-vented Bulbul	77	5.74
3. Ashy Drongo	43	3.61
4. Purple-rumped Sunbird	40	3.53
5. Indian Robin	39	3.02
6. White-headed Babbler	38	2.95
7. Common Bee-eater	34	2.95
8. Ring Dove	33	2.72
9. Purple Sunbird	31	2.58
10. Paradise Flycatcher	26	2.50
11. Magpie Robin	26	2.36
12. Red-rumped Swallow	25	2.21

Plate 7. Pictures of a few birds typical of moist deciduous habitat

Emerald Dove

Rufous Babbler

Orange Minivet

Velvet-fronted Nuthatch

Racket-tailed Drongo

Paradise Flycatcher

13. White-bellied Drongo	24	1.99
14. Common Wood Shrike	24	1.84
15. Blue-winged Parakeet	23	1.84
16. White-browed Fantail Flycatcher	23	1.77
17. White-browed Bulbul	21	1.77
18. Small Minivet	18	1.62
19. Greenish Leaf Warbler	17	1.55
20. Blossom-headed Parakeet	17	1.55
21. Crimson-breasted Barbet	16	1.47
22. Bay-backed Shrike	16	1.33
23. Blyth's Reed Warbler	15	1.33
24. Tailor Bird	15	1.25
25. Iora	15	1.18
26. Grey Wagtail	14	1.18
27. Small Blue Kingfisher	14	1.18
28. Green Imperial Pigeon	13	1.18
29. Crow Pheasant	13	1.10
30. Koel	13	1.03
31. Orange Minivet	12	1.03
32. Tickell's Blue Flycatcher	12	1.03
33. Edible-nest Swiftlet	11	1.03
34. Jungle Crow	11	0.96
35. Lesser Golden-backed Woodpecker	10	0.96
36. Common Treepie	10	0.88
37. Grey Tit	9	0.88
38. House Crow	9	0.88
39. Yellow-eyed Babbler	9	0.88
40. Fairy Bluebird	8	0.81
41. Grey Jungle Fowl	8	0.81
42. Chestnut-headed Bee-eater	8	0.74
43. Grey-breasted Prinia	8	0.74
44. White-breasted Kingfisher	8	0.74
45. Mahratta Woodpecker	8	0.74

46. Little Brown Dove	8	0.66
47. Black-headed Oriole	8	0.66
48. Large Green Barbet	8	0.66
49. Crested Hawk Eagle	7	0.66
50. Stork-billed Kingfisher	7	0.66
51. Yellow-throated Sparrow	7	0.66
52. Jerdon's Chloropsis	7	0.66
53. Lorikeet	6	0.66
54. Crested Serpent Eagle	6	0.59
55. Small Green Barbet	5	0.59
56. Black Drongo	5	0.59
57. Brown-breasted Flycatcher	5	0.52
58. Malabar Wood Shrike	5	0.52
59. Rose-ringed Parakeet	5	0.52
60. White-throated Babbler	5	0.44
61. Hoopoe	5	0.44
62. Crested Tree Swift	5	0.44
63. Pond Heron	4	0.44
64. Shikra	4	0.44
65. Peafowl	4	0.44
66. Green Sandpiper	4	0.37
67. Spotted Babbler	3	0.37
68. Small Sunbird	3	0.37
69. Brown Flycatcher	3	0.37
70. Gold-fronted Chloropsis	3	0.37
71. Crested Honey Buzzard	3	0.29
72. Pied Flycatcher Shrike	3	0.29
73. Bronzed Drongo	3	0.29
74. Pitta	3	0.29
75. Hawk Cuckoo	3	0.29
76. Malabar Whistling Thrush	2	0.29
77. Black-winged Kite	2	0.29
78. Verditer Flycatcher	2	0.29

79. White-bellied Blue Flycatcher	2	0.29
80. Red-wattled Lapwing	2	0.29
81. Jungle Bush Quail	2	0.22
82. Black-backed Woodpecker	2	0.22
83. Brown Fish Owl	2	0.22
84. Pigmy Woodpecker	2	0.22
85. Little Egret	2	0.22
86. Red-whiskered Bulbul	1	0.22
87. Emerald Dove	1	0.22
88. Scimitar Babbler	1	0.22
89. White-throated Ground Thrush	1	0.15
90. Tickell's Flowerpecker	1	0.15
91. Loten's Sunbird	1	0.15
92. Plain Wren Warbler	1	0.15
93. Nilgiri Flowerpecker	1	0.15
94. Brown Shrike	1	0.15
95. Thick-billed Flowerpecker	1	0.15
96. Great Reed Warbler	1	0.15
97. Crested Goshawk	1	0.15
98. Pied Bush Chat	1	0.15
99. Large Cuckoo Shrike	1	0.15
100.Common Myna	1	0.15
101.Scaly-bellied Green Woodpecker	1	0.15
102.Bush Lark	1	0.15
103.House Martin	1	0.15
104.Common Sandpiper	1	0.15
105.Blue-bearded Bee-eater	1	0.15
106.Jungle Owlet	1	0.15
107.Jungle Babbler	1	0.15
108.Green-billed Malkoha	1	0.15

The dominant bird families of dry-deciduous forest are Columbidae (pigeons), Pycnobnotidae (bulbuls), Dicruridae (drongos), Nectarinidae (sunbirds), Turdinae (thrushes and babblers), Meropodidae (bee-eaters), Muscicapinae (flycatchers), Hirundinidae (swallows), Camphephagidae (minivets and wood-shrikes), Psittacidae (parakeets), Sylvinae (warblers), Capitonidae (barbets), Laniidae (shrikes), Irenidae (ioras and choloropsis).

Dry-deciduous forest also supported three Red Data Book (RDB) species such as White-rumped Vulture (*Gyps bengalensis*), Nilgiri Wood-pigeon (*Columba elphinstoni*) and Yellow-throated Bulbul (*Pycnonotus xantholaemus*). The White-rumped Vulture has the Critically Endangered (CR) conservation status of IUCN, while the Nilgiri Wood-pigeon and the Yellow-throated Bulbul are having the Vulnerable (VU) status.

4.3.1.3 Species composition at moist-deciduous forest

Summary statistics of the bird species abundance, richness and diversity of birds at moist-deciduous forest is given in Table 9. The five study sites at moist-deciduous forest were Kettuchira, Kizhakanam, Murukkoli, Vakavanom and Chembakassery. Among the five sites the species abundance and richness were maximum at Chembakassery and Kizhakanam, while the species diversity was maximum at the Murukkoli.

Table 9. Summary statistics of the bird species abundance, richness and diversity of birds at moist-deciduous forest

Site	Number of individuals	Number of species	Shannon	Simpson
Chembakassery	156	28	2.70	0.90
Kizhakanam	107	25	2.87	0.92
Murukkoli	87	23	2.91	0.94
Vakavanom	73	18	2.48	0.88
Kettuchira	56	17	2.39	0.87

Moist-deciduous forest reported 215 species of birds in 56 families during the present study (Appendix 3). The common ten birds in moist-deciduous forest during the present survey were Small Green Barbet (*Megalaima viridis*), Purple Sunbird (*Nectarinia asiatica*), Hill Myna (*Gracula geligiosa*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Little Egret (*Egretta garzetta*), Grey-breasted Kingfisher (*Halcyon smyrnensis*), Golden Oriole (*Oriolus oriolus*), Racket-tailed Drongo (*Dicrurus paradiseus*), Blue-winged Parakeet (*Psittacula columboides*) and Orange Minivet (*Pericrocotus flammeus*).

The dominant bird families of moist-deciduous forest were Capitonidae (barbets), Nectarinidae (sunbirds), Sturnidae (mynas), Pycnobnotidae (bulbuls), Ardeidae (herons and egrets), Alcedinidae (kingfishers), Oriolidae (orioles), Dicruridae (drongos), Psittacidae (parakeets), Camphephagidae (minivets and wood-shrikes), Phasianidae (pheasants), Corvidae (crows), Cuculidae (cuckoos),

Sittidae (nuthatches), Paridae (tits), Motacillidae (pipits and wagtails), Phalacrocoracidae (cormorants) and Apodidae (swifts).

The frequency and the dominance index of the birds of moist-deciduous forest are given in Table 10. Only Small Green Barbet (*Megalaima viridis*) had an encounter rate of more than 40, while the remaining 113 species had an encounter rate of less than 40, with 95 of them were encountered only less than ten times. The dominance index at the dry-deciduous forest varied between 5.60 and 0.21. Pictures of a few birds typical of moist deciduous forest are given in Plate 8.

Table 10. Frequency and the dominance index of birds of moist-deciduous forest

Species	Encounter rate	Dominance index
1. Small Green Barbet	52	5.60
2. Purple Sunbird	28	3.06
3. Hill Myna	26	3.06
4. Red-whiskered Bulbul	25	3.06
5. Little Egret	23	2.53
6. White-breasted Kingfisher	21	2.53
7. Golden Oriole	20	2.32
8. Racket-tailed Drongo	17	2.32
9. Blue-winged Parakeet	17	2.22
10. Orange Minivet	16	2.01
11. Blossom-headed Parakeet	16	1.90
12. Pond Heron	14	1.90
13. Grey Jungle Fowl	13	1.90
14. Malabar Wood Shrike	11	1.80
15. Jungle Crow	10	1.58

Plate 8. Pictures of a few birds typical of shola habitat

Grey-breasted Laughingthrush

Grey-headed Flycatcher

Yellow-browed Bulbul

Black and Orange Flycatcher

White-bellied Shortwing

Nilgiri Flycatcher

16. Red-vented Bulbul	10	1.48
17. Hawk Cuckoo	10	1.48
18. Jungle Myna	10	1.37
19. Velvet-fronted Nuthatch	9	1.27
20. Grey Tit	9	1.27
21. Crow Pheasant	9	1.27
22. Paddyfield Pipit	9	1.16
23. Little Cormorant	9	1.16
24. House Swift	9	1.16
25. Ashy Drongo	8	1.16
26. Southern Treepie	8	1.06
27. Bronzed Drongo	8	1.06
28. Crimson-breasted Barbet	8	1.06
29. Rose-ringed Parakeet	8	1.06
30. Jungle Babbler	8	1.06
31. Yellow-browed Bulbul	7	1.06
32. Black Drongo	7	0.95
33. Malabar Grey Hornbill	7	0.95
34. Grey Wagtail	6	0.95
35. Greenish Leaf Warbler	6	0.95
36. Loten's Sunbird	6	0.95
37. Common Treepie	6	0.95
38. Small Blue Kingfisher	6	0.95
39. Common Sandpiper	6	0.95
40. Indian Roller	6	0.95
41. Crested Serpent Eagle	5	0.84
42. Grey-breasted Prinia	5	0.84
43. Nilgiri Flowerpecker	5	0.84
44. Iora	5	0.84
45. Lesser Golden-backed Woodpecker	5	0.84
46. Magpie Robin	5	0.74
47. Pied Kingfisher	5	0.74
48. River Tern	5	0.74

49. Paradise Flycatcher	4	0.74
50. Purple-rumped Sunbird	4	0.74
51. Tailor Bird	4	0.74
52. Black-headed Oriole	4	0.74
53. Shag	4	0.74
54. Jerdon's Imperial Pigeon	3	0.74
55. Lorikeet	3	0.63
56. Edible-nest Swiftlet	3	0.63
57. Brown Flycatcher	3	0.63
58. Alpine Swift	3	0.63
59. Grey-fronted Green Pigeon	3	0.63
60. Forest Wagtail	3	0.63
61. House Crow	3	0.63
62. Small Minivet	3	0.63
63. Red-wattled Lapwing	3	0.63
64. Brown-throated Spinetail Swift	3	0.53
65. Large Egret	3	0.53
66. Malabar Whistling Thrush	2	0.53
67. White Eye	2	0.53
68. Fairy Bluebird	2	0.53
69. Malabar Trogon	2	0.53
70. Black Eagle	2	0.53
71. Crimson-throated Barbet	2	0.53
72. Blyth's Reed Warbler	2	0.53
73. Chestnut-headed Bee-eater	2	0.53
74. Rosefinch	2	0.53
75. Heart-spotted Woodpecker	2	0.53
76. Pitta	2	0.53
77. Common Myna	2	0.42
78. Shikra	2	0.42
79. Jerdon's Chloropsis	2	0.42
80. Tickell's Blue Flycatcher	2	0.42
81. Intermediate Egret	2	0.42

82. Brahminy Kite	2	0.42
83. Darter	2	0.42
84. Forest Eagle Owl	2	0.32
85. Scimitar Babbler	1	0.32
86. White-throated Ground Thrush	1	0.32
87. Spotted Dove	1	0.32
88. Rufous Babbler	1	0.32
89. Grey-headed Flycatcher	1	0.32
90. Spiderhunter	1	0.32
91. Black-headed Cuckoo Shrike	1	0.32
92. Black Bird	1	0.32
93. Brown Shrike	1	0.32
94. Crested Honey Buzzard	1	0.32
95. Painted Bush Quail	1	0.32
96. Black Woodpecker	1	0.32
97. Great Reed Warbler	1	0.32
98. Little Green Heron	1	0.32
99. Larger Golden-backed Woodpecker	1	0.21
100.Crested Goshawk	1	0.21
101.Common Bee-eater	1	0.21
102.Green Imperial Pigeon	1	0.21
103.White-throated Babbler	1	0.21
104.Green Sandpiper	1	0.21
105.Pigmy Woodpecker	1	0.21
106.Indian Cuckoo	1	0.21
107.Thick-billed Warbler	1	0.21
108.White-headed Myna	1	0.21
109.Large Pied Wagtail	1	0.21
110.Collard Scops Owl	1	0.21
111.Barred Jungle Owlet	1	0.21
112.Barn Owl	1	0.21
113.Pariah Kite	1	0.21
114.Spotted Munia	1	0.21

4.3.1.4 Species composition at shola forest

Summary statistics of the bird species abundance, richness and diversity of birds at shola forest is given in Table 11. The three study sites at the shola forest were Wattle, Shola-low and Shola-high. Among the three sites the species abundance, richness and diversity were maximum at Shola-low, followed by Shola-high.

Table 11. Summary statistics of the bird species abundance, richness and diversity of birds at Shola forest

Site	Number of individuals	Number of species	Shannon	Simpson
Shola-high	71	12	2.10	0.84
Shola-low	105	15	2.03	0.76
Wattle	48	13	1.94	0.75

Seventy-one species of birds in 31 families were reported from shola forest (Appendix 4). The ten common species at Shola forest shola are Grey-breasted Laughingthrush (*Garrulax jerdoni*), Grey-headed Flycatcher (*Culicicapa ceylonensis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), White Eye (*Zosterops palpebrosa*), Nilgiri Flycatcher (*Eumyias albicaudata),* Velvet-fronted Nuthatch (*Sitta frontalis*), Quaker Babbler (*Alcippe poioicephala*), Black Bulbul (*Hypsipetes leucocephalus*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), and Yellow-browed Bulbul (*Pycnonotus luteolus*).

The dominant bird families of shola forest are Turdinae (thrushes and babblers), Muscicapinae (flycatchers), Sylvinae (warblers), Zoesteropidae (white-eyes), Sittidae (nuthatches), Pycnobnotidae (bulbuls), Dicaedae (flowerpecker), Meropodidae (bee-eaters), Camphephagidae (minivets and wood-shrikes), Capitonidae (barbets), Columbidae (pigeons), Nectarinidae (sunbirds), and Trogonidae (trogons).

The frequency and the dominance index of the birds of shola forest are given in Table 12. Only three species Grey-breasted Laughingthrush (*Garrulax jerdoni*), Grey-headed Flycatcher (*Culicicapa ceylonensis*) and Greenish Leaf-Warbler (*Phylloscopus trochiloides*), had an encounter rate of more than 40, while the remaining 46 species had an encounter rate of less than 40, with 34 of them were encountered less than ten times. The dominance index at the shola forest varied between 12.54 and 0.32. Pictures of a few birds typical of shola forest are given in Plate 9.

Table 12. Frequency and the dominance index of birds of shola forest

Species	Encounter rate	Dominance index
1. White-breasted Laughing Thrush	75	12.54
2. Grey-headed Flycatcher	68	11.43
3. Greenish Leaf Warbler	53	9.05
4. White Eye	34	6.19
5. Nilgiri Flycatcher	33	5.40
6. Velvet-fronted Nuthatch	27	4.76

Plate 9. Pictures of a few threatened birds of Western Ghats recorded from the study locations

Grey-breasted Laughingthrush

Black-and-Orange Flycatcher

White-backed Vulture

Nilgiri Laughingthrush

White-bellied Shortwing

Nilgiri Flycatcher

Great Pied Hornbill

Yellow-throated Bulbul

7. Quaker Babbler	19	3.17
8. Black Bulbul	16	3.17
9. Black & Orange Flycatcher	16	3.17
10. Yellow-browed Bulbul	15	3.02
11. Red-whiskered Bulbul	15	2.86
12. Nilgiri Flowerpecker	14	2.54
13. Chestnut-headed Bee-eater	12	2.38
14. Pied Flycatcher Shrike	10	1.75
15. Malabar Whistling Thrush	9	1.59
16. Small Green Barbet	9	1.59
17. Tickell's Flowerpecker	9	1.59
18. Large-billed Leaf Warbler	9	1.59
19. Nilgiri Wood Pigeon	8	1.59
20. Small Sunbird	7	1.59
21. Scimitar Babbler	6	1.43
22. Orange Minivet	6	1.27
23. Blyth's Reed Warbler	5	1.27
24. Malabar Trogon	4	1.27
25. Rosefinch	4	0.95
26. Pied Bush Chat	4	0.95
27. Magpie Robin	4	0.79
28. Grey Wagtail	3	0.79
29. Blue Chat	3	0.79
30. Yellow-cheeked Tit	3	0.63
31. Grey-breasted Prinia	3	0.63
32. Black Bird	3	0.63
33. Tickell's Leaf Warbler	3	0.63
34. Tree Pipit	3	0.63
35. Emerald Dove	2	0.63
36. Verditer Flycatcher	2	0.63
37. Grey Jungle Fowl	2	0.48
38. Lesser Golden-backed Woodpecker	2	0.48
39. Pigmy Woodpecker	2	0.48

40. Jungle Myna	2	0.48
41. Crested Serpent Eagle	1	0.48
42. Three-toed Woodpecker	1	0.48
43. Grey Tit	1	0.32
44. Malabar Wood Shrike	1	0.32
45. Ashy Wren-Warbler	1	0.32
46. Iora	1	0.32
47. Large Cuckoo Shrike	1	0.32
48. Crow Pheasant	1	0.32
49. Small Minivet	1	0.32

4.4 Individual bird species distribution at various study locations

4.4.1 Individual bird species distribution at evergreen forest

The distribution pattern of the different bird species at evergreen forest is given in Table 13. It is evident from the Table that 68 species (58.12%) were 'randomly' distributed, while 49 species (41.88%) were 'aggregated' in distribution.

Table 13. Bird species distribution pattern at evergreen forest

Species	Mean	Chi-sq	d.f.	Aggregation
1. Jerdon's Imperial Pigeon	20.2	4.8	4	Random
2. Malabar Whistling Thrush	13.2	10.5	4	Random
3. Greenish Leaf Warbler	11.2	3.5	4	Random
4. Paradise Flycatcher	5.0	7.2	4	Random
5. Golden Oriole	4.8	8.9	4	Random
6. Three-toed Woodpecker	4.2	10.2	4	Random
7. Blue Chat	3.8	9.7	4	Random
8. Rosefinch	3.6	10.3	4	Random
9. Black-winged Kite	3.2	8.4	4	Random
10. Large-billed Leaf Warbler	3.0	10.0	4	Random

11. Blue-headed Rock Thrush	2.6	5.1	4	Random
12. Rufous-tailed Flycatcher	2.6	5.8	4	Random
13. Spiderhunter	2.6	4.3	4	Random
14. Spotted Babbler	2.0	4.0	4	Random
15. Malabar Grey Hornbill	1.8	3.8	4	Random
16. Brown-breasted Flycatcher	1.6	2.0	4	Random
17. Fairy Bluebird	1.6	8.3	4	Random
18. Velvet-fronted Nuthatch	1.6	7.0	4	Random
19. Black-naped Blue Flycatcher	1.4	6.6	4	Random
20. Bronzed Drongo	1.4	10.9	4	Random
21. Black Eagle	1.2	2.3	4	Random
22. Crested Serpent Eagle	1.2	4.0	4	Random
23. Black Woodpecker	1.0	4.0	4	Random
24. Heart-spotted Woodpecker	1.0	6.0	4	Random
25. Nilgiri House Swallow	1.0	6.0	4	Random
26. Southern Treepie	1.0	8.0	4	Random
27. Iora	0.8	8.5	4	Random
28. Larger Golden-backed Woodpecker	0.8	6.0	4	Random
29. Purple Sunbird	0.8	8.5	4	Random
30. Speckled Piculet	0.6	5.3	4	Random
31. White-breasted Kingfisher	0.6	5.3	4	Random
32. Yellow-naped Green Woodpecker	0.6	5.3	4	Random
33. Black & Orange Flycatcher	0.4	3.0	4	Random
34. Black-headed Cuckoo Shrike	0.4	3.0	4	Random
35. Blue-eared Kingfisher	0.4	8.0	4	Random
36. Booted Warbler	0.4	3.0	4	Random
37. Crested Hawk Eagle	0.4	8.0	4	Random
38. Dusky Crag Martin	0.4	8.0	4	Random
39. Grey-fronted Green Pigeon	0.4	8.0	4	Random
40. Loten's Sunbird	0.4	8.0	4	Random
41. Malabar Trogon	0.4	3.0	4	Random
42. Pied Flycatcher Shrike	0.4	8.0	4	Random
43. Plain Wren Warbler	0.4	8.0	4	Random
44. Pond Heron	0.4	8.0	4	Random
45. Purple-rumped Sunbird	0.4	3.0	4	Random
46. Rufous-bellied Hawk Eagle	0.4	8.0	4	Random
47. Spotted Dove	0.4	8.0	4	Random
48. Tickell's Flowerpecker	0.4	3.0	4	Random
49. Alpine Swift	0.2	4.0	4	Random
50. Blue-throated Flycatcher	0.2	4.0	4	Random
51. Booted Eagle	0.2	4.0	4	Random
52. Broad-tailed Grass Warbler	0.2	4.0	4	Random
53. Cattle Egret	0.2	4.0	4	Random
54. Chestnut Bittern	0.2	4.0	4	Random

55. Crested Goshawk	0.2	4.0	4	Random
56. Crested Honey Buzzard	0.2	4.0	4	Random
57. Gold-fronted Chloropsis	0.2	4.0	4	Random
58. Great Reed Warbler	0.2	4.0	4	Random
59. Indian Scops Owl	0.2	4.0	4	Random
60. Jungle Crow	0.2	4.0	4	Random
61. Little Green Heron	0.2	4.0	4	Random
62. Nilgiri Thrush	0.2	4.0	4	Random
63. Pitta	0.2	4.0	4	Random
64. Red Spurfowl	0.2	4.0	4	Random
65. Shahin Falcon	0.2	4.0	4	Random
66. Stork-billed Kingfisher	0.2	4.0	4	Random
67. Tailor Bird	0.2	4.0	4	Random
68. White-backed Munia	0.2	4.0	4	Random
69. Edible-nest Swiftlet	67.0	235.0	4	Aggregated
70. Small Sunbird	51.6	47.3	4	Aggregated
71. Yellow-browed Bulbul	38.6	120.4	4	Aggregated
72. Quaker Babbler	21.0	12.7	4	Aggregated
73. Black Bulbul	19.2	126.8	4	Aggregated
74. Black-capped Babbler	18.4	95.3	4	Aggregated
75. Small Green Barbet	15.8	11.6	4	Aggregated
76. Chestnut-headed Bee-eater	12.6	117.7	4	Aggregated
77. Lorikeet	12.6	13.9	4	Aggregated
78. Large-crowned Leaf Warbler	11.6	72.5	4	Aggregated
79. Red-rumped Swallow	11.6	87.7	4	Aggregated
80. Blyth's Reed Warbler	11.2	17.0	4	Aggregated
81. Hill Myna	9.6	182.2	4	Aggregated
82. Red-whiskered Bulbul	8.2	32.8	4	Aggregated
83. White Eye	7.0	16.9	4	Aggregated
84. Grey Wagtail	6.2	21.7	4	Aggregated
85. Black Bird	6.0	92.3	4	Aggregated
86. Grey-headed Flycatcher	6.0	49.0	4	Aggregated
87. Scimitar Babbler	5.8	17.0	4	Aggregated
88. White-throated Ground Thrush	5.4	44.7	4	Aggregated
89. Ashy Drongo	5.2	15.9	4	Aggregated
90. Emerald Dove	5.0	12.4	4	Aggregated
91. Racket-tailed Drongo	4.0	11.5	4	Aggregated
92. White-rumped Spinetail Swift	3.6	72.0	4	Aggregated
93. Orange Minivet	3.2	17.8	4	Aggregated
94. White-bellied Blue Flycatcher	3.2	19.6	4	Aggregated
95. Yellow-cheeked Tit	3.2	19.6	4	Aggregated
96. Blossom-headed Parakeet	3.0	26.7	4	Aggregated
97. Blue-winged Parakeet	3.0	16.7	4	Aggregated
98. Grey-headed Bulbul	3.0	20.7	4	Aggregated
99. Nilgiri Flowerpecker	3.0	27.3	4	Aggregated
100.Rufous Babbler	3.0	60.0	4	Aggregated

101.Brown Flycatcher	2.8	31.0	4	Aggregated
102.Grey Jungle Fowl	2.8	19.6	4	Aggregated
103.Rufous-bellied Munia	2.8	46.7	4	Aggregated
104.Nilgiri Flycatcher	2.6	27.4	4	Aggregated
105.Painted Bush Quail	2.6	35.1	4	Aggregated
106.Black Drongo	2.4	18.0	4	Aggregated
107.Verditer Flycatcher	2.4	18.8	4	Aggregated
108.Grey-breasted Prinia	2.0	31.0	4	Aggregated
109.Malabar Wood Shrike	1.6	17.0	4	Aggregated
110.Tickell's Leaf Warbler	1.6	32.0	4	Aggregated
111.Brown Shrike	1.4	13.7	4	Aggregated
112.Forest Wagtail	1.2	15.7	4	Aggregated
113.Grey Tit	1.0	20.0	4	Aggregated
114.Ashy Wren-Warbler	0.6	12.0	4	Aggregated
115.Black-capped Kingfisher	0.6	12.0	4	Aggregated
116.Crimson-throated Barbet	0.6	12.0	4	Aggregated
117.Thick-billed Flowerpecker	0.6	12.0	4	Aggregated

4.4.2 Individual bird species distribution at dry-deciduous forest

The distribution pattern of the different bird species at dry-deciduous forest is given in Table 14. It is evident from the Table that 72 species (66.06%) were 'randomly' distributed, while 37 species (33.94%) were 'aggregated' in distribution.

Table 14. Bird species distribution pattern at dry-deciduous forest

Species	Mean	Chi-sq	d.f.	Aggregation
1. Spotted Dove	36.7	6.1	2	Random
2. Red-rumped Swallow	31.0	4.1	2	Random
3. Small Minivet	19.0	2.9	2	Random
4. Magpie Robin	8.7	5.8	2	Random
5. White-bellied Drongo	8.3	3.0	2	Random
6. Iora	7.0	2.0	2	Random
7. Tailor Bird	6.7	4.9	2	Random
8. Greenish Leaf Warbler	6.3	5.5	2	Random
9. Small Blue Kingfisher	6.3	3.9	2	Random
10. Blyth's Reed Warbler	5.7	3.3	2	Random
11. Crimson-breasted Barbet	5.7	2.2	2	Random

12. House Crow	5.0	3.6	2	Random
13. Crow Pheasant	4.7	2.7	2	Random
14. Koel	4.3	2.5	2	Random
15. Common Treepie	4.0	6.5	2	Random
16. Jerdon's Chloropsis	4.0	6.5	2	Random
17. Little Brown Dove	4.0	3.5	2	Random
18. Bush Quail sp?	3.7	6.7	2	Random
19. Grey Tit	3.7	4.5	2	Random
20. Large Green Barbet	3.7	0.7	2	Random
21. White-breasted Kingfisher	3.7	1.3	2	Random
22. Lesser Golden-backed Woodpecker	3.3	1.4	2	Random
23. Lorikeet	3.3	2.6	2	Random
24. Grey Jungle Fowl	3.0	0.7	2	Random
25. Grey-breasted Prinia	3.0	4.7	2	Random
26. Pond Heron	3.0	6.0	2	Random
27. Black-headed Oriole	2.7	3.3	2	Random
28. Mahratta Woodpecker	2.7	1.0	2	Random
29. Stork-billed Kingfisher	2.3	5.4	2	Random
30. Crested Serpent Eagle	2.0	7.0	2	Random
31. Crested Tree Swift	2.0	1.0	2	Random
32. Hoopoe	2.0	3.0	2	Random
33. Black Drongo	1.7	1.6	2	Random
34. Brown-breasted Flycatcher	1.7	5.2	2	Random
35. Gold-fronted Chloropsis	1.3	3.5	2	Random
36. Green Sandpiper	1.3	3.5	2	Random
37. Peafowl	1.3	3.5	2	Random
38. Red-wattled Lapwing	1.3	3.5	2	Random
39. Shikra	1.3	0.5	2	Random
40. Bronzed Drongo	1.0	2.0	2	Random
41. Brown Flycatcher	1.0	2.0	2	Random
42. Crested Honey Buzzard	1.0	2.0	2	Random
43. Hawk Cuckoo	1.0	6.0	2	Random
44. Pied Flycatcher Shrike	1.0	6.0	2	Random
45. Black-backed Woodpecker	0.7	4.0	2	Random
46. Black-winged Kite	0.7	4.0	2	Random
47. Brown Fish Owl	0.7	1.0	2	Random
48. Little Egret	0.7	4.0	2	Random
49. Malabar Whistling Thrush	0.7	1.0	2	Random
50. Pigmy Woodpecker	0.7	4.0	2	Random
51. Verditer Flycatcher	0.7	4.0	2	Random
52. White-bellied Blue Flycatcher	0.7	4.0	2	Random
53. Blue-bearded Bee-eater	0.3	2.0	2	Random
54. Brown Shrike	0.3	2.0	2	Random
55. Bush Lark	0.3	2.0	2	Random
56. Common Sandpiper	0.3	2.0	2	Random

57. Crested Goshawk	0.3	2.0	2	Random
58. Emerald Dove	0.3	2.0	2	Random
59. Great Reed Warbler	0.3	2.0	2	Random
60. Green-billed Malkoha	0.3	2.0	2	Random
61. Jungle Owlet	0.3	2.0	2	Random
62. Large Cuckoo Shrike	0.3	2.0	2	Random
63. Loten's Sunbird	0.3	2.0	2	Random
64. Nilgiri Flowerpecker	0.3	2.0	2	Random
65. Pied Bush Chat	0.3	2.0	2	Random
66. Plain Wren Warbler	0.3	2.0	2	Random
67. Red-whiskered Bulbul	0.3	2.0	2	Random
68. Scaly-bellied Green Woodpecker	0.3	2.0	2	Random
69. Scimitar Babbler	0.3	2.0	2	Random
70. Thick-billed Flowerpecker	0.3	2.0	2	Random
71. Tickell's Flowerpecker	0.3	2.0	2	Random
72. White-throated Ground Thrush	0.3	2.0	2	Random
73. White-headed Babbler	62.0	139.6	2	Aggregated
74. Red-vented Bulbul	48.3	10.9	2	Aggregated
75. Edible-nest Swiftlet	22.0	34.5	2	Aggregated
76. Purple-rumped Sunbird	20.3	12.2	2	Aggregated
77. Ring Dove	19.7	20.6	2	Aggregated
78. Indian Robin	17.0	15.6	2	Aggregated
79. Ashy Drongo	16.3	9.3	2	Aggregated
80. Purple Sunbird	16.0	18.5	2	Aggregated
81. Common Bee-eater	14.7	7.8	2	Aggregated
82. Common Wood Shrike	13.0	9.4	2	Aggregated
83. Blue-winged Parakeet	12.3	29.9	2	Aggregated
84. White-browed Bulbul	12.0	15.2	2	Aggregated
85. White-browed Fantail Flycatcher	11.7	11.9	2	Aggregated
86. Blossom-headed Parakeet	11.3	12.2	2	Aggregated
87. Jungle Crow	11.0	13.3	2	Aggregated
88. Paradise Flycatcher	9.3	15.1	2	Aggregated
89. White-throated Babbler	9.3	39.9	2	Aggregated
90. Green Imperial Pigeon	9.0	20.2	2	Aggregated
91. Yellow-eyed Babbler	8.3	10.6	2	Aggregated
92. Bay-backed Shrike	6.3	10.2	2	Aggregated
93. Orange Minivet	5.3	9.9	2	Aggregated
94. Grey Wagtail	5.0	11.2	2	Aggregated
95. Tickell's Blue Flycatcher	4.7	13.9	2	Aggregated
96. Rose-ringed Parakeet	3.7	16.5	2	Aggregated
97. White-headed Babbler	3.7	22.0	2	Aggregated
98. Chestnut-headed Bee-eater	3.3	14.6	2	Aggregated
99. Fairy Bluebird	3.3	14.6	2	Aggregated
100. Crested Hawk Eagle	3.0	0.0	2	Aggregated
101. Jungle Babbler	2.7	16.0	2	Aggregated
102. Malabar Wood Shrike	2.7	16.0	2	Aggregated

103. Yellow-throated Sparrow	2.7	10.8	2	Aggregated
104. Small Sunbird	2.0	12.0	2	Aggregated
105. Small Green Barbet	1.7	10.0	2	Aggregated
106. Spotted Babbler	1.7	10.0	2	Aggregated
107. Common Myna	1.3	8.0	2	Aggregated
108. House Martin	1.3	8.0	2	Aggregated
109. Pitta	1.0	0.0	2	Aggregated

4.4.3 Individual bird species distribution at moist-deciduous forest

The distribution pattern of the different bird species at moist-deciduous forest is given in Table 15. It is evident from the Table that 70 species (61.95%) were 'randomly' distributed, while 43 species (38.05%) were 'aggregated' in distribution.

Table 15. Bird species distribution pattern at moist-deciduous forest

Species	Mean	Chi-sq	d.f.	Aggregation
1. Racket-tailed Drongo	6.2	7.23	4	Random
2. Golden Oriole	5.8	6.35	4	Random
3. Grey Jungle Fowl	4	8	4	Random
4. Jungle Crow	3.4	8.59	4	Random
5. Velvet-fronted Nuthatch	3.4	8	4	Random
6. Crow Pheasant	3.2	10.88	4	Random
7. Hawk Cuckoo	2.8	11	4	Random
8. Southern Treepie	2.6	2	4	Random
9. Bronzed Drongo	2.4	7.17	4	Random
10. Crimson-throated Barbet	2.4	8	4	Random
11. Black Drongo	2.2	9.46	4	Random
12. Common Treepie	2.2	3.09	4	Random
13. Grey Wagtail	2	11	4	Random
14. Iora	2	9	4	Random
15. Malabar Grey Hornbill	2	11	4	Random
16. Ashy Drongo	1.8	7.11	4	Random
17. Magpie Robin	1.8	7.11	4	Random
18. Nilgiri Flowerpecker	1.8	9.33	4	Random
19. Yellow-browed Bulbul	1.8	9.33	4	Random

20. Indian Roller	1.6	8.25	4	Random
21. Loten's Sunbird	1.6	3.25	4	Random
22. Purple-rumped Sunbird	1.6	10.75	4	Random
23. Small Minivet	1.4	8	4	Random
24. Lesser Golden-backed Woodpecker	1.2	5.66	4	Random
25. Small Blue Kingfisher	1.2	5.66	4	Random
26. Brown Flycatcher	1	8	4	Random
27. Paradise Flycatcher	1	4	4	Random
28. Shag	1	4	4	Random
29. Jerdon's Chloropsis	0.8	6	4	Random
30. Jerdon's Imperial Pigeon	0.8	3.5	4	Random
31. Fairy Bluebird	0.6	5.33	4	Random
32. Forest Wagtail	0.6	2	4	Random
33. Heart-spotted Woodpecker	0.6	5.33	4	Random
34. Rosefinch	0.6	5.33	4	Random
35. Barn Owl	0.4	8	4	Random
36. Barred Jungle Owlet	0.4	8	4	Random
37. Black Eagle	0.4	8	4	Random
38. Black-headed Cuckoo Shrike	0.4	8	4	Random
39. Blyth's Reed Warbler	0.4	8	4	Random
40. Brahminy Kite	0.4	3	4	Random
41. Collard Scops Owl	0.4	8	4	Random
42. Common Bee-eater	0.4	8	4	Random
43. Crested Honey Buzzard	0.4	8	4	Random
44. Darter	0.4	8	4	Random
45. Forest Eagle Owl	0.4	8	4	Random
46. Little Green Heron	0.4	8	4	Random
47. Malabar Trogon	0.4	3	4	Random
48. Malabar Whistling Thrush	0.4	8	4	Random
49. Pigmy Woodpecker	0.4	8	4	Random
50. Pitta	0.4	8	4	Random
51. Rufous Babbler	0.4	8	4	Random
52. Scimitar Babbler	0.4	8	4	Random
53. Shikra	0.4	3	4	Random
54. White Eye	0.4	8	4	Random
55. Black Woodpecker	0.2	4	4	Random
56. Brown Shrike	0.2	4	4	Random
57. Crested Goshawk	0.2	4	4	Random
58. Great Reed Warbler	0.2	4	4	Random
59. Green Imperial Pigeon	0.2	4	4	Random
60. Green Sandpiper	0.2	4	4	Random
61. Grey-headed Flycatcher	0.2	4	4	Random
62. Indian Cuckoo	0.2	4	4	Random
63. Large Pied Wagtail	0.2	4	4	Random
64. Painted Bush Quail	0.2	4	4	Random

65. Pariah Kite	0.2	4	4	Random
66. Spiderhunter	0.2	4	4	Random
67. Spotted Dove	0.2	4	4	Random
68. Spotted Munia	0.2	4	4	Random
69. Thick-billed Warbler	0.2	4	4	Random
70. White-throated Ground Thrush	0.2	4	4	Random
71. House Swift	118.4	2221.80	4	Aggregated
72. Small Green Barbet	16.8	97.91	4	Aggregated
73. Little Cormorant	16.4	149.46	4	Aggregated
74. Hill Myna	14.4	45.92	4	Aggregated
75. Brown-throated Spinetail Swift	11.4	208.71	4	Aggregated
76. Red-whiskered Bulbul	10	28.6	4	Aggregated
77. Jungle Myna	9.4	56.09	4	Aggregated
78. Little Egret	9.2	88.13	4	Aggregated
79. Pond Heron	8.6	44.09	4	Aggregated
80. Purple Sunbird	8.6	102.47	4	Aggregated
81. Blossom-headed Parakeet	7.4	27.46	4	Aggregated
82. Orange Minivet	7.2	55.11	4	Aggregated
83. Jungle Babbler	6.4	19.56	4	Aggregated
84. Blue-winged Parakeet	6.2	28.19	4	Aggregated
85. Alpine Swift	6	120	4	Aggregated
86. Greenish Leaf Warbler	5.4	73.93	4	Aggregated
87. White-breasted Kingfisher	5.4	19.48	4	Aggregated
88. Paddyfield Pipit	4.4	25.73	4	Aggregated
89. Rose-ringed Parakeet	3.8	13.37	4	Aggregated
90. Malabar Wood Shrike	3.6	14.22	4	Aggregated
91. Edible-nest Swiftlet	3.4	23.29	4	Aggregated
92. Grey Tit	3	18.67	4	Aggregated
93. Red-vented Bulbul	3	16	4	Aggregated
94. Grey-fronted Green Pigeon	2.8	56	4	Aggregated
95. Common Myna	2.4	31.33	4	Aggregated
96. Crested Serpent Eagle	2.2	26.73	4	Aggregated
97. River Tern	2	16	4	Aggregated
98. Black-headed Oriole	1.8	36	4	Aggregated
99. Chestnut-headed Bee-eater	1.8	27.11	4	Aggregated
100. Grey-breasted Prinia	1.8	19.33	4	Aggregated
101. Common Sandpiper	1.6	17	4	Aggregated
102. Lorikeet	1.6	23.25	4	Aggregated
103. Pied Kingfisher	1.4	13.71	4	Aggregated
104. Tailor Bird	1.4	13.71	4	Aggregated
105. White-headed Myna	1.4	28	4	Aggregated
106. White-throated Babbler	1.2	24	4	Aggregated
107. House Crow	1	20	4	Aggregated
108. Black Bird	0.8	16	4	Aggregated
109. Intermediate Egret	0.8	16	4	Aggregated
110. Large Egret	0.6	12	4	Aggregated

111.Larger Golden-backed Woodpecker	0.6	12	4	Aggregated
112.Red-wattled Lapwing	0.6	12	4	Aggregated
113.Tickell's Blue Flycatcher	0.6	12	4	Aggregated

4.4.4 Individual bird species distribution at shola forest

The distribution pattern of the different bird species at shola forest is given in Table 16. It is evident from the Table that 30 species (61.22%) were 'randomly' distributed, while 43 species (38.78%) were 'aggregated' in distribution.

Table 16. Bird species distribution pattern at Shola forest

Species	Mean	Chi-sq	d.f.	Aggregation
1. Black Bulbul	10.3	4.3	2	Random
2. Pied Flycatcher Shrike	6.3	2.9	2	Random
3. Yellow-browed Bulbul	6.0	4.0	2	Random
4. Nilgiri Flowerpecker	5.3	2.4	2	Random
5. Malabar Whistling Thrush	3.7	5.6	2	Random
6. Large-billed Leaf Warbler	3.3	0.8	2	Random
7. Tickell's Flowerpecker	3.3	3.2	2	Random
8. Small Green Barbet	3.0	0.7	2	Random
9. Small Sunbird	3.0	6.0	2	Random
10. Pied Bush Chat	2.0	7.0	2	Random
11. Malabar Trogon	1.7	2.8	2	Random
12. Blyth's Reed Warbler	1.7	5.2	2	Random
13. Black Bird	1.3	3.5	2	Random
14. Yellow-cheeked Tit	1.0	2.0	2	Random
15. Grey Wagtail	1.0	2.0	2	Random
16. Verditer Flycatcher	1.0	2.0	2	Random
17. Blue Chat	1.0	2.0	2	Random
18. Lesser Golden-backed Woodpecker	0.7	1.0	2	Random
19. Pigmy Woodpecker	0.7	1.0	2	Random
20. Grey Jungle Fowl	0.7	4.0	2	Random
21. Emerald Dove	0.7	1.0	2	Random
22. Small Minivet	0.7	4.0	2	Random
23. Jungle Myna	0.7	4.0	2	Random

24. Three-toed Woodpecker	0.3	2.0	2	Random
25. Crested Serpent Eagle	0.3	2.0	2	Random
26. Grey Tit	0.3	2.0	2	Random
27. Malabar Wood Shrike	0.3	2.0	2	Random
28. Tickell's Leaf Warbler	0.3	2.0	2	Random
29. Ashy Wren-Warbler	0.3	2.0	2	Random
30. Iora	0.3	2.0	2	Random
31. Grey-headed Flycatcher	77.7	44.3	2	Aggregated
32. White-breasted Laughing Thrush	58.3	26.8	2	Aggregated
33. White Eye	41.3	42.1	2	Aggregated
34. Velvet-fronted Nuthatch	28.7	44.0	2	Aggregated
35. Greenish Leaf Warbler	22.7	7.6	2	Aggregated
36. Nilgiri Flycatcher	18.0	29.8	2	Aggregated
37. Red-whiskered Bulbul	12.0	41.2	2	Aggregated
38. Quaker Babbler	9.0	8.2	2	Aggregated
39. Chestnut-headed Bee-eater	8.3	26.0	2	Aggregated
40. Black & Orange Flycatcher	8.0	32.3	2	Aggregated
41. Nilgiri Wood Pigeon	4.3	12.2	2	Aggregated
42. Orange Minivet	4.3	20.5	2	Aggregated
43. Rosefinch	3.7	8.9	2	Aggregated
44. Scimitar Babbler	3.3	7.4	2	Aggregated
45. Tickell's Leaf Warbler	2.7	16.0	2	Aggregated
46. Large Cuckoo Shrike	2.0	12.0	2	Aggregated
47. Magpie Robin	1.3	8.0	2	Aggregated
48. Grey-breasted Prinia	1.3	8.0	2	Aggregated
49. Tree Pipit	1.3	8.0	2	Aggregated

4.5 Feeding guild structure at various study locations

Feeding guild structure of the birds of various study locations is given in Table 17 and Fig. 6 to Fig. 9.

Table 17. Feeding guild structure of the birds at various study locations (%)

	UND	FRU	NEC	CAN	CAR	AER	BAR	OMN	TER	PIS	AQ	PAR
Evergreen forest	26.3	10.2	13.6	14.4	10.2	5.1	6.8	5.1	2.5	2.5	3.4	0
Dry-deciduous forest	25	9.3	13.9	13.9	11.1	3.7	4.6	8.3	3.7	1.9	3.7	0.9
Moist-deciduous forest	19.3	10.5	13.2	11.4	12.3	3.5	5.3	8.8	2.6	4.4	7	1.8
Shola forest	32.7	12.2	6.1	30.6	4.1	0	8.2	4.1	2	0	0	0

Legend: aerial (AER), aquatic (AQ), bark surface feeders (BAR), canopy insectivores (CAN), carnivorous (CAR), frugivores (FRU), nectarivore – insectivore (NEC), omnivore (OMN), parasitic cuckoos (PAR), piscivores (PIS), terrestrial insectivores (TER), under-storey insectivores (UND), modified after Raman *et al.* (1998).

4.6 Status of birds at various study locations

Maximum number of endemic species of birds of Western Ghats were seen in shola forest (12.2 %), followed by evergreen forest (10.2 %), then moist-deciduous forest (4.4 %) and dry-deciduous forest (3.7 %) (Table 18, Fig. 10 to Fig. 13). Pictures of a few endemic birds of the different study locations are given in Plate 10.The migratory species of birds were also seen more at evergreen (22%) and shola forests (18%) when compared to the deciduous types of forests. Pictures of a few migratory birds of the different study locations are given in Plate 11.

Fig. 6 Feeding guild structure of birds of everegreen forests

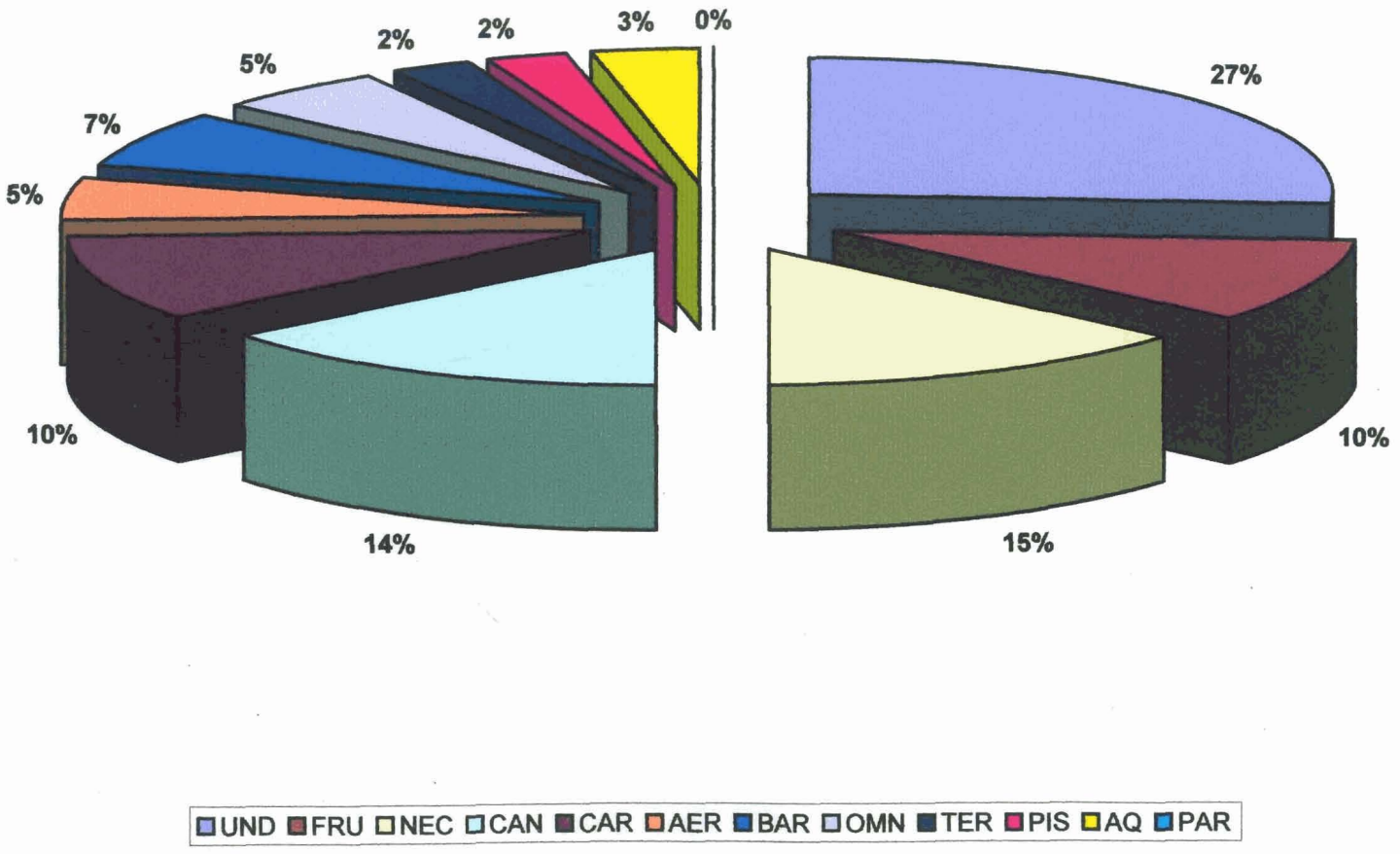


Fig. 7 Feeding guild structure of birds of dry-deciduos forests

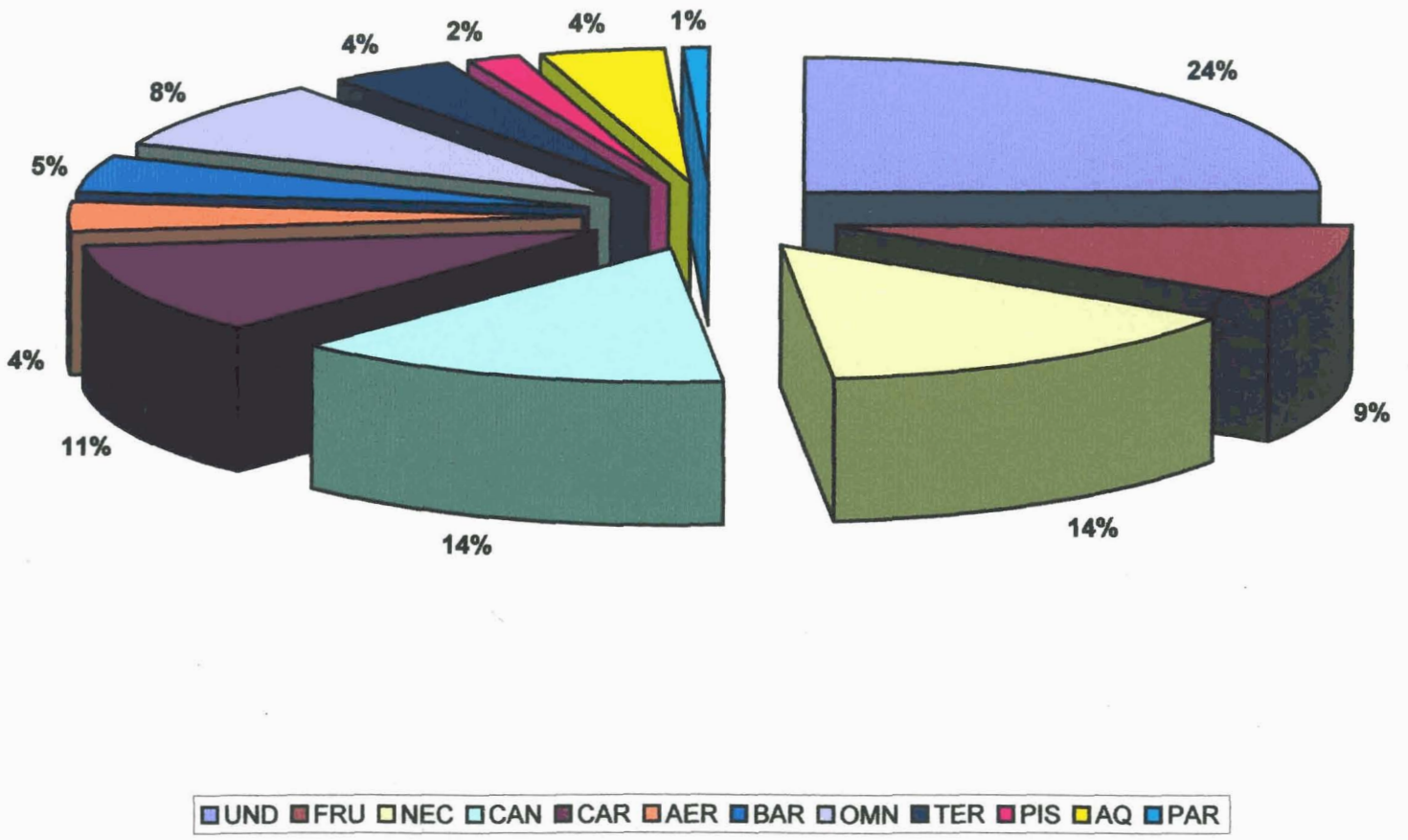


Fig. 8 Feeding guild structure of birds of moist-deciduous forests

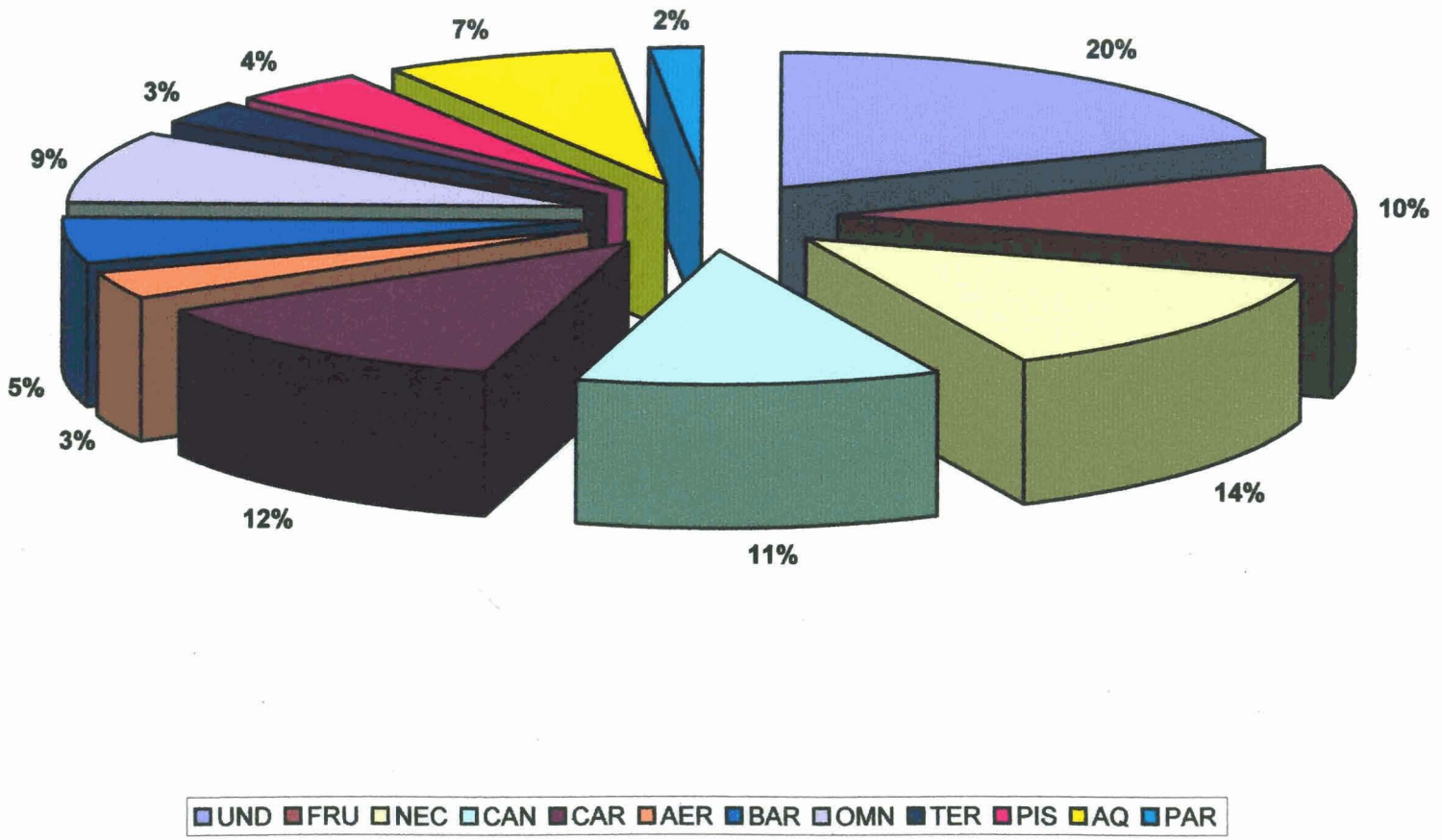


Fig. 9 Feeding guild structure of birds of shola forests

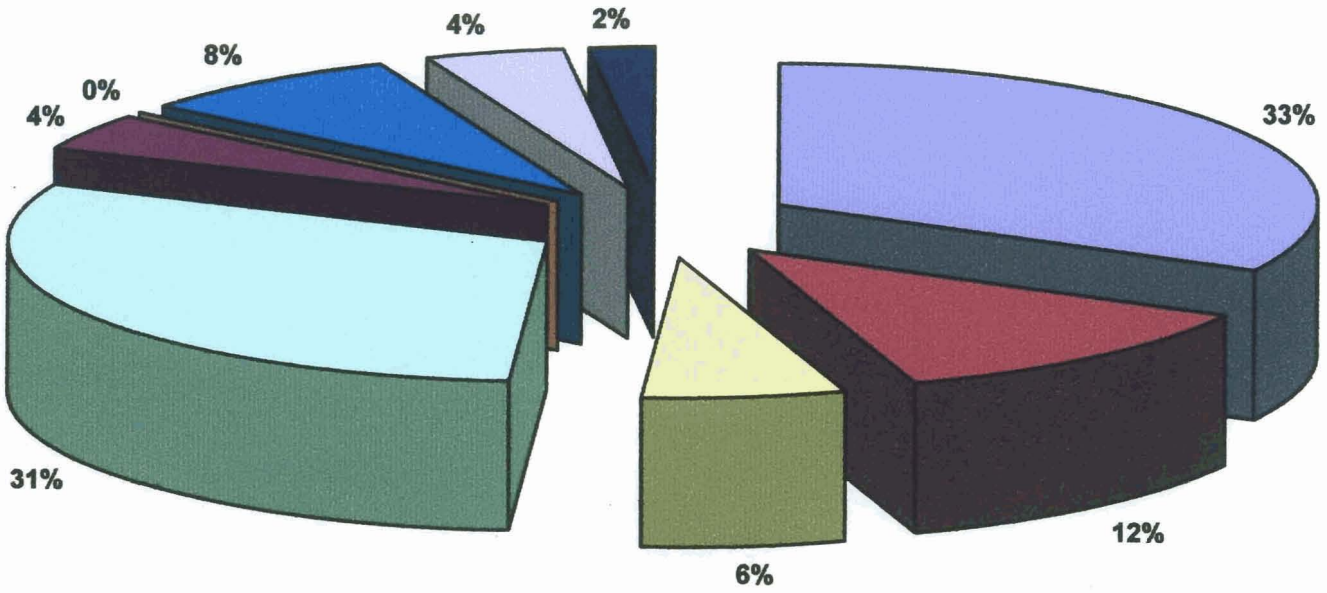


Fig. 10 Status of birds at evergreen forests

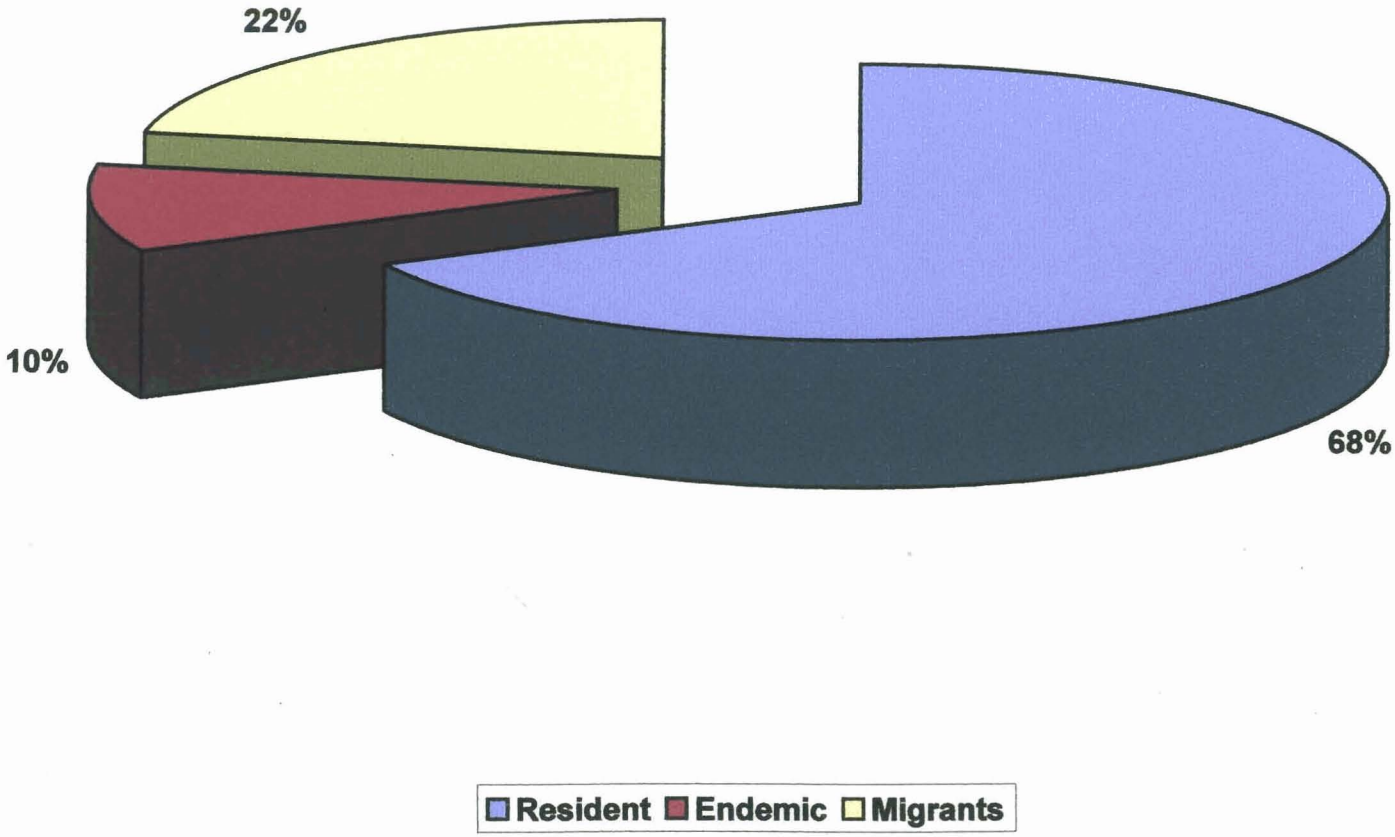


Fig. 11 Status of birds at dry-deciduous forests

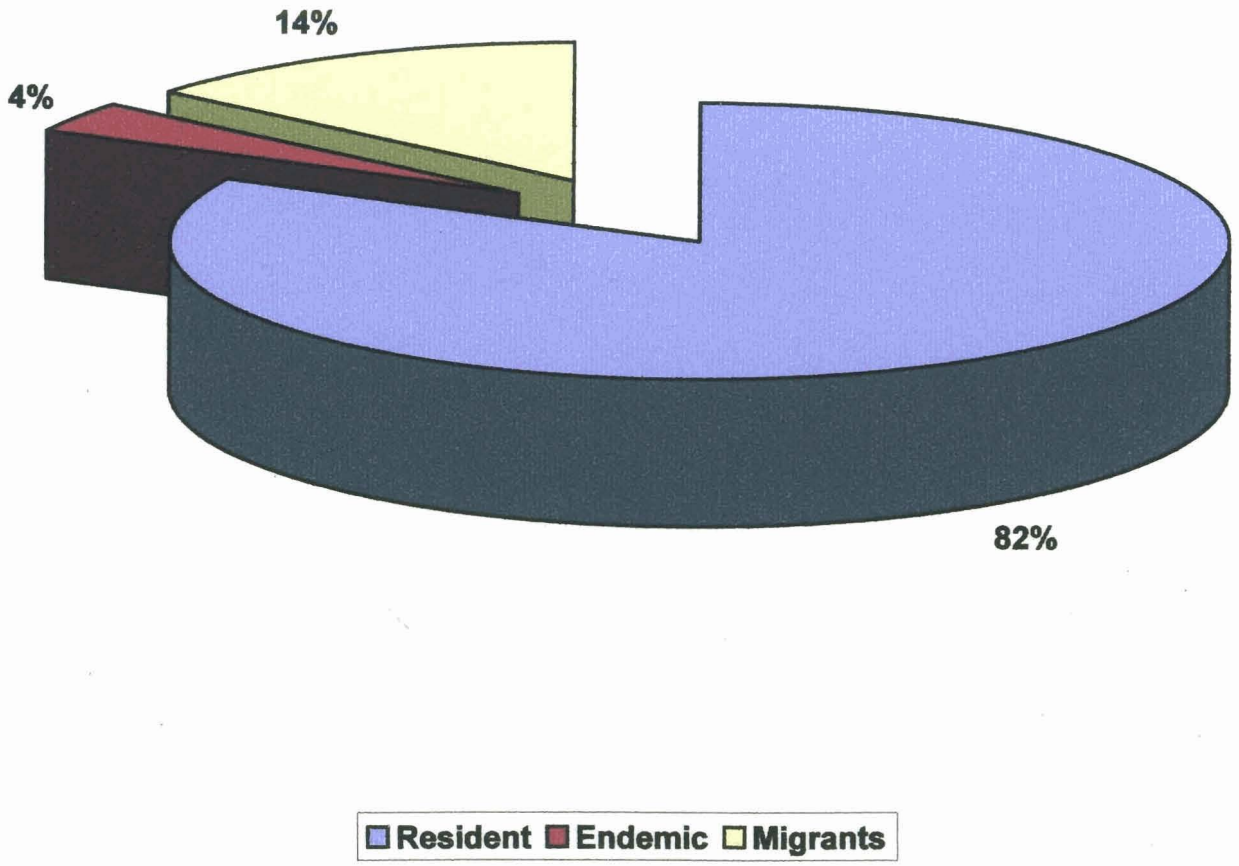


Fig. 12 Status of birds at moist-deciduous forests

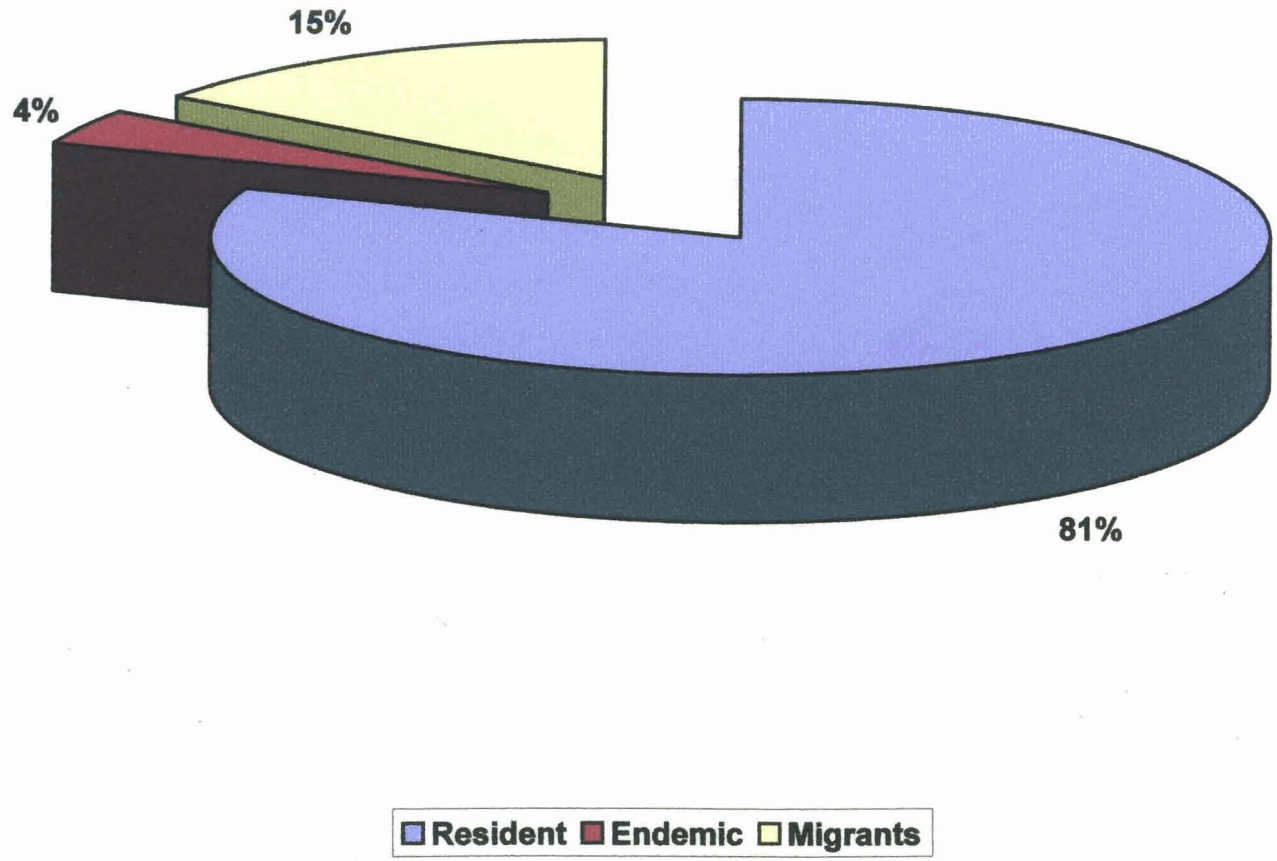


Fig. 13 Status of birds at shola forests

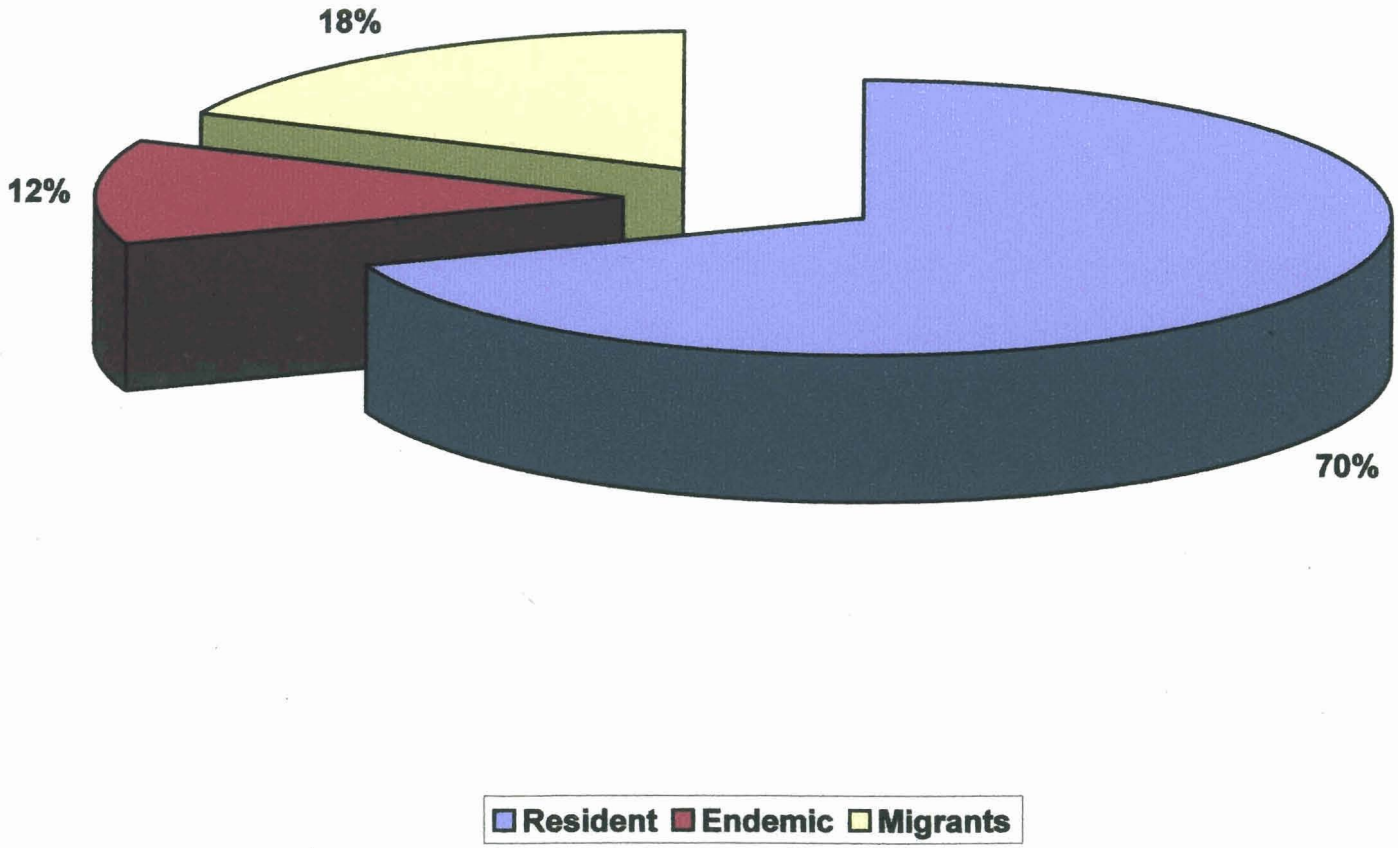


Plate 10. Pictures of a few endemic birds of Western Ghats recorded from the study locations

Rufous Babbler

Grey-breasted Laughingthrush

White-bellied Blue Flycatcher

Black-and-Orange Flycatcher

Nilgiri Laughingthrush

Nilgiri Flycatcher

Plate 11. Pictures of a few migratory birds of Kerala recorded from the study locations

Blue-headed Rock Thrush

Blyths Reed Warbler

Brown Flycatcher

Forest Wagtail

Ashy Drongo

Paradise Flycatcher

Table 18. Status of birds at various study locations

Location	Resident (%)	Endemic to Western Ghats (%)	Migrant (%)
Evergreen forest	67.8	10.2	22
Dry-deciduous forest	82.4	3.7	13.9
Moist-deciduous forest	80.7	4.4	14.9
Shola forest	69.4	12.2	18.4

4.6.1 Endemic and migratory birds of evergreen forest

Evergreen forest has 15 (93.75%) out of the sixteen endemic species of birds of Kerala. They are, Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus priocephalus*), Wynaad Laughingthrush (*Garrulax delesserti*), Nilgiri Laughingthrush (*Garrulax cachinnans*), Rufous Babbler (*Turdoides subrufus*), Broad-tailed Grassbird (*Schoenicola platyura*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), Malabar Grey Hornbill (*Ocyceros griseus*), White-bellied Shortwing (*Brachypteryx major*), Nilgiri Pipit (*Anthus nilghiriensis*) and White-bellied Treepie (*Dendrocitta leucogastra*). Silent Valley (evergreen forest) is perhaps the only location in Kerala where all the endemic species of birds of Kerala other than Grey-breasted Laughingthrush are seen. The endemic species of birds are primarily habitat specialists and their presence in considerable proportion implies the fact that the evergreen habitat of Silent Valley is a primary forest. This further strengthens the fact that evergreen forest of Silent

Valley should be protected at any cost. This also further strengthens my earlier argument that more evergreen forests should be brought under the protected area network.

The State of Kerala has about 170 (35%) of migratory species of birds out of the total of 488 species (Neelakantan, 1996). 22% of the total birds of evergreen forest are migratory in nature. Some of the migratory birds of evergreen forest are Montagu's Harrier (*Circus pygargus*), Northern House-Martin (*Delichon urbica*), Eurasian Crag-Martin (*Hirundo rupestris*), Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Red-throated Flycatcher (*Ficedula parva*), Verditer Flycatcher (*Eumyias thalassina*), Blue-throated Flycatcher (*Cyornis rubeculoides*), Tickell's Leaf Warbler (*Phylloscopus affinis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*), Black-naped Oriole (*Oriolus chinensis*) and Ashy Drongo (*Dicrurus leucophaeus*). The migratory birds visit the evergreen forest of Kerala form far of places like Eurasia and Himalayas (Ali & Ripley, 1987).

4.6.2 Endemic and migratory birds of dry-deciduous forest

Dry-deciduous forest has 11 (68.75%) out of the sixteen endemic species of birds of Kerala. They are Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus*

priocephalus), Rufous Babbler (*Turdoides subrufus*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), Malabar Grey Hornbill (*Ocyceros griseus*), Nilgiri Pipit (*Anthus nilghiriensis*) and White-bellied Treepie (*Dendrocitta leucogastra*).

13.9% of the total birds of dry-deciduous forest are migratory in nature. Some of the migratory birds of dry-deciduous forest are Booted Eagle (*Hieraaetus pennatus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), Drongo Cuckoo (*Surniculus lugubris*), Northern House-Martin (*Delichon urbica*), Forest Wagtail (*Dendronanthus indicus*), Grey Wagtail (*Motacilla cinerea*), Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Tickell's Leaf Warbler (*Phylloscopus affinis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*) and Ashy Drongo (*Dicrurus leucophaeus*).

4.6.3 Endemic and migratory birds of moist-deciduous forest

Moist-deciduous forest has 11 (68.75%) out of the sixteen endemic species of birds of Kerala. They are, Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus*

priocephalus), Wynaad Laughingthrush (*Garrulax delesserti*), Rufous Babbler (*Turdoides subrufus*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Malabar Grey Hornbill (*Ocyceros griseus*), Small Sunbird (*Nectarinia minima*) and White-bellied Treepie (*Dendrocitta leucogastra*).

14.9% of the total birds of moist-deciduous forest are migratory in nature. Some of the migratory birds of moist-deciduous forest are Pallid Harrier (*Circus macrourus*), Common Buzzard (*Buteo buteo*), Osprey (*Pandion haliaetus*), Kentish Plover (*Charadrius alexandrinus*), Green Sandpiper (*Tringa ochropus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), Whiskered Tern (*Chlidonias hybridus*), Blue-tailed Bee-eater (*Merops philippinus*), Indian Pitta (*Pitta brachyuran*), Forest Wagtail (*Dendronanthus indicus),* White Wagtail (*Motacilla alba*), Yellow Wagtail (*Motacilla fiava*), Grey Wagtail (*Motacilla cinerea*), Brown Shrike (*Lanius cristatus*), Blue-headed Rock-Thrush (*Monticola cinclorhynchus*), Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*) and Ashy Drongo (*Dicrurus leucophaeus*).

4.6.4 Endemic and migratory birds of shola forest

Shola forest has 9 (56.25%) out of the sixteen endemic species of birds of Kerala. They are Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-breasted Laughingthrush (*Garrulax jerdoni*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), White-bellied Shortwing (*Brachypteryx major*) and Nilgiri Pipit (*Anthus nilghiriensis*)

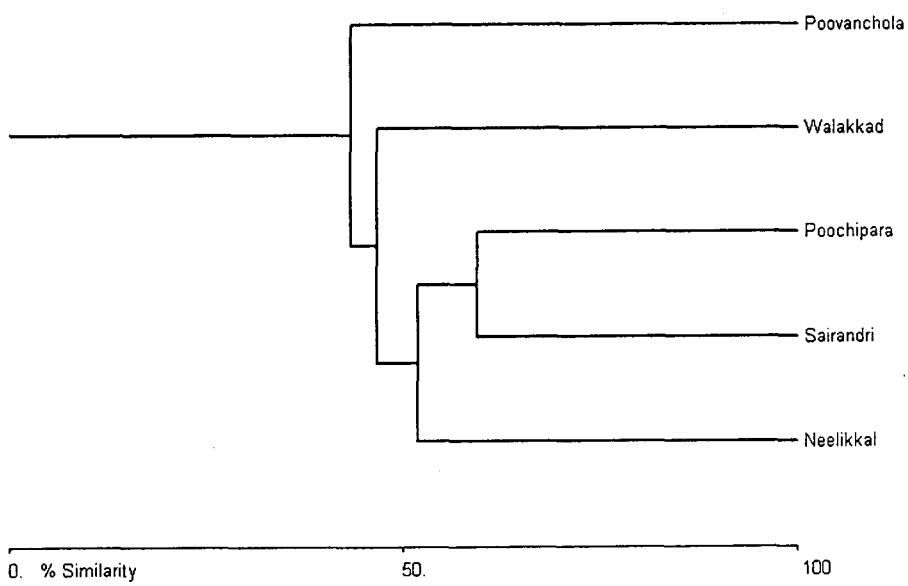
18.4% of the total birds of shola forest are migratory in nature. Some of the migratory birds of shola forest are Eurasian Golden Oriole (*Oriolus oriolus*), Ashy Drongo (*Dicrurus leucophaeus*), Brown-breasted Flycatcher (*Muscicapa muttui*), Verditer Flycatcher (*Eumyias thalassina*), Blyth's Reed Warbler (*Acrocephalus dumetorum*), Tickell's Leaf-Warbler (*Phylloscopus affinis*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Greenish Warbler (*Phylloscopus trochiloides*), Western Crowned Warbler (*Phylloscopus occipitalis*), Indian Blue Robin (*Luscinia brunnea*), Grey Wagtail (*Motacilla cinerea*) and Common Rosefinch (*Carpodacus erythrinus*).

4.7 Similarity of the bird fauna within and between the study sites

4.7.1 Similarity of birds within evergreen forest

Bray-Curtis cluster analysis of similarity of birds within the five study sites in evergreen forest is given in Fig. 14. The maximum similarity was between the birds of Poochipara and Sairandri (59.69 %), followed by the birds of Neelikkal (51.98 %), and Walakkad (46.64 %) and then with the birds of Poovanchola (28 %). Birds of Poochipara, Sairandri and Neelikkal were more similar to each other when compared to the birds of Walakkad and Poovanchola.

Fig. 14 Bray-Curtis Cluster Analysis of similarity of birds at evergreen forests of Silent Valley



4.7.2 Similarity of birds within dry-deciduous forest

Bray-Curtis cluster analysis of similarity of birds within the three study sites in dry-deciduous forest is given in Fig. 15. The maximum similarity was between the birds of Churulapetty and the birds of Kootar (63.64 %). The similarity between the birds of above two sites with the riverine site was only 43.80 %.

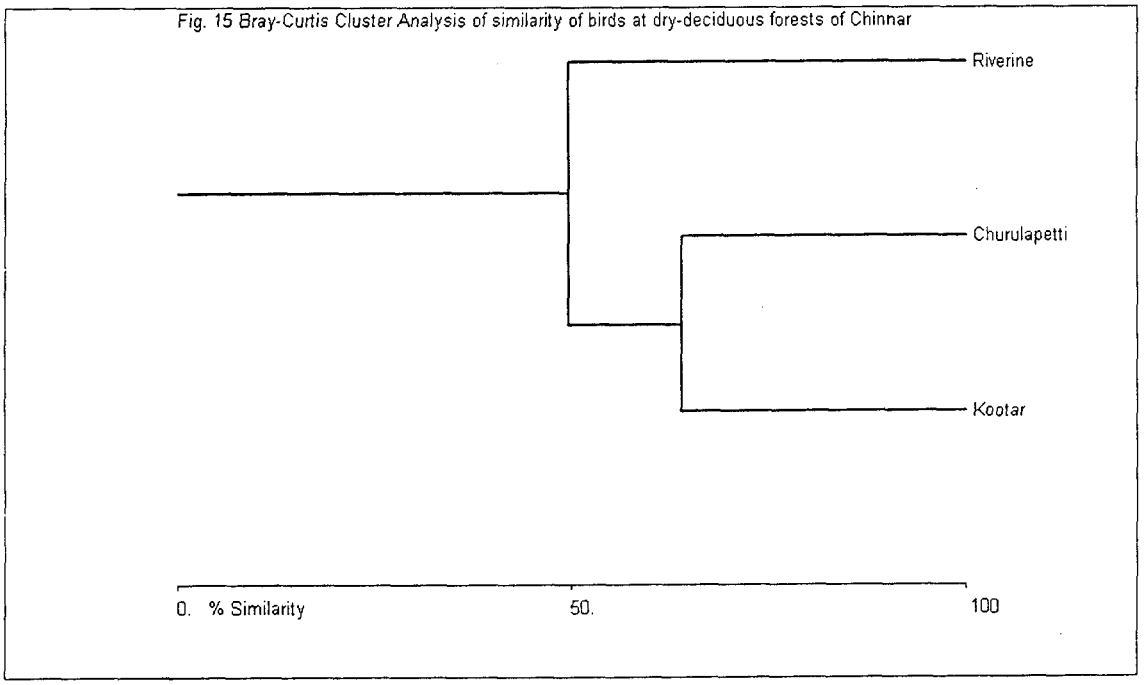


Fig. 15 Bray-Curtis Cluster Analysis of similarity of birds at dry-deciduous forests of Chinnar

4.7.3 Similarity of birds within moist-deciduous forest

Bray-Curtis cluster analysis of similarity of birds within the five study sites in moist-deciduous forest is given in Fig. 16. The maximum similarity was between the birds of Kettuchira and birds of Kizhakanam (40.71 %), followed by the birds of Murukkoli (38.13 %), then with birds of Vakavanom (30.03 %) and with the birds of Chembakassery (17.77 %).

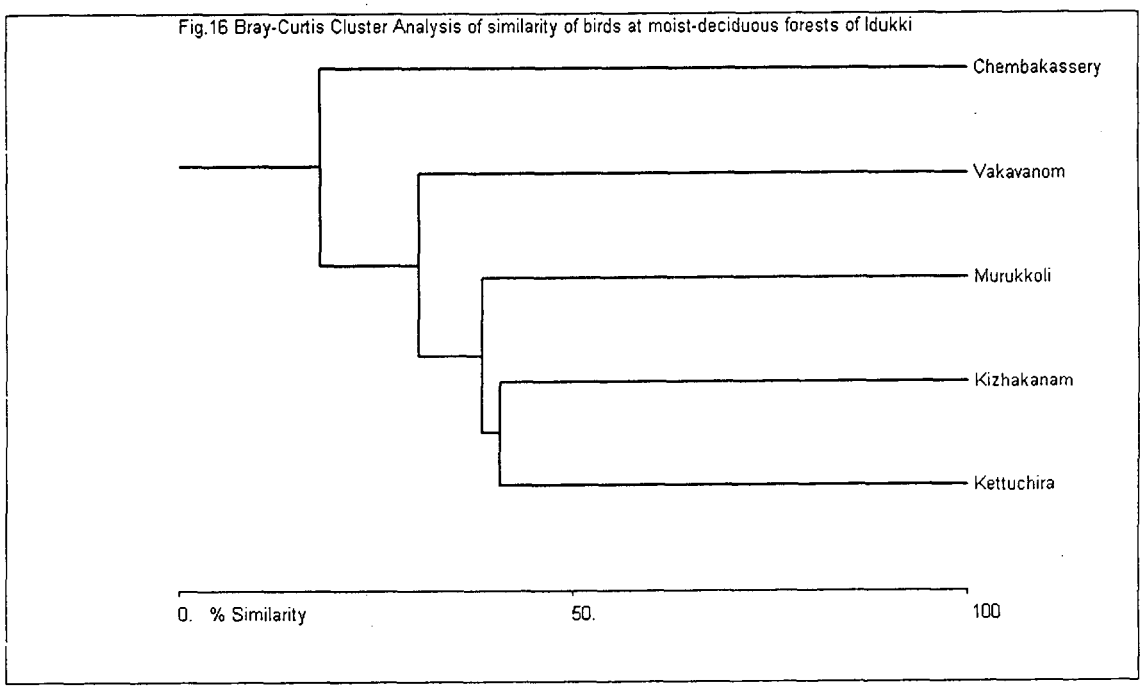
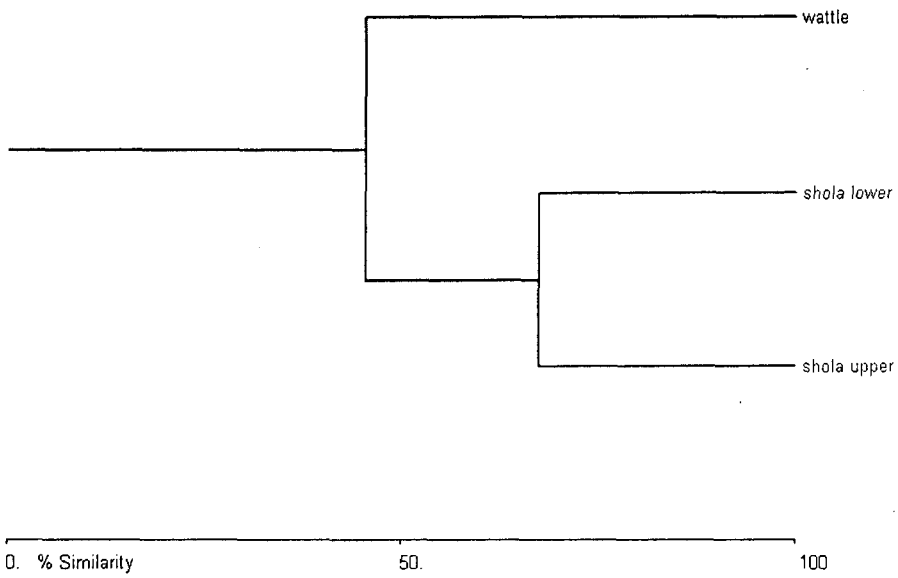


Fig.16 Bray-Curtis Cluster Analysis of similarity of birds at moist-deciduous forests of Idukki

4.7.4 Similarity of birds within shola forest

Bray-Curtis cluster analysis of similarity of birds within the three study sites in shola forest is given in Fig. 17. The maximum similarity was between the birds of 'Shola-upper and the birds of 'Shola-lower' (67.40 %), however, the similarity between the birds of shola patches and the wattle plantation was only 45.45 %.

Fig. 17 Bray-Curtis Cluster Analysis of similarity of birds at Shola forests of Mannavan



4.7.5 Similarity of birds among the study locations

The similarity of bird fauna among the study sites is given in Table 19 and Table 20. Between all the four locations in whatever combinations compared, the bird fauna was more dissimilar. In most of the cases more than 50 % of the species were not common to the two sites compared. The dissimilarity was highest among shola forest, dry-deciduous forest and moist-deciduous forest, where the dissimilarity was up to 65 %.

Table 19. Similarity of bird fauna among the study sites using Jaccard's index

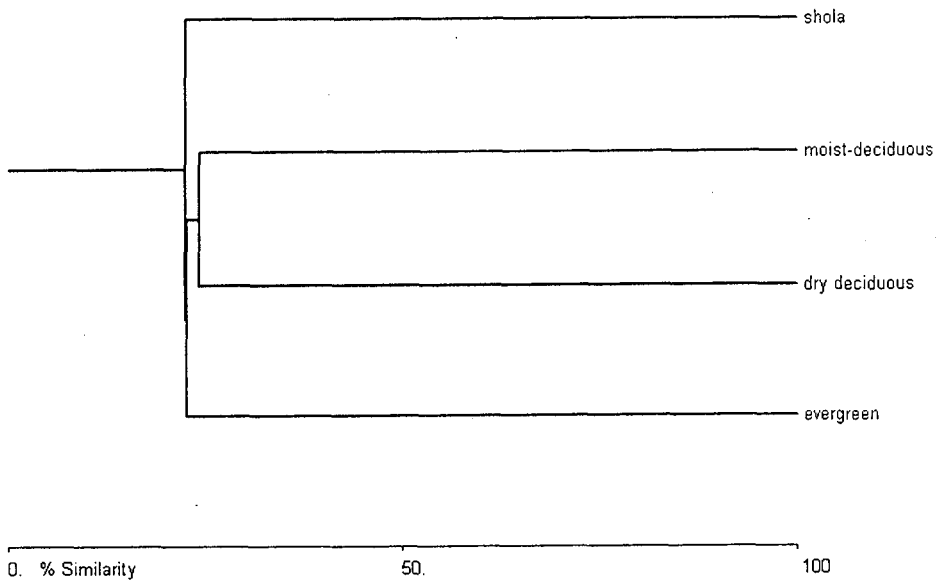
	Evergreen forest	Dry-deciduous forest	Moist-deciduous forest	Shola forest
Evergreen forest	-	-	-	-
Dry-deciduous forest	0.32	-	-	-
Moist-deciduous forest	0.41	0.41	-	-
Shola forest	0.31	0.21	0.22	-

Table 20. Similarity of bird fauna among the study sites using Sorensen's index

	Evergreen forest	Dry-deciduous forest	Moist-deciduous forest	Shola forest
Evergreen forest	-	-	-	-
Dry-deciduous forest	0.49	-	-	-
Moist-deciduous forest	0.58	0.58	-	-
Shola forest	0.47	0.34	0.35	-

The Fig. 18 also give a similar pattern of dissimilarity among the four study location habitats such as evergreen, moist deciduous, scrub jungle and shola forest. With more similarity between the birds of dry-deciduous and moist-deciduous forests, followed with birds of evergreen forests.

Fig. 18 Bray-Curtis Cluster Analysis of similarity of birds at four different habitats studied



4.8 Average detection width, flock size and density of birds at shola forest

Average detection width, flock size and density of birds at the study sites are given in the Table 21.

Table 21. Average detection widths, flock size, density of birds at the two study sites in shola forest

Transect		Estimate	CV	95% Confidence interval	
Shola - upper	Width	15			
	Effective detection radius	9.3	1.90	8.96	9.65
	Encounter rate / point	3.4	6.66	2.94	3.82
	Detection probability	0.38	3.79	0.36	0.41
	Average flock size	2.3	4.35	2.11	2.51
	Density of individuals	28307	8.58	23913	33508
Shola - lower	Width	18			
	Effective detection radius	10.22	2.21	9.78	10.7
	Encounter rate / point	3.85	5.59	3.45	4.30
	Detection probability	0.32	4.42	0.29	0.35
	Average flock size	2.48	4.85	2.25	2.73
	Density of individuals	28537	8.02	24378	33404

It is evident from the result that the shola-upper had a detection length of 15 meters while that of the shola-lower was 18 meters. The effective detection radius was also lower in shola-upper than that of shola-lower. The overall density of

the birds was 28,307 per sq. km in the shola-upper while in the shola-lower it was 28,537.

4.9 Density of different species of birds at shola forest

Density of different species of birds at the shola forest is given in the Table 22. It is evident from the table that most abundant birds such as Grey-breasted Laughingthrush, Grey-headed Flycatcher, White Eye, Velvet-fronted Nuthatch, Black and Orange Flycatcher, Quaker Babbler, Greenish Leaf-Warbler and White-bellied Blue Flycatcher etc were also found to be the denser species of birds in the study sites. The greater density was recorded by the Grey-breasted Laughingthrush in the shola-lower, which supported 13222 individuals of birds per sq. km. The species of bird that recorded the lowest density was the Blackbird (49).

Table 22. Density of different species of birds at the shola forest

Sl. No.	Species	Density (number of birds / km^2)	
		Shola upper	Shola lower
1.	Grey-breasted Laughingthrush	9391	13222
2.	Grey-headed Flycatcher	6462	7460
3.	White Eye	3034	1689
4.	Velvet-fronted Nuthatch	1702	835
5.	Black and Orange Flycatcher	1641	159
6.	Quaker Babbler	1542	2573
7.	Greenish Leaf Warbler	1369	1026
8.	Blue-winged Parakeet	531	127

9.	Malabar Whistling Thrush	478	265
10.	Black Bulbul	442	481
11.	Chestnut-headed Bee-eater	424	685
12.	White-bellied Blue Flycatcher	398	1528
13.	Nilgiri Flycatcher	348	255
14.	Nilgiri Flowerpecker	348	255
15.	Yellow-browed Bulbul	332	505
16.	Grey Tit	298	398
17.	Pigmy Woodpecker	265	127
18.	Yellow-cheeked Tit	199	398
19.	Black Bird	199	49
20.	Large Golden-backed Woodpecker	198	0
21.	Verditer Flycatcher	158	318
22.	Large-billed Leaf Warbler	157	57
23.	Nilgiri Wood Pigeon	157	350
24.	Tickllе's Flowerpecker	157	223
25.	Malabar Trogon	149	44
26.	Pied Flycatcher Shrike	127	316
27.	Crested Serpent Eagle	106	29
28.	Grey Wagtail	99	223
29.	Small Green Barbet	95	64
30.	Lesser Golden-backed Woodpecker	53	132
31.	Scarlet Minivet	0	170
32.	Scimitar Babbler	0	155
33.	Red-whiskered Bulbul	0	348
34.	Small Sunbird	0	133
35.	Rosefinch	0	66
36.	Grey Jungle Fowl	0	64
37.	Malabar Wood Shrike	0	199
38.	Blyth's Reed Warbler	0	265
39.	Blue Chat	0	265

40.	Emerald Dove	0	199
41.	Tickell's Leaf Warbler	0	199

The denser species constituted about 80-86 % of the total density of the birds in the study site. The summary statistics of the density of birds seen in shola forest is given in Appendix 5.

4.10 Species richness and diversity of vegetation at shola forest

Species richness and diversity of vegetation at shola forests is given in Table 23. The shola-upper and shola-lower had 16 and 17 species of trees respectively. The richness index values as well as diversity index values were more or less the same in the shola-upper and shola-lower, so also evenness index.

Table 23. Species richness and diversity of vegetation at the two study sites

Diversity and Richness measures	**Shola – upper**	**Shola – lower**
Number of species	16	17
Margalef's index	2.46	2.57
Menhinick's index	0.76	0.75
Simpson's index	0.09	0.07
Shannon- Wiener index	2.51	2.68
Evenness index	0.91	0.95

4.11 Phytosociological analysis of the vegetation of the shola sites

Phytosociological analysis of the vegetation of the study of the shola sites is given in Table 24.

Table 24. Phytosociological analysis of the vegetation of the two study sites at Shola forest

Shola upper							
Species	**DEN.**	**FREQ.**	**COVER**	**RDEN**	**RFREQ**	**RDOM**	**IVI**
Syzygium arnottianum	80.1	180	14.9	17.9	14.8	30.2	62.9
Mastixia arborea	68.6	170	10.3	15.4	13.9	20.9	50.2
Cinnamomum wightii	45.8	120	3.8	10.3	9.8	7.8	27.9
Rhododendron nilagiricum	45.8	120	3.6	10.3	9.8	7.3	27.4
Syzygium caryophyllatum	34.3	100	3.8	7.7	8.2	7.7	23.6
Elaecarpus munronii	22.9	80	2.8	5.1	6.6	5.6	17.3
Turpinia cochinchinensis	22.9	80	2.1	5.1	6.6	4.3	16.0
Photinia integrifolia	34.3	70	0.6	7.7	5.7	1.3	14.7
Phoebe wightii	11.4	40	1.6	2.6	3.3	3.3	9.2
Syzygium sp.	11.4	40	1.6	2.6	3.3	3.2	9.1
Glochidion neilgherrense	11.4	40	1.3	2.6	3.3	2.6	8.4
Neolitsea scrobiculata	11.4	20	1.5	2.6	1.6	3.1	7.3
Isonandra candolleana	11.4	40	0.4	2.6	3.3	0.9	6.7
Ilex wightiana	11.4	40	0.4	2.6	3.3	0.9	6.7
Ilex tritiseae	11.4	40	0.2	2.6	3.3	0.4	6.3
Acronychia pedunculata	11.4	40	0.2	2.6	3.3	0.3	6.2
	446.1	**1220**	**49.2**	**100**	**100**	**100**	**300**
Shola lower							
Species	**DEN.**	**FREQ.**	**COVER**	**RDEN**	**RFREQ**	**RDOM**	**IVI**
Syzygium arnottianum	65.7	170	8.9	12.8	13.2	19.6	45.6
Acronychia pedunculata	52.5	150	3.7	10.3	11.6	8.1	30.0
Syzygium caryophyllatum	39.4	90	6.2	7.7	7.0	13.7	28.3
Mastixia arborea	39.4	100	5.5	7.7	7.8	12.1	27.6
Phoebe wightii	39.4	90	4.8	7.7	7.0	10.5	25.2
Hydnocarpus alpina	39.4	90	3.3	7.7	7.0	7.2	21.9
Viburnum coriaceum	52.5	80	2.0	10.3	6.2	4.3	20.8
Symplocos cochinchinensis	39.4	100	1.2	7.7	7.8	2.5	18.0
Turpinia cochinchinensis	26.3	80	1.9	5.1	6.2	4.2	15.6
Litsea zeylanica	26.3	70	1.4	5.1	5.4	3.1	13.6

Isonandra candolleana	13.1	40	1.9	2.6	3.1	4.1	9.8
Schefflera recemosa	13.1	40	1.5	2.6	3.1	3.4	9.0
Elaecarpus munronii	13.1	40	0.8	2.6	3.1	1.8	7.5
Persea macrantha	13.1	40	0.8	2.6	3.1	1.8	7.4
Ligustum robustum	13.1	40	0.6	2.6	3.1	1.3	7.0
Vaccinium leschenaultii	13.1	30	0.9	2.6	2.3	1.9	6.8
Meliosma pinnata	13.1	40	0.2	2.6	3.1	0.4	6.0
	512.3	**1290**	**45.5**	**100**	**100**	**100**	**300**

Legend: DEN = density; FREQ = frequency; RDEN = relative density; RFREQ = relative frequency; RDOM = relative dominance; IVI = Important Value Index.

As the table indicates the shola-upper vegetation community is constituted by the dominant trees such as *Syzygium arnottianum, Mastixia arborea, Cinnamomum wightii, Rhododendron nilagiricum, and Syzygium caryophyllatum*, while that of shola-lowerare *Syzygium arnottianum, Acronychia pedunculata, Syzygium caryophyllatum, Mastixia arborea and Phoebe wightii.* The basal area was the maximum at shola-upper (49.2 m^2) followed by the shola-lower with a basal area of 45.5 m^2. The density of trees at the different study sites however was 446 and 512 respectively.

4.12 Attributes of birds and vegetation of the two study sites of shola forest

The various attributes of the vegetation and the bird fauna are given in the Table 25. The attributes presented for vegetation are woody plant diversity, woody plant richness, tree density, vertical stratification and canopy density. Bird species richness, bird density and bird diversity are the attributes of bird fauna. These

attributes were examined at different study sites. Between the study sites shola-upper and shola-lower there was no significant difference in the attributes.

Table 25. Attributes of vegetation and birds at the two study sites at shola forest

Attributes	Vegetation type	Mean	Std. Dev.	Min.	Max.	Statistical significance
Woody plant diversity	Shola – upper	2.01	0.84	1.6	3.12	NS
	Shola – lower	2.11	0.62	1.22	3.07	
Woody plant richness	Shola – upper	3.3	0.68	2	4	NS
	Shola – lower	3.2	0.63	2	4	
Tree density	Shola – upper	454	87	331	625	NS
	Shola – lower	558	231	256	947	
Vertical stratification	Shola – upper	3	0.42	2.78	4	NS
	Shola – lower	3	0.57	2.33	4.5	
Canopy density	Shola – upper	3.9	0.32	3	4	NS
	Shola – lower	3.5	0.53	3	4	
Bird species richness	Shola – upper	14	2.6	9	17	NS
	Shola – lower	16.8	3.49	11	23	
Bird density	Shola – upper	20884	7820	6363	30545	NS
	Shola – lower	16749	5467	7765	23885	
Bird diversity	Shola – upper	2.12	0.23	1.68	2.37	NS
	Shola – lower	2.26	0.26	1.88	2.75	

NS = not significant

1. Tree density = number of trees per hectare, plants ≥30 cm girth at breast height (GBH)
2. Vertical stratification = $1/\Sigma\ pi^{2}$, where "pi" is the proportion of individual plants in the i^{th} height class
3. Canopy density = mean ten points scored as 1, 2, 3 and 4 (1= 0-25%; 2 = 26-50%; 3 = 51-75%; and 4 = 76 – 100 %)
4. Bird species richness = number of species of birds
5. Bird density = number of birds per sq. km.
6. Bird diversity = H` (Shannon-Weiner index)
7. Woody plant species diversity = H`(Shannon Weiner index)
8. Woody plant species richness = number of woody plant species.

4.13 Correlation of bird-vegetation attributes

Correlation matrix of attributes of study sites is given in Table 26. For shola forest bird species richness, bird diversity and bird density correlated negatively with woody plant species diversity as well as with woody plant species richness, canopy density, tree density and vertical stratification.

Table 26. Correlation matrixes of attributes of the study sites at shola forest

Attributes	**Location**	**Bird species richness**	**Bird density**	**Bird diversity**
Woody plant Diversity	Shola upper	-0.02	-0.17	-0.39
	Shola lower	-0.68	-0.73	-0.65
Woody plant Richness	Shola upper	-0.59	-0.54	-0.09
	Shola lower	-0.38	-0.62	-0.64
Canopy Density	Shola upper	-0.39	-0.28	-0.36
	Shola lower	-0.56	-0.72	-0.37
Tree Density	Shola upper	-0.22	-0.51	-0.68
	Shola lower	-0.32	-0.11	-0.15
Vertical stratification	Shola upper	-0.48	-0.31	-0.35
	Shola lower	-0.65	-0.08	-0.34

DISCUSSION

Nameer P.O“Bird community structure in a few selected forest types of Kerala” Thesis. Department of Zoology, University of Calicut, 2005

Discussion

DISCUSSION

5.1 Bird species richness, abundance, and diversity

The result of the present study indicates that the bird species richness, abundance and diversity were higher in the deciduous forests when compared to the evergreen and shola forests. The moist-deciduous forest as well as dry-deciduous forest is more heterogeneous spatially with a variety of habitats, lot of secondary undergrowth and openings. Such habitats are known to be more productive (Connell, 1978; Schemske and Brokov, 1981). In neotropical forest studies have found higher species richness in secondary growth areas (Lynch, 1989, Kricher and Davis, 1992). Daniels (1989) and Daniels *et al.* (1990) also observed greater bird species diversity in secondary / moist deciduous forest in Uttara Kannada district, Western Ghats.

Connell (1978) relates higher levels of diversity to disturbed conditions and lower levels to stability within tropics. Unlike plants the number of taxa increases with the decreasing rainfall, and reaches the highest densities of taxa in the zones of intermediate rainfall (Daniels, 1989). This further explains the greater species diversity in the low rainfall deciduous forest (where the annual rainfall is as low as 700mm to 2500mm, (Basha, 1997), as against the shola forest with an annual rainfall of 4500mm to 4800 mm (Nair, 1991).

The high altitude areas are known to support fewer number of bird species when compared to the lower altitude areas. Studies on the birds of neotropics (Stotz, *et al.* 1996) had shown that a plateau in species number between 500 to 1000 m, then there is a decline in species richness as the altitude increases at the rate of approximately 5% with every 100m gain in elevation from 1000 to 3000m. This further explains the lower species richness and diversity observed in the present study in the shola forest, where the altitude is from 1500m to 2500m.

The diversity of birds is rather low, in the tropical forest of Western Ghats unlike the neotropical or African rain forest. In any part of the Western Ghats, a maximum of 150 species of birds may be present in an area less than 15 km^2 (Daniels, 1989), where as Pearson (1982) has observed 478 species from Ecuador and 365 species from Gabon, Africa. In Western Ghats there are not many narrow habitat specialists and endemics. Even the highly localised birds tend to use all the available habitats, where they are found. Birds with highly specialised niche are scarce. For instance, there are very few obligate frugivores, no ant followers and no specialised nectarivores, except the few species of sunbirds. Diversification within a family or genus has not reached the levels that of neotropical rainforest birds. This is true even with the entire avifauna of the Oriental rainforest. Less diversification has probably determined the more generalised resource utilisation in these birds.

5.2 Species-area curve

At dry-deciduous forest, in the very first transect 43 species were sighted, while at shola forest it was only 10 and at evergreen forest just over 20. Dry-deciduous forest, while recorded 100 species by the 17th transect, at evergreen forest it took 20 transects effort, while at shola forest shola even after 25 transects only 49 species were recorded. The species area curve results also show that the dry-deciduous forest is the most diverse habitat, when compared to evergreen and shola habitats. The species area curve plateaus at 18 to 21 transect efforts at different habitats also suggest that a minimum of 18 to 21 transect effort is required at different forest types of Kerala to get an idea about birds found in each of these forest. The shola forest require a transect effort of 18 transects, while the scrub jungle requires 20 transect efforts, and the evergreen forest requires 21 transect efforts.

Unlike plants the number of bird taxa shows an increasing trend with the decreasing rainfall, reaching the highest densities of taxa in the zone of intermediate rainfalls (Daniels, 1989). In the secondary forest and heterogeneity of the habitats resulting from the greater human interference has favored invaders from the moist deciduous zone. The dry deciduous forest zone also being more similar to the moist deciduous zone suggests that the latter is a transitional zone between the wetter and dry zones.

5.3 Bird community structure

5.3.1 Species composition at various study locations

5.3.1.1 Species composition at the evergreen forest

The dominant bird families as well as the dominant species of birds at the evergreen forest indicate that these forest support birds that are typical of primary habitats, those habitats that are not modified by humans. Evergreen forest contain proportionality more habitat specialists such as the bulbuls, sunbirds, flycatchers, pigeons, thrushes, babblers, warblers etc.

The bird species composition of evergreen forest is mostly constituted by forest dependant species. It may also be noted that evergreen forest support eight (26.7%) out of the 30 red data book (RDB) species that are found in Kerala (Birdlife International, 2001). Out of the eight red data book birds reported from evergreen forest, Nilgiri Laughingthrush (*Garrulax cachinnans*) is having the Endangered (EN) status of IUCN (International Union for Conservation of Nature or World Conservation Union), while the Nilgiri Wood-pigeon (*Columba elphinstonii*), White-bellied Shortwing (*Brachypteryx major*) and Broad-tailed Grassbird (*Schoenicola platyura*) belong to the Vulnerable (VU) category of IUCN. The Great Hornbill (*Buceros bicornis*), Nilgiri Pipit (*Anthus nilghiriensis*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*) and Nilgiri Flycatcher (*Eumyias albicaudata*) belong to the Near Threatened (NT) category of IUCN (Birdlife International, 2001).

Apart from this the present study also recorded several interesting birds from evergreen forest. The following birds, which were sighted from the evergreen forest, are not included in *Birds of Kerala* of Salim Ali (1969). They are Nilgiri Laughingthrush (*Garrulax cachinnans*), Rufous-bellied Shortwing (*Brachypteryx major major*), Northern House-Martin (*Delichon urbica*), Barn Swallow (*Hirundo rustica*), Eurasian Crag-Martin (*Hirundo rupestris*), Oriental Scops-Owl (*Otus sunia*) and Wire-tailed Swallow (*Hirundo smithii*). All these birds are being reported from Kerala for the first time through this study from the evergreen forests of Silent Valley.

Nilgiri Laughingthrush (*Garrulax cachinnans*): is a high altitude specialist species and is highly restricted in its distribution, was known only from the Nilgiri Mountains of Western Ghats in Tamil Nadu. Ali and Ripley (1987) describes the distribution of Nilgiri Laughingthrush as "range curiously restricted, confined to the Nilgiri Hills of western Tamil Nadu". There were no previous sight records of Nilgiri Laughingthrush from Kerala prior to the present sighting. Apart from being a restricted range species it is also an Endangered species and the sighting of the same from the evergreen forests of Silent Valley is of great significance. This was sighted from the Sispara-Angida regions of Silent Valley National Park.

Rufous-bellied Shortwing (*Brachypteryx major major*): This species was known only from the Nilgiri Mountains of Tamil Nadu and Brahmagiri hills southern Mysore (Ali and Ripley, 1987), until it was sighted from Nilikkal at Silent Valley National Park during the present study. The Rufous-bellied Shortwing is a restricted range species, having Vulnerable status.

Northern House-Martin (*Delichon urbica*): Ali (1969) included House Martin in the *Birds of Kerala*, but says that he did not come across it during the Travnecore and Cochin ornithological survey during mid 1930,s. He expresses a doubt about the origin of a single British Museum specimen labeled 'Travencore'. The present sighting of this species from the Silent Valley is of significance as it is the first recent sight record from Kerala. The species is known up to Mysoreand Nilgiri hills in south (Ali and Ripley, 1987).

Streak-throated (Cliff) Swallow (*Hirundo fluvicola*): The southernmost distributional range of this bird until now was from Coimbatore (Ali and Ripley, 1987). The present sighting of this species from the Silent Valley is of great significance as this is the first sight record from Kerala.

Eurasian Crag-Martin (*Hirundo rupestris*): According to Ali and Ripley (1987) seen South to Mysore and Tamil Nadu, probably also from Kerala

whence not yet recorded. The sighting of the birds from Silent Valley was the first sighting from Kerala.

The breeding of the following birds was also reported from the evergreen forest. They are Malayan Night-Heron, Shahin Falcon, Jerdon's Imperial Pigeon, Malabar Trogon, Great Black Woodpecker, House Swallow, White-bellied Treepie, White-bellied Blue Flycatcher, Nilgiri Flycatcher, Malabar Whistling Thrush and Small Sunbird.

Out of these the breeding of Malayan Night-Heron and the Shahin Falcon, are of significance because these are the first breeding records of these species for Kerala. There are no prior records of breeding of this species from Kerala. The nest of the Malayan Night-Heron was located during the mid-May, among an *Ochalndra* belt near Poochipara. There were three pure white eggs in the nest. The nestlings were also pure white in colour at the time of hatching, contrary to the rufous brown colour of the parents. The description of the nest and the nesting habitat fits exactly with the description of Ali and Ripley (1987), who says "nest a flimsy structure of twigs, with a lining of reed leaves. Usually placed between 5 to 8 m up in a small tree overhanging a stream in thick forest. Not concealed but easily overlooked".

The Shahin Falcon nest was located in a sharp precipitous cliff at Neelikkal. According to Ali and Ripley (1987), the nest is a large compact platform of sticks sometimes lined with wool and grass, placed on a ledge or in a niche on a cliff face – usually inaccessible situations". The parent birds were shown exhibiting the courtship as well as mating displays. The same was observed during the end of December. The breeding of the other birds such as Jerdon's Imperial Pigeon, Malabar Trogon, Great Black Woodpecker, House Swallow, White-bellied Treepie, White-bellied Blue Flycatcher, Nilgiri Flycatcher, Malabar Whistling Thrush and Small Sunbird, were reported by Ali (1969) from Kerala.

The birds of prey are also very well represented at evergreen forest. Out of the 37 species of Accipitridae of Western Ghats, evergreen forest has 17 (45.95%) of them. The birds of prey being carnivorous, their presence in good numbers necessitates presence of adequate prey base, which in turn is an indication of a healthy habitat.

All the above listed points are suggestive of the importance of evergreen habitat in the conservation of threatened, endemic and habitat specialist birds. It may be noted at this juncture that the many of the undisturbed evergreen forest, in Kerala are lying outside the protected are network. New Amarambalam reserve forest and Siruvani reserve forest adjacent to Silent Valley, in Palakkad districts, Kottiyur reserve forest in Kannur district, Nelliampathies, Vazhachal and

Sholayar reserve forest in Palakkad and Thrissur districts, Pooyamkutty and Edamalayar reserve forest in Ernakulam and Idukki districts, Goodrickal and Achenkoil reserve forest in Idukki and Kottayam districts, Kallada, Kulathupuzha and Palode reserve forest in Kollam and Thiruvananthapuram districts of Kerala, all support undisturbed evergreen forest but all lie outside the protected area network and receive very little attention from the conservation point of view. If some of these areas can be brought under the protected area network it would definitely improve the conservation scenario of many of the restricted range and threatened birds of Kerala.

5.3.1.2 Species composition at the dry-deciduous forest

Dry-deciduous forest and natural arid scrubs are distributed only in very few locations in Kerala. One important area is Chinnar in Idukki district, others being Wayanad and Attappady regions. Birds that occur in the dry formations are less likely to be restricted to a single habitat type. On a closer examination of the bird species composition of dry-deciduous forest, it can be seen that the proportion of the generalist species is more. These habitat generalists lived in forest edges, tree-fall openings, or other natural openings within the vegetation. Birds of secondary habitats have proliferated around human-caused disturbances ever since people began altering the landscape. Certainly the future of these species is secure as habitat alteration accelerates across the forest of Kerala. They are also the most common and conspicuous bird species.

However, certain drier area dependent species such as Eurasian Collared-Dove (*Streptopelia decaocto*), Little Brown Dove (*Streptopelia senegalensis*), Brown-headed Barbet (*Megalaima zeylanica*), Bay-backed Shrike (*Lanius vittatus*) are only found in dry-deciduous forest.

The dry-deciduous forest supports three Red Data Book (RDB) species. The White-rumped Vulture has the Critically Endangered (CR) conservation status of IUCN, while the Nilgiri Wood-pigeon and the Yellow-throated Bulbul are having the Vulnerable (VU) status (Birdlife International, 2001). The presence of the Critically Endangered, White-rumped Vulture (*Gyps bengalensis*) at the dry-deciduous forest is of interest. Over the last five years or so there has been considerable reduction in the number of vultures, of the genus *Gyps* from throughout India. The presence of *Gyps bengalensis* is of interest as dry-deciduous forest of Chinnar is the only place in Kerala, south of Palghat gap, where this species has been sighted recently as part of the present study. Vultures are essentially scavenging birds, that primarily feed on carcass of dead animals (Ali and Ripley, 1987). Hence so as to locate the carcass of the animals, vulture can survive only in open forests such as the dry-deciduous forests and scrub jungles, characteristic of Chinnar. This could be reason for the occurrence of vultures at Chinnar wildlife sanctuary.

Similarly the sighting of the Yellow-throated Bulbul (*Pycnonotus xantholaemus*) also attains significance, as this is the first sighting of the Yellow-

throated Bulbul from Kerala. Prior to the present sighting as part of the current study, the Yellow-throated Bulbul was known only from Eastern Ghats in Karnataka and Andra Pradesh. Regarding the birds of prey, dry-deciduous forest has 10 out of the 37 (27.03%) species of accipitridae members.

The dry-deciduous forest and arid habitats, though mostly support generalist species, they also have very unique species of birds, which are seen only there. White-backed Vulture and Yellow-throated Bulbul to cite couple of example. So from the point of view of conservation of biological diversity it is important that such habitats are also well protected and managed. Many of the arid zone environments are disappearing as fast as, the humid forest. The destruction of dry habitats generally receives much less attention and publicity when compared to the humid forest. This is because of the fact that the dry habitats are less charismatic when compared to the rain forests.

This is true with the forest managers also. Chinnar Wildlife Sanctuary is the only area in Kerala State that legally protects the dry deciduous and scrub jungle habitats, is being grossly mismanaged by the forest department. The department officials who are generally overwhelmed by the charismatic mega-vertebrates, their management prescriptions are also biased more towards the larger mammals. One of the important management activities carried out by the forest department officials at Chinnar wildlife sanctuary is the complete checking of the

forest fire. As a result of this the habitat of Chinnar is slowly shifting towards wetter, greener and denser vegetation. The same may be good for the larger mammals such as elephants, gaur, sambar deer and spotted deer, but can be deleterious to several dry habitat specialist species such as White-backed Vulture, Yellow-throated Bulbul, Bay-backed Shrikes, Collard Dove, Brown Dove etc among the birds.

5.3.1.3 Species composition at the moist-deciduous forest

Moist-deciduous forest has five Red Data Book species, four of which are Near Threatened, while the one is Vulnerable. They are Nilgiri Wood-Pigeon (*Columba elphinstonii*), Nilgiri Flycatcher (*Eumyias albicaudata*), Darter (*Anhinga melanogaster*), Greater Grey-headed Fish-Eagle (*Ichthyophaga ichthyaetus*) and Black-and-Orange Flycatcher (*Ficedula nigrorufa*). Nilgiri Wood-Pigeon is the species with Vulnerable status, while the rest (four species) are of Near Threatened category of IUCN. The greater proportion of the aquatic birds in moist-deciduous forest is an artifact owing to the presence of the reservoir of Idukki dam in the study site. The moist-deciduous forest are also characterised by the habitat generalist species of birds. These habitat generalists lived in forest edges, tree-fall openings, or other natural openings within the vegetation.

5.3.1.4 Species composition at the shola forest

Shola forest is seen only in the higher altitudes. And higher altitudes have been reported to have fewer number of bird species. Moreover, shola forest generally tends to have very low number of species owing to a greater uniformity in the habitat available in shola. On a closer examination at the species composition it is evident that the shola birds are typical of the primary forest, with a greater proportion of endemism. It is also evident from the Table 12 that Nilgiri Wood Pigeon, a RDB species, ranked 19 with regard to the commonness in shola forest. Shola forest supports six out of 30 Red Data Book species of Kerala. They are Nilgiri Wood-pigeon *Columba elphinstonii*, White-bellied Shortwing *Brachypteryx major*, Nilgiri Pipit *Anthus nilghiriensis*, Grey-breasted Laughingthrush *Garrulax jerdoni*, Black-and-Orange Flycatcher *Ficedula nigrorufa* and Nilgiri Flycatcher *Eumyias albicaudata*.

Shola forest contain proportionately more habitat specialists than do low land forest. The endemism and the presence of threatened birds are also more in shola forest. These forests are rich in endemics, which are vulnerable to extinction. Shola forest is one of the most threatened habitats in Kerala. This forest type is protected only in Eravikulam and Silent Valley National Parks. Recently in 2004 Mannavan shola was given the status of a National Park, there by according protection to some more shola forest. However, there are still quite a few shola forests

lying outside the protected area network, which need to be brought under the protected area system.

5.3.2 Significance of protected area network in conservation of forest birds

A total of 323 bird species (or c.12% of the Asian avifauna) are globally threatened with extinction. The most worrying aspect is that 41 species are Critically Endangered, which means that they have only an estimated 50% chance of surviving over the next 10 years or three generations (Islam and Rahmani, 2004). A further 65 species are Endangered and 217 species are Vulnerable. An additional 317 (Near Threatened) species are close to qualifying as globally threatened. For the 23 (Data Deficient) species, there is inadequate information to make a direct, or indirect, assessment of their probability of extinction, but these too may be at risk. All told, 664 (c.25%) species in the Asian avifauna are of conservation concern at the global level. See Appendix 6 for a complete list of red data book birds of Kerala.

Of the 41 species that are classified as Critically Endangered, at least eight could already be extinct. The following are examples of Critically Endangered species where conservation action is essential if extinction is to be prevented. Chinese Crested-tern *Sterna bernsteini* was rediscovered in 2000 when six adults and six chicks were found in a seabird colony on an island off mainland China. Gurney's Pitta *Pitta gurneyi* has a known population of just 26 birds confined to one locality,

Khao Nor Chuchi, in peninsular Thailand, where forest degradation continues to be a serious threat to Bali Starling *Leucopsar rothschildi* numbers, only nine birds in the wild and is confined to just one locality in Bali, Indonesia, where the main reason for its decline is illegal trapping. With the population now at such a critically low level, other threats may include inter-specific competition, natural predation and disease (Birdlife International, 2001).

Forests are by far the most important of all the habitats for threatened bird species in the Asian region, holding the greatest proportion (c.80% occurs in total, 75% where the habitat is essential for their survival). Grasslands, savanna and shrub lands are second (nearly 30%) but for nearly half of these species these habitats are of only minor importance. Although artificial habitats (such as plantations, arable land, artificial wetlands etc.) apparently feature quite highly, they are also of minor importance for the great majority (88%) of threatened species occurring in them, meaning that it is unlikely that these species can survive without adjacent natural or semi-natural habitats for feeding and/or breeding (Birdlife International, 2001). 130 species of Indian birds are threatened with extinction. Out of which eight are Critically Endangered, ten Endangered, 57 Vulnerable and 52 are Near Threatened.

Of the birds with an endangered status over the world 62.2% are forest birds, 16.8% are scrub and grassland birds, and 12.7% are wetland birds (King, 1978). Not all species are however, sensitive to habitat fragmentation. Birds with

large body size are considered to be more susceptible to extinction with habitat reduction. However, in Java, the raptors were found to be adapting to utilise the smaller patches of forest (Thiollay, 1993).

The present study reveals that the protected area network of Kerala, covers representative habitats of the State and there by conserve all the different Red Data Book bird species of the State. However, inclusion of more evergreen, dry-deciduous and shola forests under the protected area network would definitely result in ensuring better conservation of the threatened and restricted range species of forest dependent birds of Kerala.

5.4 Individual bird species distribution at various study locations

The individual bird species richness at various study locations indicate that in all the four forest types studied most of the species (58 to 66%) are randomly distributed. The species with aggregate distribution pattern are the one with flocking behaviour such as babblers, laughingthrushes, etc or the ones with that are seen in large congregations such as bee-eaters, swifts etc.

5.5 Feeding guild structure at various study locations

The general trend in the feeding guild structure is that in all the sites the guilds that predominate are the understorey-insectivores (UND), nectarivores - insectivores (NEC), canopy insectivores (CAN) and frugivores (FRU), at varying degrees of concentration between the sites. The understorey insectivores are mostly members of the Muscicapinae (flycatchers), Turdinae (thrushes) and Timalinae (babblers), nectarivores-insectivores are mostly the members of the Nectarianidae (sunbirds), Dicaeidae (flowerpeckers) and Psittacidae (parakeets and lorikeets), while canopy insectivores are mostly members of Sylvinae (warblers), Irenidae (ioras and allies) and Camphephaginae (minivets and allies), and that of frugivores are constituted by Columbidae (pigeons), Pycnonotidae (bulbuls), Capitonidae (barbets) and Bucerotidae (hornbills).

However, on a closer observation interesting patterns of shift in the feeding guild composition can be seen. Fig. 6 to Fig. 9 show the feeding guild structure of the birds of evergreen forest, dry-deciduous forest, moist-deciduous forest and shola forest respectively. One very striking observation is that the parasitic cuckoos were conspicuous by their absence in both the primary vegetation types viz. evergreen forest and shola forest. The presence of the parasitic cowbirds in the New World is considered as an indication of disturbance (Hunter, 1996). The absence of

the parasitic cuckoos of the family Cuculidae, further emphasis the fact that the evergreen and the shola forest are primary habitats.

In the present study when the percentage of the three different feeding guilds such as frugivores (FRU), nectarivore–insectivore (NEC), canopy insectivores (CAN), were added up it was seen that 49% of the birds of shola forest were belonging to these three feeding guilds, followed by evergreen forest (39%), then dry-deciduous forest (37%) and moist-deciduous forest (35%). Raman *et al.* (1998) noted that the number of species in frugivores (FRU), nectarivore–insectivore (NEC), canopy insectivores (CAN) increased with the successional age of the forests. This implies that shola forest is at a late successional stage, when compared to the deciduous types of forest.

The bark surface feeders (BAR), generally were lower in concentration in all the communities studied, however, when each of the locations were separately studied, it was shown to follow a pattern similar to the previous one, i.e. shola forest with 8% of bark surface feeders (BAR), followed by evergreen forest (7%), while dry-deciduous forest (5%) and moist-deciduous forest (5%). Raman *et al.* (1998) also noted that the number of bark surface feeders (BAR) increased with the successional age of the forest.

The omnivorous (OMN) bird percentage at various study locations were moist-deciduous forest had the maximum (9%), followed by dry-deciduous forest (8%), evergreen forest (5%) and shola forest (4%), respectively. The omnivorous (OMN), birds occurred mainly in the open one year fallow of the slash and burn cultivation (Raman *et al.* 1998), and the presence of them indicate disturbance. So the presence of more of omnivorous category of birds at the deciduous forests when compared to the evergreen and shola forests imply that the latter type of habitats are more intact and less disturbed when compared to the deciduous type of vegetation.

5.6 Status of birds at various study locations

Maximum number of endemic species of Western Ghats birds is in evergreen forest (93.75%), followed by moist-deciduous forest (68.75%) and dry-deciduous forest (68.75%) and then by shola forest (56.25%). Daniels (1989) observed that the birds of the Western Ghats, especially those birds of the evergreen forest are amongst the most geographically restricted of Indian birds. On these grounds, they have to be assigned a greater conservation value (Hunter, 1996). The more endemism is expressed in a locality, the more typical the locality is. Several of the endemic species of Western Ghats have very small ranges and populations may number only few thousand pairs (e.g. *Garrulax spp., Muscicapa nigrorufa, Brachyopteryx major*). However, this is clearly a function of relatively small area of

natural evergreen forest of Western Ghats (Gaston, 1984). The Western Ghats supports 16 species of endemic birds. In addition the avifauna includes many species of "disjuncts" populations that are isolated from other conspecific species elsewhere in India, usually in Eastern Gats and in the Himalayas. Disjunct populations are of special interest because they may represent relict outliers of formerly continuous populations interconnected during the Pleistocene (Ali, 1969).

The observation on the percentage of migratory birds in each of the study location is also of interest. The maximum concentration of migratory birds was found in evergreen forest (22%), followed by shola forest (18.4%), and by moist-deciduous forest (14.9%) and dry-deciduous forest (13.9%). The decline in the Neotropical forest migrants during the 1970's were perceived as a problem of "forest fragmentation" (Terborgh, 1989), implying that the declines were a consequence of subdividing the initially continuous forest into discontinuous urban and rural woodlots.

In moist-deciduous forest the habitat is fragmented owing to the presence of the vast expanse of reservoir as well as the conversion of certain areas in to teak (*Tectona grandis*) plantations. These could be the reasons for this area supporting lower concentrations of migrants when compared to the relatively undisturbed evergreen forest and shola forest. Birds that are particularly susceptible to extinction are characterised by those that are seen on the fringes of their geographical

distribution, those with special habitat preferences, birds of larger size and birds hunted by man for food (Diamond, 1971, Terborgh, 1974).

93% of the migratory birds to Western Ghats are Palearctic in origin. Two major migratory routes arise from the Palearctic western entering the Ethiopian region and the eastern spreading over most of the Indian subcontinent. Many of the resident Indian taxa are shared with Ethiopian region while a greater number of wintering birds are from Palearctic (Ali and Ripley, 1983).

5.7 Similarity of the bird fauna between the study sites.

5.7.1 Similarity of birds within evergreen forest

The Bray-Curtis cluster analysis of similarity of birds (Fig. 14) within the five study sites in evergreen forest indicate that birds of Poochipara, Sairandri and Neelikkal were more similar to each other when compared to the birds of Walakkad and Poovanchola. This could be consequent to the fact that the habitats and the altitude of the Poochipara, Sairandri and Neelikkal were more or less similar. While the Poovanchola is a riverine tract of forest in lower altitude and the Walakkad is high elevation area. The vegetation also shows marked changes at Walakkad, when compared to the other sites. The dissimilarity of the bird fauna in Walakkad and Poovanchola from the rest of the three sites could be owing to this.

5.7.2 Similarity of birds within dry-deciduous forest

The Bray-Curtis cluster analysis of similarity of birds (Fig. 15) within the three study sites in the dry-deciduous forest show that maximum similarity was between the birds of Churulapetty and the birds of Kootar (63.64%), where as the similarity between the birds of above two sites with the riverine site was only 43.80%. This would be because of the fact that the habitats of Churulapetty and Kootar are similar, supporting scrub jungle to dry deciduous. Hence the birdlife of the two sites show greater similarity. While the habitat of riverine tract, as is implied in the name is evergreen in nature, on either sides of the Chinnar and Kootar rivers.

5.7.3 Similarity of birds within moist-deciduous forest

The Bray-Curtis cluster analysis of similarity of birds (Fig. 16) within the five study sites in moist-deciduous forest indicate that the maximum similarity was between the birds of Kettuchira and birds of Kizhakanam (40.71%), followed by the birds of Murukkoli (38.13%), then with birds of Vakavanom (30.03%) and with the birds of Chembakassery (17.77%). Here also the bird similarity between the sites was more because of the similarity of habitats at Kettuchira, Kizhakanam and Murukkoli, while not so at Vakavanom and Chambakassery.

5.7.4 Similarity of birds within shola forest

The Bray-Curtis cluster analysis of similarity of birds (Fig. 17) within the three study sites in the shola forest indicate that the maximum similarity was between the birds of Shola-upperand the birds of Shola-lower (67.40%), however, the similarity between the birds of shola patches and the wattle plantation was only 45.45%. The shola patches obviously had shown more similarity between the bird species, when compared to that of the birds of the wattle plantations. Shola patches that are studied were structurally similar when compared to the wattle plantation, which is a monoculture of the exotic species, *Acacia mearnsii.*

5.7.5 Similarity of birds among the four habitats

The similarity of the bird fauna among the four study habitats viz. evergreen forest, dry-deciduous forest, moist-deciduous forest and shola forest show that among all the four habitats in whatever combinations compared, the bird fauna was more dissimilar. The Bray-Curtis cluster analysis of similarity of birds (Fig. 18) also indicated a similar pattern. This observation clearly indicates that the four different major forest habitats of Kerala are important for conservation, at least from ornithological point of view, as they support completely dissimilar bird communities. And there by important for the conservation of forest birds of Kerala.

5.8 Detection width, flock size and density of birds of the study sites at shola forest

The detection width, the effective detection radius, flock size and density of birds were found to be more or less same in both the shola patches studied. The low detection radius observed at shola forest could be due to the dense vegetation structure of the shola forests. Shola forest also recorded very high density of birds.

5.9 Correlation matrix of attributes of the study sites

The bird species richness, diversity and density were negatively correlated with different vegetation variables such as woody plant diversity, woody plant richness, canopy density, tree density and vertical stratification. Similar observations were also reported by Daniels *et. al.* (1992) from Uttara Kannada forest of Western Ghats. They argued that this result was because the Western Ghats was relatively impoverished in evergreen forest bird species compared to the Eastern Himalayas. Drier and open forest habitats and plantations in the Western Ghats had higher bird species richness as they were colonized by birds from large source pool of species of more open forest habitats in the Indian sub-continent. The lower level of bird species richness in the structurally more complex and dense vegetation such as evergreen and shola forest is because of the smaller size of potential pool of colonisers for such vegetation.

Habitat utilisation of the birds is primarily influenced by the availability of food (Connell and Orias, 1964, MacArthur, 1965 and Clout and Gaze, 1984). Vegetation structure is only an indicator of the availability of these primary requirements of birds (Erdelen, 1984). Maturity of vegetation leads to an increase in bird species diversity in monoculture (Clout and Gaze, 1984). The local assemblage of birds is determined by the floristics and not the physiognomy of the vegetation (Galli *et al.* 1973; Terborgh, 1973 and Rotenberry, 1985). Tree fall gaps and canopy openings increase heterogeneity, thereby increasing the bird diversity. This prediction is related to the fact that the shola forests of Kerala are part of the shola forest vegetation of Western Ghats, constituting a relatively restricted habitat island (64,750 km^2) at a great distance (1500 km) from the larger continuous tract of vegetation in the Eastern Himalayas and South-east Asia. On the other hand, the deciduous forest vegetation of Kerala is part of and contiguous with the large tract of deciduous and scrub vegetation (277,4850 km^2) that covers most of the Indian subcontinent.

The bird fauna of Western Ghats is, indeed, impoverished especially with respect to the land birds in comparison with the Eastern Himalayas. Thus Western Ghats harbors a total of 363 land birds (Daniels, 1989) while the Eastern Himalayas harbor 523 species of land birds (Ali and Ripley, 1987). This general impoverishment of birds of Western Ghats could be owing to the fact that the members of Timaliinae (babblers and laughingthrushes) are generally low in number in Western Ghats, when compared to the Eastern Himalayas.

Conservation of biological diversity has emerged as a key environmental concern of the day. Effective action in this context calls for an understanding of how biodiversity is distributed and maintained in particular within the different habitats of the tropical regions of the world such as Western Ghats that are being rapidly depleted. The documentation of the bird diversity of different major forest types of Kerala part of Western Ghats is thus important from conservation of the avian diversity within this region.

All the forests of Kerala have been much degraded by human activities in recent decades, with forests changing from moist evergreen towards deciduous as they are opened up. As a result of recent encroachment by agriculturalists and the opening up of forests through widespread timber felling, few forest blocks are now undisturbed. In addition large areas of high altitude grasslands have been taken over by the plantations of exotic species such as eucalyptus and wattle. Pure natural ecosystems, untouched by felling, grazing or planting, are relatively rare, even within protected areas.

SUMMARY

Nameer P.O“Bird community structure in a few selected forest types of Kerala”
Thesis. Department of Zoology, University of Calicut, 2005

Summary

SUMMARY

The information available about the bird communities of the various forest types in Kerala is very meager and is evident from the available literature. Hence a study was carried out in the selected major forest types of Kerala, with a broad objective of finding out the bird community structure, in the forest types of Kerala such as evergreen forests, moist deciduous forests, dry deciduous forests and shola forests. These four forest types were chosen because of the fact that these are the major forest types in Kerala.

Standard methods were followed for the conduct of the study. The major findings are,

1. Bird species richness was the maximum at moist-deciduous forests, followed by evergreen forests and was lowest at shola forests.
2. Bird species abundance and diversity also followed a similar pattern.
3. The species area curve indicates that the shola forests require a transect effort of 18 transects, while the scrub jungle requires 20 transect efforts, and the evergreen forests requires 21 transect efforts.

4. The species area curve plateaus at 18 to 21 transect efforts at different habitats also suggest that a minimum of 18 to 21 transect effort is required at different forests types of Kerala to get an idea about birds found in each of these forests.

5. The Bray-Curtis cluster analysis of similarity of birds within the five study sites in Silent Valley indicate that birds of Poochipara, Sairandri and Neelikkal were more similar to each other when compared to the birds of Walakkad and Poovanchola.

6. The Bray-Curtis cluster analysis of similarity of birds within the three study sites in Chinnar show that maximum similarity was between the birds of Churulapetty and the birds of Kootar (63.64%), where as the similarity between the birds of above two sites with the riverine site was only 43.80%.

7. The Bray-Curtis cluster analysis of similarity of birds within the five study sites in Idukki indicate that the maximum similarity was between the birds of Kettuchira and birds of Kizhakanam (40.71%), followed by the birds of Murukkoli (38.13%), then with birds of Vakavanom (30.03%) and with the birds of Chembakassery (17.77%).

8. The Bray-Curtis cluster analysis of similarity of birds within the three study sites in Mannavan indicate that the maximum similarity was between the birds of Upper-shola and the birds of

Lower-shola (67.40%), however, the similarity among the birds of shola patches and the wattle plantation was only 45.45%.

9. The bird fauna was showing greater amount of dissimilarity among the four different habitats studied. In all the cases the dissimilarity was > 50%, with maximum dissimilarity of 65% between birds of dry deciduous forests and shola forests.

10. Though the bird species richness, abundance and diversity were more in deciduous forests, the bird fauna of the deciduous forests were characterised by more generalist species, while the evergreen and shola forests were characterised by the specialists.

11. Similarly evergreen and shola forests supported more restricted range (endemic), endangered and migratory species of birds.

12. During the present study, 115 species of birds are recorded from Silent Valley. Small Sunbird (*Nectarinia minima*), Yellow-browed Bulbul (*Iole indica*), Small Green Barbet (*Megalaima viridis*), Malabar Whistling Thrush (*Myiophonus horsfieldii*), Jerdon's Imperial Pigeon (*Ducula badia*), Black Bulbul (*Hypsipetes leucocephalus*), Quaker Babbler (*Alcippe poioicephala*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Lorikeet (*Loriculus vernalis*) and Blyth's Reed Warbler (*Acrocephalus dumetorum*) were the ten common species of birds recorded at Silent Valley.

13. Silent valley is perhaps the only protected area in the State that supports eight (26.7%) out of the 30 Red Data Book (RDB) species that are found in Kerala.

14. The Red Data Book species found in Silent Valley are Rufous-breasted Laughingthrush (*Garrulax cachinnans*), Nilgiri Wood-pigeon (*Columba elphinstonii*), White-bellied Shortwing (*Brachypteryx major*), Broad-tailed Grassbird (*Schoenicola platyura*), Great Hornbill (*Buceros bicornis*), Nilgiri Pipit (*Anthus nilghiriensis*), Black and OrangeF1ycatcher (*Ficedula nigrorufa*) and Nilgiri Flycatcher (*Eumyias albicaudata*).

15. Out of the eight red data book birds reported form Silent Valley Nilgiri Laughingthrush (*Garrulax cachinnans*) is having the Endangered (EN) status of IUCN (World Conservation Union), while the Nilgiri Wood-pigeon (*Columba elphinstonii*), White-bellied Shortwing (*Brachypteryx major*) and Broad-tailed Grassbird (*Schoenicola platyura*) belong to the Vulnerable (VU) category of IUCN. The Great Hornbill (*Buceros bicornis*), Nilgiri Pipit (*Anthus nilghiriensis*), Black and Orange F1ycatcher (*Ficedula nigrorufa*) and Nilgiri Flycatcher (*Eumyias albicaudata*) belong to the Near Threatened (NT) category of IUCN.

16. The following birds were sighted from Silent Valley National Park, which is not included in *Birds of Kerala* of Salim Ali (1969). They are Nilgiri Laughingthrush (*Garrulax cachinnans*), White-bellied Shortwing (*Brachypteryx major*), Northern House-Martin (*Delichon urbica*), Streak-throated (Cliff) Swallow (*Hirundo fluvicola*), Eurasian Crag-Martin (*Hirundo rupestris*), Oriental Scops-Owl (*Otus sunia*) and Wire-tailed Swallow (*Hirundo smithii*)

17. One Hundred and eight species have been recorded from Chinnar. The common ten birds sighted at Chinnar are Spotted Dove (*Streptopelia chinensis*), Red-vented Bulbul (*Pycnonotus cafer*), Ashy Drongo (*Dicrurus leucophaeus*), Purple-rumped Sunbird (*Nectarinia zeylonica*), Indian Robin (*Saxicoloides fulicata*), White-headed Babbler (*Turdoides affinis*), Common Bee-eater (*Merops orientalis*), Ring Dove (*Streptopelia decaocto*), Purple Sunbird (*Nectarinia asiatica*) and Paradise Flycatcher (*Terpsiphone paradisi*).

18. Chinnar also support three RDB species such as White-rumped Vulture *Gyps bengalensis*, Nilgiri Wood-pigeon *Columba elphinstoni,* Yellow-throated Bulbul *Pycnonotus xantholaemus.* The White-rumped Vulture has the Critically Endangered (CR) conservation status of IUCN, while the Nilgiri Wood-pigeon and

the Yellow-throated Bulbul are having the Vulnerable (VU) status.

19. The sighting of the Yellow-throated Bulbul (*Pycnonotus xantholaemus*), from Chinnar is of significance as this is the first sighting of the Yellow-throated Bulbul from Kerala.

20. Idukki reported 114 species of birds during the present study. The common ten birds sighted in Idukki during the present survey are Small Green Barbet (*Megalaima viridis*), Purple Sunbird(*Nectarinia asiatica*), Hill Myna (*Gracula geligiosa*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Little Egret (*Egretta garzetta*), Grey-breasted Kingfisher (*Halcyon smyrnensis*), Golden Oriole (*Oriolus oriolus*), Racket-tailed Drongo (*Dicrurus paradiseus*), Blue-winged Parakeet (*Psittacula columboides*)and Orange Minivet (*Pericrocotus flammeus*).

21. Idukki has six Red Data Book species, five of which are Near Threatened, while the one is Vulnerable. They are Nilgiri Wood-Pigeon (*Columba elphinstonii*), Nilgiri Flycatcher (*Eumyias albicaudata*), Darter (*Anhinga melanogaster*), Greater Grey-headed Fish-Eagle (*Ichthyophaga ichthyaetus*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*) and Nilgiri Flycatcher (*Eumyias albicaudata*). Nilgiri Wood-Pigeon is the species with Vulnerable

status, while the rest five species are of Near Threatened category of IUCN.

22. Forty-nine species of birds have been reported from Mannavan Shola. The ten common species sighted at Mannavan shola are Grey-breasted Laughingthrush (*Garrulax jerdoni*), Grey-headed Flycatcher (*Culicicapa ceylonensis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), White Eye (*Zosterops palpebrosa*), Nilgiri Flycatcher (*Eumyias albicaudata),* Velvet-fronted Nuthatch (*Sitta frontalis*), Quaker Babbler (*Alcippe poioicephala*), Black Bulbul (*Hypsipetes leucocephalus*), Black and Orange Flycatcher (*Ficedula nigrorufa*), Yellow-browed Bulbul (*Pycnonotus luteolus*).

23. Mannavan shola support six out of 30 RDB species of Kerala. They are Nilgiri Wood-pigeon *Columba elphinstonii*, White-bellied Shortwing *Brachypteryx major*, Nilgiri Pipit *Anthus nilghiriensis*, Grey-breasted Laughingthrush *Garrulax jerdoni*, Black and Orange Flycatcher *Ficedula nigrorufa* and Nilgiri Flycatcher *Eumyias albicaudata*.

24. The general trend in the feeding guild structure was that in all the sites the guilds that predominate are the understorey insectivores (UND), nectarivores-insectivores (NEC), canopy insectivores

(CAN) and frugivores (FRU), at varying degrees of concentration among the sites.

25. Parasitic cuckoos were conspicuous by their absence in both the primary vegetation types viz. Silent Valley and Mannavan Shola.

26. Silent Valley has 15 (93.75%) out of the sixteen endemic species of birds of Kerala. They are, Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus priocephalus*), Wynaad Laughingthrush (*Garrulax delesserti*), Nilgiri Laughingthrush (*Garrulax cachinnans*), Rufous Babbler (*Turdoides subrufus*), Broad-tailed Grassbird (*Schoenicola platyura*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), Malabar Grey Hornbill (*Ocyceros griseus*), White-bellied Shortwing (*Brachypteryx major*), Nilgiri Pipit (*Anthus nilghiriensis*) and White-bellied Treepie (*Dendrocitta leucogastra*).

27. Silent Valley is perhaps the only location in Kerala where all the endemic species of birds of Kerala other than Grey-breasted Laughingthrush are seen.

28. Chinnar has 11 (68.75%) out of the sixteen endemic species of birds of Kerala. They are Nilgiri Wood-Pigeon (*Columba*

elphinstonii), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus priocephalus*), Rufous Babbler (*Turdoides subrufus*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), Malabar Grey Hornbill (*Ocyceros griseus*), Nilgiri Pipit (*Anthus nilghiriensis*) and White-bellied Treepie (*Dendrocitta leucogastra*).

29. Idukki has 11 (68.75%) out of the sixteen endemic species of birds of Kerala. They are, Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-headed Bulbul (*Pycnonotus priocephalus*), Wynaad Laughingthrush (*Garrulax delesserti*), Rufous Babbler (*Turdoides subrufus*), Nilgiri Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Malabar Grey Hornbill (*Ocyceros griseus*), Small Sunbird (*Nectarinia minima*) and White-bellied Treepie (*Dendrocitta leucogastra*).

30. Mannavan has 9 (56.25%) out of the sixteen endemic species of birds of Kerala. They are, Nilgiri Wood-Pigeon (*Columba elphinstonii*), Blue-winged Parakeet (*Psittacula columboides*), Grey-breasted Laughingthrush (*Garrulax jerdoni*), Nilgiri

Flycatcher (*Eumyias albicaudata*), White-bellied Blue-Flycatcher (*Cyornis pallipes*), Black-and-Orange Flycatcher (*Ficedula nigrorufa*), Small Sunbird (*Nectarinia minima*), White-bellied Shortwing (*Brachypteryx major*) and Nilgiri Pipit (*Anthus nilghiriensis*)

31. 22% of the total birds of Silent Valley are migratory in nature. Some of the migratory birds of Silent Valley are Montagu's Harrier (*Circus pygargus*), Northern House-Martin (*Delichon urbica*), Eurasian Crag-Martin (*Hirundo rupestris*), Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Red-throated Flycatcher (*Ficedula parva*), Verditer Flycatcher (*Eumyias thalassina*), Blue-throated Flycatcher (*Cyornis rubeculoides*), Tickell's Leaf Warbler (*Phylloscopus affinis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*), Black-naped Oriole (*Oriolus chinensis*) and Ashy Drongo (*Dicrurus leucophaeus*).

32. 13.9% of the total birds of Chinnar are migratory in nature. Some of the migratory birds of Chinnar are Booted Eagle (*Hieraaetus pennatus*), Wood Sandpiper (*Tringa glareola*), Common

Sandpiper (*Actitis hypoleucos*), Drongo Cuckoo (*Surniculus lugubris*), Northern House-Martin (*Delichon urbica*), Forest Wagtail (*Dendronanthus indicus*), Grey Wagtail (*Motacilla cinerea*), Rusty-tailed Flycatcher (*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Tickell's Leaf Warbler (*Phylloscopus affinis*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*) and Ashy Drongo (*Dicrurus leucophaeus*).

33. 14.9% of the total birds of Idukki are migratory in nature. Some of the migratory birds of Idukki are Pallid Harrier (*Circus macrourus*), Common Buzzard (*Buteo buteo*), Osprey (*Pandion haliaetus*), Kentish Plover (*Charadrius alexandrinus*), Green Sandpiper (*Tringa ochropus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), Whiskered Tern (*Chlidonias hybridus*), Blue-tailed Bee-eater (*Merops philippinus*), Indian Pitta (*Pitta brachyuran*), Forest Wagtail (*Dendronanthus indicus),* White Wagtail (*Motacilla alba*), Yellow Wagtail (*Motacilla flava*), Grey Wagtail (*Motacilla cinerea*), Brown Shrike (*Lanius cristatus*), Blue-headed Rock-Thrush (*Monticola cinclorhynchus*), Rusty-tailed Flycatcher

(*Muscicapa ruficauda*), Brown-breasted Flycatcher (*Muscicapa muttui*), Greenish Leaf-Warbler (*Phylloscopus trochiloides*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Western Crowned Warbler (*Phylloscopus occipitalis*), Eurasian Golden Oriole (*Oriolus oriolus*) and Ashy Drongo (*Dicrurus leucophaeus*).

34. 18.4% of the total birds of Mannavan are migratory in nature. Some of the migratory birds of Idukki are Eurasian Golden Oriole (*Oriolus oriolus*), Ashy Drongo (*Dicrurus leucophaeus*), Brown-breasted Flycatcher (*Muscicapa muttui*), Verditer Flycatcher (*Eumyias thalassina*), Blyth's Reed Warbler (*Acrocephalus dumetorum*), Tickell's Leaf-Warbler (*Phylloscopus affinis*), Large-billed Leaf-Warbler (*Phylloscopus magnirostris*), Greenish Warbler (*Phylloscopus trochiloides*), Western Crowned Warbler (*Phylloscopus occipitalis*), Indian Blue Robin (*Luscinia brunnea*), Grey Wagtail (*Motacilla cinerea*) and Common Rosefinch (*Carpodacus erythrinus*).

35. The bird species richness, bird diversity and bird density were found to be negatively correlated with woody plant species diversity as well as with woody plant species richness, canopy density, tree density and vertical stratification at the shola forest.

36. The evergreen forests and shola forests both harbour species poor communities. However, the evergreen forests and shola forests are cohesive assemblages of restricted geographical distributions, while those of deciduous forests comprise of species of widespread occurrence.

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Appendices

Appendix 1. Summary statistics of the density of the bird species of Mannavan Shola

Species	Location	Density of birds	%Coefficient of Variation	95% Confidence Interval	
Black and Orange Flycatcher	Shola upper	1641.3	28.78	938.78	2869.5
	Shola lower	159.15	60.55	52.24	484.9
Black Bird	Shola upper	198.9	100.00	38.132	1037.9
	Shola lower	48.72	77.85	11.81	201.1
Black Bulbul	Shola upper	442.1	38.73	210	930.72
	Shola lower	481.0	27.64	280.87	823.72
Grey-headed Flycatcher	Shola upper	6461.7	16.7	4656.2	8967.2
	Shola lower	7460.4	40.85	3414.5	16300
White breasted Laughingthrush	Shola upper	9390.5	18.22	6577	13408
	Shola lower	13222.0	34.81	6746.5	25913.0
Velvet fronted Nuthatch	Shola upper	1702.1	24.42	1056.7	2741.7
	Shola lower	834.68	28.36	481.1	1448.1
White Eye	Shola upper	3033.9	22.34	1960.0	4696.2
	Shola lower	1689.0	50.02	661.0	4315.6
Greenish leaf Warbler	Shola upper	1368.7	21.36	901.11	2079.0
	Shola lower	1025.9	28.27	592.43	1776.6
Nilgiri flycatcher	Shola upper	1571.9	29.91	877.96	1062.9
	Shola lower	2197.7	27.1	1298.1	3720.8
Quaker Babbler	Shola upper	1541.8	27.07	909.24	2614.5
	Shola lower	2572.7	29.96	1439.5	4598.1
Yellow browed Bulbul	Shola upper	331.57	29.15	188.26	583.99
	Shola lower	504.74	45.32	208.52	1221.8
Malabar Whistling thrush	Shola upper	477.46	27.52	279.51	815.61
	Shola lower	265.3	36.34	131.91	533.41
White-bellied Blue flycatcher	Shola upper	397.89	54.42	144.83	1093.1
	Shola lower	1527.9	30.42	847.61	2754.1
Nilgiri Flowerpecker	Shola upper	348.15	47.17	142.73	849.24
	Shola lower	254.65	34.1	131.9	491.6
Grey tit	Shola upper	298.42	77.85	72.3	1231.6
	Shola lower	397.89	46.41	165.49	956.63
Verditer Flycatcher	Shola upper	157.84	75.93	35.099	709.8
	Shola lower	318.31	100	61.0	1660.7
Tickle's Flowerpecker	Shola upper	157.19	62.38	49.699	497.17
	Shola lower	222.82	51.27	85.39	581.42
Chestnut headed Bee-eater	Shola upper	424.41	100	81.348	2214.3
	Shola lower	685.25	37.4	334.57	1403.5

Large billed Leaf warbler	Shola upper	157.19	49.24	62.365	396.19
	Shola lower	56.59	62.38	17.89	178.98
Nilgiri Wood Pigeon	Shola upper	157.2	49.2	62.37	396.2
	Shola lower	350.14	62.8	111.1	1103.5
Malabar Trogon	Shola upper	149.21	77.85	36.151	615.82
	Shola lower	44.2	70.35	12.56	155.58
Pied Flycatcher Shrike	Shola upper	127.32	60.72	41.893	386.97
	Shola lower	315.68	43.77	137.15	726.62
Yellow-cheeked Tit	Shola upper	194.88	77.85	47.218	804.34
	Shola lower	397.89	60.62	125.1	1265.7
Small Green Barbet	Shola upper	95.493	57.15	33.255	274.21
	Shola lower	63.66	70.35	18.1	224.0
Lesser Golden-backed Woodpecker	Shola upper	52.61	70.35	14.95	185.15
	Shola lower	132.3	100	25.4	691.96
Grey wagtail	Shola upper	99.47	70.35	28.27	350.1
	Shola lower	222.82	36.63	110.19	450.55
Blue-winged Parakeet	Shola upper	530.52	100	101.7	2767.8
	Shola lower	127.32	70.35	36.18	448.1
Crested Serpent Eagle	Shola upper	106.1	100	20.337	553.57
	Shola lower	29.47	77.85	7.14	121.64
Pigmy Woodpecker	Shola upper	265.26	100	50.843	1383.9
	Shola lower	127.32	100	24.4	664.3
Large Golden-backed Woodpecker	Shola upper	198.94	100	38.1	1037.9
	Shola lower	-	-	-	-
Scarlet Minivet	Shola upper	-	-	-	-
	Shola lower	169.77	61.75	54.97	524.28
Scimitar Babbler	Shola upper	-	-	-	-
	Shola lower	154.73	62.38	49.62	484.6
Red-whiskered Bulbul	Shola upper	-	-	-	-
	Shola lower	348.15	62.38	111.64	1085.7
Small Sunbird	Shola upper	-	-	-	-
	Shola lower	132.63	52.86	49.324	356.63
Rosefinch	Shola upper	-	-	-	-
	Shola lower	66.32	77.85	16.1	273.7
Grey –jungle Fowl	Shola upper	-	-	-	-
	Shola lower	63.66	70.35	18.1	224.0
Malabar Wood Shrike	Shola upper	-	-	-	-
	Shola lower	198.94	100	38.1	1037.9
Blyth's Reed Warbler	Shola upper	-	-	-	-
	Shola lower	265.26	100	50.843	1383.9

Tickllе's Leaf Warbler	Shola upper	-	-	-	-
	Shola lower	198.94	100	38.1	1037.9
Blue Chat	Shola upper	-	-	-	-
	Shola lower	265.3	100	50.84	1383.9
Emerald Dove	Shola upper	-	-	-	-
	Shola lower	198.94	100	38.1	1037.9

Appendix 2. Checklist of birds of Silent Valley

FAMILY / COMMON NAME / SCIENTIFIC NAME		STATUS
I. HERONS, EGRETS & BITTERNS ARDEIDAE		
1. Indian Pond-Heron (42-42a)	*Ardeola grayii* (Sykes, 1832)	R
2. Little Green Heron (38-41)	*Butorides striatus* (Linnaeus, 1758)	R
3. Malayan Night-Heron (53-54)	*Gorsachius melanolophus* (Raffies, 1822)	R
4. Chestnut Bittern (56)	*Ixobrychus cinnamomeus* (Gmelin, 1789)	R
5. Black Bittern (58)	*Dupetor flavicollis* (Latham, 1790)	R
II. HAWKS, EAGLES, BUZZARDS, OLD WORLD VULTURES, KITES, HARRIERS - ACCIPITRIDAE		
6. Jerdon's Baza (125-126)	*#Aviceda jerdoni* (Blyth, 1842)	R
7. Black Baza (127-128a)	*Aviceda leuphotes* (Dumont, 1820)	R
8. Oriental Honey-Buzzard (129-130)	*Pernis ptilorhynchus* (Temminck, 1821)	R
9. Black-shouldered Kite (124)	*Elanus caeruleus* (Desfontaines, 1789)	R
10. Greater Grey-headed Fish-Eagle (175-176)	NT *#Ichthyophaga ichthyaetus* (Horsfield, 1821)	R
11. Short-toed Snake-Eagle (195)	*Circaetus gallicus* (Gmelin, 1788)	R
12. * Crested Serpent-Eagle (196-200)	*Spilornis cheela* (Latham, 1790	R
13. Montagu's Harrier (191)	*Circus pygargus* (Linnaeus, 1758)	W
14. Crested Goshawk (144-146)	*Accipiter trivirgatus* (Temminck, 1824)	R
15. * Shikra (137-140)	*Accipiter badius* (Gmelin, 1788)	R
16. Besra Sparrowhawk (149-151)	*Accipiter virgatus* (Temminck, 1822)	R
17. Eurasian Sparrowhawk (147-148)	*Accipiter nisus* (Linnaeus, 1758)	W
18. Common Buzzard (155-156)	*Buteo buteo* Linnaeus, 1758	W
19. Black Eagle (172)	*Ictinaetus malayensis* (Temminck, 1822)	R
20. Bonelli's Eagle (163)	*Hieraaetus fasciatus* (Vieillot, 1822)	R
21. Booted Eagle (164)	*Hieraaetus pennatus* (Gmelin, 1788)	W
22. Rufous-bellied Eagle (165)	*Hieraaetus kienerii* (E. Geoffroy, 1'835)	R
23. Changeable Hawk-Eagle (160-162)	*Spizaetus cirrhatus* (Gmelin, 1788)	R
24. Mountain Hawk-Eagle (158-159)	*Spizaetus nipalensis* (Hodgson, 1836)	W
III. FALCONS FALCONIDAE		
25. Common Kestrel (222-224)	*Falco tinnunculus* Linnaeus, 1758	R
26. Shahin Falcon (209-211)	*Falco peregrinus peregrinator* Tunstall, 1771	R
IV. PHEASANTS, PARTRIDGES, QUAILS PHASIANIDAE		
27. Painted Bush-Quail (262-263)	*Perdicula erythrorhyncha* (Sykes, 1832)	R
28. Red Spurfowl (275-277)	*Galloperdix spadicea* (Gmelin, 1789)	R
29. Grey Junglefowl (301)	*#Gallus sonneratii* Temminck, 1813	R

V. BUTTONQUAIL/BUSTARD QUAILS TURNICIDAE		
30. Yellow-legged Buttonquail (314-315)	*Turnix tanki* Blyth, 1843	R
31. Common Buttonquail (316-319)	*Turnix suscitator* (Gmelin, 1789)	R
VI. PIGEONS & DOVES COLUMBIDAE		
32. #Nilgiri Wood-Pigeon (521)	VU *#Columba elphinstonii* (Sykes, 1833)	R
33. Emerald Dove (542-544a)	*Chalcophaps indica* (Linnaeus, 1758)	R
34. Pompadour Green-Pigeon (496-500)	*Treron pompadora* (Gmelin, 1789)	R
35. Yellow-legged Green-Pigeon (503-505)	*Treron phoenicoptera* (Latham, 1790)	R
36. Mountain Imperial-Pigeon (510-512)	*Ducula badia* (Hames, 1822)	R
VII. PARAKEETS & HANGING-PARROTS PSITTACIDAE		
37. Indian (Vernal) Hanging-Parrot (566, 567)	*Loriculus vernalis* (Sparrman, 1787)	R
38. Rose-ringed Parakeet (549-550)	*Psittacula krameri* (Scopoli, 1769)	R
39. Plum-headed Parakeet (557-558)	*Psittacula cyanocephala* (Linnaeus, 1766)	R
40. Blue-winged Parakeet (564)	*Psittacula columboides* (Vigors, 1830)	R
VIII. CUCKOOS, MALKOHAS & COUCALS CUCULIDAE		
41. Drongo Cuckoo (588-589)	*Surniculus lugubris* (Horsfield, 1821)	R
42. * Lesser Coucal (605)	*Centropus bengalensis* (Gmelin, 1788)	R
IX. BARN OWLS TYTONIDAE		
43. Oriental Bay-Owl (609-610)	*Phodilus badius* (Horsfield, 1821)	R
X. OWLS STRIGIDAE		
44. * Oriental Scops-Owl (616-618b)	*Otus sunia* (Hodgson, 1836)	R
45. Collared Scops-Owl (619-624)	*Otus bakkamoena* Pennant, 1769	R
46. Forest (Spot-bellied) Eagle-Owl (628-629)	*#Bubo nipalensis* Hodgson, 1836	R
47. Brown Fish-Owl (631-632)	*Ketupa zeylonensis* (Gmelin, 1788)	R
48. Brown Wood-Owl (658-660)	*Strix leptogrammica* Temminck, 1831	R
49. Brown Hawk-Owl (642-645)	*Ninox scutulata* (Rames, 1822)	R
XI. FROGMOUTHS		
50. Ceylon Frogmouth (666)	*# Batrachostomus moniliger* Blyth, 1846	R
XII. NIGHTJARS CAPRIMULGIDAE		
51. Great Eared-Nightjar (668-669)	*Eurostopodus macrotis* (Vigors, 1831)	R
52. Indian Jungle (Grey) Nightjar (670-672a)	*Caprimulgus indicus* Latham, 1790	R
53. * Jerdon's Nightjar (676,677)	*Caprimulgus atripennis* Jerdon, 1845	R
XIII. SWIFTS APODIDAE		
54. Indian Edible-nest Swiftlet (685)	*Collocalia unicolor* (Jerdon, 1840)	R
55. White-rumped Needletail-Swift (692)	*Zoonavena sylvatica* (Tickell, 1846)	R
56. Brown-backed Needletail-Swift (691)	*Hirundapus giganteus* (Temminck, 1846)	R
57. Alpine Swift (693-695)	*Tachymarptis melba* (Linnaeus, 1758)	R

XIV. TROGONS TROGONIDAE		
58. Malabar Trogon (710-712)	*Harpactes fasciatus* (Pennant, 1769)	R
XV. KINGFISHERS ALCEDINIDAE		
59. Small Blue Kingfisher (722-724)	*Alcedo atthis* (Linnaeus, 1758)	R
60. Blue-eared Kingfisher (725-726a)	*Alcedo meninting* Horsfield, 1821	R
61. Oriental Dwarf Kingfisher (727-728)	*Ceyx erithaca* (Linnaeus, 1758)	R
62. Stork-billed Kingfisher (730-732)	*Halcyon capensis* (Linnaeus, 1766)	R
63. White-breasted Kingfisher (735- 738)	*Halcyon smyrnensis* (Linnaeus, 1758)	R
64. Black-capped Kingfisher (739)	*Halcyon pileata* (Boddaert, 1783)	R
XVI. BEE-EATERS MEROPIDAE		
65. Small Bee-eater (749-752)	*Merops orientalis* Latham, 1801	R
66. Chestnut-headed Bee-eater (744-745)	*Merops leschenaulti* Vieillot, 1817	R
XVII. HORNBILLS BUCEROTIDAE		
67. * Malabar Grey Hornbill (768)	#*Ocyceros griseus* (Latham, 1790) .	R
68. Great Pied Hornbill (776)	NT *Buceros bicornis* Linnaeus, 1758	R
XVIII. BARBETS CAPITONIDAE		
69. White-cheeked Barbet (785)	*Megalaima viridis* (Boddaert, 1783)	R
70. Crimson-throated Barbet (790-791)	*Megalaima rubricapillus* (Gmelin, 1788)	R
XIX. WOODPECKERS PICIDAE		
71. Speckled Piculet (798-799)	*Picumnus innominatus* Burton, 1836	R
72. Brown-capped Pygmy Woodpecker (851-854)	*Dendrocopos nanus* (Vigors, 1832)	R
73. * Great Black / White-bellied Woodpecker (830)	*Dryocopus javensis* (Horsfield, 1821)	R
74. Small Yellow-naped Woodpecker /Lesser Yellownape (814-817)	*Picus chlorolophus* Vieillot, 1818	R
75. Little Scaly-bellied Green (Streak-throated) Woodpecker (808)	*Picus xanthopygaeus* (J.E. Gray & G.R. Gray, 1846)	R
76. Common Golden-backed Woodpecker / Common Flameback (825-826)	*Dinopium javanense* (Ljungh, 1797)	R
77. Greater Golden-backed Woodpecker / Greater Flameback (860-863)	*Chrysocolaptes lucidus* (Scopoli, 1786)	R
78. Heart-spotted Woodpecker (856)	*Hemicircus canente* (Lesson, 1830)	R
XX. PITTAS PITTIDAE		
79. Indian Pitta (867)	*Pitta brachyura* (Linnaeus, 1766)	W
XXI. LARKS ALAUDIDAE		
80. Eastern Skylark (904-909)	*Alauda gulgula* Franklin, 1831	R
XXII. SWALLOWS & MARTINS HIRUNDINIDAE		
81. Eurasian Crag-Martin (913)	*Hirundo rupestris* Scopoli, 1769	W
82. Dusky Crag-Martin (914)	*Hirundo concolor* Sykes, 1833	R
83. House Swallow (919-920)	*Hirundo tahitica* Gmelin, 1789	R

84. Wire-tailed Swallow (921)	*Hirundo smithii* Leach, 1818	R
85. Red-rumped Swallow (923-928)	*Hirundo daurica* Linnaeus, 1771	R
86. Streak-throated Swallow (922)	*Hirundo fluvicola* Blyth, 1855	R
87. * Northern House-Martin (930)	*Delichon urbica* (Linnaeus, 1758)	W
XXIII. WAGTAILS & PIPITS MOTACILLIDAE		
88. Forest Wagtail (1874)	*Dendronanthus indicus* (Gmelin, 1789)	W
89. Grey Wagtail (1884)	*Motacilla cinerea* Tunstall, 1771	W
90. * Paddyfield Pipit (1858-1860)	*Anthus rufulus* Vieillot, 1818	R
91. Oriental Tree (Olive-backed) Pipit (1852-1853)	*Anthus hodgsoni* Richmond, 1907	W
92. #Nilgiri Pipit (1870)	NT *Anthus nilghiriensis* Sharpe, 1885	R
XXIV. CUCKOO-SHRIKES, FLYCATCHER-SHRIKES, TRILLERS, MINIVETS, WOODSHRIKES CAMPEPHAGIDAE		
93. * Large Cuckoo-Shrike (1072-1075)	*Coracina macei* (Lesson, 1830)	R
94. Black-headed Cuckoo-Shrike (1078-1079)	*Coracina melanoptera* (Rtippell, 1839)	R
95. Scarlet Minivet (1080-1083)	*Pericrocotus flammeus* (Forster, 1781)	R
96. Pied Flycatcher-Shrike (1064-1066)	*Hemipus picatus* (Sykes, 1832)	R
97. Large Woodshrike (1067-1068)	*Tephrodornis gularis* (Rames, 1822)	R
XXV. BULBULS & FINCHBILLS PYCNONOTIDAE		
98. Grey-headed Bulbul (1114)	*#Pycnonotus priocephalus* (Jerdon, 1839)	R
99. Black-crested Bulbul (1115-1117)	*Pycnonotus melanicterus* (Gmelin, 1789)	R
100. Red-whiskered Bulbul (1118-1122)	*Pycnonotus jocosus* (Linnaeus, 1758)	R
101. Red-vented Bulbul (1126-1132)	*Pycnonotus cafer* (Linnaeus, 1766)	R
102. Yellow-browed Bulbul (1143-1145)	*Iole indica* (Jerdon, 1839)	R
103. * Black Bulbul (1148-1151)	*Hypsipetes leucocephalus* (P.L.S. Muller, 1776)	R
XXVI. IORAS, CHLOROPSIS/LEAFBIRD, FAIRY-BLUEBIRD IRENIDAE		
104. Gold-fronted Chloropsis (1103-1105)	*Chloropsis aurifrons* (Temminck, 1829)	R
105. Asian Fairy-Bluebird (1109, 1110)	*Irena puella* (Latham, 1790)	R
XXVII. SHRIKES LANIIDAE		
106. Brown Shrike (949-950a)	*Lanius cristatus* Linnaeus, 1758	W
XXVIII. THRUSHES, SHORTWINGS, ROBINS, FORKTAILS, WHEATERS TURDINAE		
107. Blue-headed (Blue-capped) Rock-Thrush (1723)	*Monticola cinclorhynchus* (Vigors, 1832)	W
108. Malabar Whistling-Thrush (1728)	*Myiophonus horsfieldii* (Vigors, 1831)	R
109. Pied Thrush (1731)	*#Zoothera wardii* (Blyth, 1842)	W
110. White-throated Ground Thrush (1733-1736)	*Zoothera citrine cyanotus* (Latham, 1790)	R
111. Scaly Thrush (1741-1744)	*Zoothera dauma* (Latham, 1790)	R

112.Eurasian Blackbird (1751-1757)	*Turdus merula* Linnaeus, 1758	R
113.#Rufous-bellied Shortwing (1637-1638)	VU *#Brachypteryx major major* (Jerdon, 1844)	R
114.Indian Blue Robin (Bluechat) (1650, 1651)	*Luscinia brunnea* (Hodgson, 1837)	W
115.Pied Bushchat (1700-1703)	*Saxicola caprata* (Linnaeus, 1766)	R
XXIX. BABBLERS, LAUGHINGTHRUSHES, BABAXES, BARWINGS, YUHINAS - TIMALIINAE		
116.* Wynaad Laughingthrush (1287)	*#Garrulax delesserti* (Jerdon, 1839)	R
117.#Nilgiri Laughingthrush (1307, 1308)	EN *#Garrulax cachinnans* (Jerdon, 1839)	R
118.Spotted (Puff-throated) Babbler (1152-1159)	*Pellorneum ruficeps* Swainson, 1832	R
119.* Indian Scimitar-Babbler (1172-1177)	*Pomatorhinus horsfieldii* Sykes, 1832	R
120.Black-headed (Dark-fronted) Babbler (1224-1227)	*Rhopocichla atriceps* (Jerdon, 1839	R
121.(Indian) Rufous Babbler (1259-1260)	*Turdoides subrufus* (Jerdon, 1839)	R
XXX. GOLDCREST, PRINIAS, TESIAS, WARBLERS SYLVIINAE		
122.Franklin's (Grey-breasted) Prinia (1502-1505)	*Prinia hodgsonii* Blyth, 1844	R
123.Blyth's Reed-Warbler (1556)	*Acrocephalus dumetorum* Blyth, 1849	W
124.Thick-billed Warbler (1549)	*Acrocephalus aedon* (Pallas, 1776)	W
125.Booted Warbler (1562-1563)	*Hippolais caligata* (Lichtenstein, 1823)	W
126.* Tickell's (Leaf) Warbler (1579)	*Phylloscopus affinis* (Tickell, 1833)	W
127.Greenish Leaf-Warbler (1602-1605)	*Phylloscopus trochiloides* (Sundevall, 1837)	W
128.Large-billed Leaf-Warbler (1601)	*Phylloscopus magnirostris* Blyth, 1843	W
129.* Western Crowned Warbler (1606)	*Phylloscopus occipitalis* (Blyth, 1845)	W
130.#Broad-tailed Grass-Warbler (Broad-tailed Grassbird) (1546)	VU *#Schoenicola platyura* (Jerdon, 1844)	R
XXXI. FLYCATCHERS MUSCICAPINAE		
131.Asian Brown Flycatcher (1407)	*Muscicapa dauurica* Pallas, 1811	W
132.Rusty-tailed Flycatcher (1409)	*Muscicapa ruficauda* Swainson, 1838	W
133.Brown-breasted Flycatcher (1408)	*#Muscicapa muttui* (Layard, 1854)	W W
134.Red-throated Flycatcher (1411-1412)	*Ficedula parva* (Bechstein, 1792)	W
135.#Black-and-Orange Flycatcher (1427)	NT *#Ficedula nigrorufa* (Jerdon, 1839)	R
136.Verditer Flycatcher (1445)	*Eumyias thalassina* (Swainson, 1838)	W
137.#Nilgiri Flycatcher (1446)	NT *#Eumyias albicaudata* (Jerdon, 1840)	R
138.White-bellied Blue-Flycatcher (1435)	*#Cyornis pallipes* (Jerdon, 1840)	R
139.Blue-throated Flycatcher (1440)	*Cyornis rubeculoides* (Vigors, 1831)	W
140.Tickell's Blue-Flycatcher (1442-1443)	*Cyornis tickelliae* Blyth, 1843	R
141.Grey-headed (Canary) Flycatcher (1448-1449)	*Culicicapa ceylonensis* (Swainson, 1820)	R

XXXII. MONARCH-FLYCATCHERS & PARADISE-FLYCATCHERS MONARCHINAE		
142.Asian Paradise-Flycatcher (1460-1464)	*Terpsiphone paradisi* (Linnaeus, 1758)	W
143.Black-naped Monarch-Flycatcher (1465-1469)	*Hypothymis azurea* (Boddaert, 1783)	R
XXXIII. TITS PARIDAE		
144.Great Tit (1790-1797) *(Grey Tit)*	*Parus major* Linnaeus, 1758	R
145.Black-lored Yellow Tit (1809-1811) *Yellow-cheeked Tit)*	*Parus xanthogenys* Vigors, 1831	R
XXXIV. NUTHATCHES, WALLCREEPER SITTIDAE		
146.Velvet-fronted Nuthatch (1838)	*Sitta frontalis* Swainson, 1820	R
XXXV. FLOWERPECKERS DICAEIDAE		
147.Thick-billed Flowerpecker (1892-1894)	*Dicaeum agile* (Tickell, 1833)	R
148.Tickell's (Pale-billed) Flowerpecker (1899-1900)	*Dicaeum erythrorhynchos* (Latham, 1790)	R
149.Plain Flowerpecker (1901-1903) *(Nilgiri Flowerpecker)*	*Dicaeum concolor* Jerdon, 1840	R
XXXVI. SUNBIRDS & SPIDERHUNTERS NECTARINIIDAE		
150.Purple-rumped Sunbird (1907-1908)	*Nectarinia zeylonica* (Linnaeus, 1766)	R
151.Small (Crimson-backed) Sunbird (1909)	*Nectarinia minima* (Sykes, 1832)	R
152.Purple Sunbird (1916-1918)	*Nectarinia asiatica* (Latham, 1790)	R
153.Loten's Sunbird (1911-1912)	*Nectarinia lotenia* (Linnaeus, 1766)	R
154.Little Spiderhunter (1931)	*Arachnothera longirostra* (Latham, 1790)	R
XXXVII. WHITE-EYES ZOSTEROPIDAE		
155.Oriental White-eye (1933-1936)	*Zosterops palpebrosus* (Temminck, 1824)	R
XXXVIII. FINCHES FRINGILLIDAE		
156.Common Rosefinch (2010-2013)	*Carpodacus erythrinus* (Pallas, 1770)	W
XXXIX. MUNIAS (ESTRILDID FINCHES) ESTRILDIDAE		
157.Black-throated (Rufous-bellied) Munia (1971-1973)	*Lonchura kelaarti* (Jerdon, 1863)	R
158.Spotted (Scaly-breasted) Munia (1974-1975)	*Lonchura punctulata* (Linnaeus, 1758)	R
XL. STARLINGS & MYNAS STURNIDAE		
159.* Southern Hill-Myna (1016)	*Gracula indica* (Cuvier, 1829)	R
XLI. ORIOLES ORIOLIDAE		
160.Eurasian Golden Oriole (952-95?)	*Oriolus oriolus* (Linnaeus, 1758)	W
161.* Black-naped Oriole (954, 956-957)	*Oriolus chinensis* Linnaeus, 1766	W
162.Black-headed (hooded) Oriole (958-960a)	*Oriolus xanthornus* (Linnaeus, 1758)	R
XLII. DRONGOS DICRURIDAE		
163.Ashy Drongo (965-966b)	*Dicrurus leucophaeus* Vieillot, 1817	W
164.Bronzed Drongo (971)	*Dicrurus aeneus* Vieillot, 1817	R

165.Spangled Drongo (973)	*Dicrurus hottentottus* (Linnaeus, 1766)	R
166.Greater Racket-tailed Drongo (976-981)	*Dicrurus paradiseus* (Linnaeus, 1766)	R
XLIII. CROWS, JAYS, TREEPIES, MAGPIES CORVIDAE		
167.White-bellied Treepie (1036)	*#Dendrocitta leucogastra* Gould, 1833	R
168.Jungle Crow (1054-1057)	*Corvus macrorhynchos* Wagler, 1827	R

a. (225-256) - Numbers within brackets after the common names are the numbers given to species in Rlpley's (1982) *Synopsis,* which was also followed in Ali & Ripley's Handbook,

b. * - An asterisk preceding the common name indicates cases of 'splits' or 'lumps', after recent taxonomic changes.

c. # - When preceding English name, denotes a species endemic to India.

d. # - When preceding scientific name, denotes a globally threatened or near-threatened species (Collar. *et al.* 1994).

e. R = resident

f. W = wintor visitor or migratory

g. EN - Endangered (BirdLife International 2001).

h. VU - Vulnerable (BirdLife International 2001).

i. NT - Near Threatened (BirdLife International 2001).

Appendix 3. Checklist of birds of Chinnar

FAMILY / COMMON NAME / SCIENTIFIC NAME		STATUS
I. HERONS, EGRETS & BITTERNS ARDEIDAE		
1. Little Egret (49)	*Egretta garzetta* (Linnaeus, 1766)	R
2. Indian Pond-Heron (42-42a)	*Ardeola grayii* (Sykes, 1832)	R
II. HAWKS, EAGLES, BUZZARDS, OLD WORLD VULTURES, KITES, HARRIERS ACCIPITRIDAE		
3. Oriental Honey-Buzzard (129-130)	*Pernis ptilorhynchus* (Temminck, 1821)	R
4. Black-shouldered Kite (124)	*Elanus caeruleus* (Desfontaines, 1789)	R
5. Indian White-backed Vulture (185)	CR #*Gyps bengalensis* (Gmelin, 1788)	R
6. Short-toed Snake-Eagle (195)	*Circaetus gallicus* (Gmelin, 1788)	R
7. * Crested Serpent-Eagle (196-200)	*Spilornis cheela* (Latham, 1790	R
8. * Shikra (137-140)	*Accipiter badius* (Gmelin, 1788)	R
9. Eurasian Sparrowhawk (147-148)	*Accipiter nisus* (Linnaeus, 1758)	W
10. Black Eagle (172)	*Ictinaetus malayensis* (Temminck, 1822)	R
11. Booted Eagle (164)	*Hieraaetus pennatus* (Gmelin, 1788)	W
12. Changeable Hawk-Eagle (160-162)	*Spizaetus cirrhatus* (Gmelin, 1788)	R
III. FALCONS FALCONIDAE		
13. Common Kestrel (222-224)	*Falco tinnunculus* Linnaeus, 1758	R
IV. PHEASANTS, PARTRIDGES, QUAILS PHASIANIDAE		
14. Jungle Bush-Quail (255-258)	*Perdicula asiatica* (Latham, 1790)	R
15. Red Spurfowl (275-277)	*Galloperdix spadicea* (Gmelin, 1789)	R
16. Grey Junglefowl (301)	#*Gallus sonneratii* Temminck, 1813	R
17. Indian Peafowl (311)	*Pavo cristatus* Linnaeus, 1758 Green Peafowl (312)	R
V. PLOVERS, DOTTERELS, LAPWINGS CHARADRIIDAE		
18. Yellow-wattled Lapwing (370)	*Vanellus malabaricus* (Boddaert, 1783)	R
19. Red-wattled Lapwing (366-368)	*Vanellus indicus* (Boddaert, 1783)	R
VI. SANDPIPERS, STINTS, SNIPES, GODWITS & CURLEWS SCOLOPACIDAE		
20. Wood Sandpiper (398)	*Tringa glareola* Linnaeus, 1758	W
21. Common Sandpiper (401)	*Actitis hypoleucos* Linnaeus, 1758	W
VII. STONE-CURLEW & STONE-PLOVERS/FHICK-KNEES BURHINIDAE		
22. Stone-Curlew (435-436)	*Burhinus oedicnemus* (Linnaeus, 1758)	R
VIII. PIGEONS & DOVES COLUMBIDAE		
23. Blue Rock Pigeon (516-517)	*Columba livia* Gmelin, 1789	R
24. #Nilgiri Wood-Pigeon (521)	VU #*Columba elphinstonii* (Sykes, 1833)	R
25. Little Brown (Laughing) Dove (541)	*Streptopelia senegalensis* (Linnaeus, 1766)	R
26. Spotted Dove (537-540)	*Streptopelia chinensis* (Scopoli, 1786)	R

27. Eurasian Collared-Dove (534)	*Streptopelia decaocto* (Frivaldszky, 1838)	R
28. Emerald Dove (542-544a)	*Chalcophaps indica* (Linnaeus, 1758)	R
29. Pompadour Green-Pigeon (496-500)	*Treron pompadora* (Gmelin, 1789)	R
30. Yellow-legged Green-Pigeon (503-505)	*Treron phoenicoptera* (Latham, 1790)	R
31. Green Imperial-Pigeon (506-508a)	*Ducula aenea* (Linnaeus, 1766)	R
32. Mountain Imperial-Pigeon (510-512)	*Ducula badia* (Hames, 1822)	R
IX. PARAKEETS & HANGING-PARROTS PSITTACIDAE		
33. Indian (Vernal) Hanging-Parrot (566, 567)	*Loriculus vernalis* (Sparrman, 1787)	R
34. Rose-ringed Parakeet (549-550)	*Psittacula krameri* (Scopoli, 1769)	R
35. Plum-headed Parakeet (557-558)	*Psittacula cyanocephala* (Linnaeus, 1766)	R
36. Blue-winged Parakeet (564)	*Psittacula columboides* (Vigors, 1830)	R
X. CUCKOOS, MALKOHAS & COUCALS CUCULIDAE		
37. Pied Crested Cuckoo (570-571)	*Clamator jacobinus* (Boddaert, 1783)	R
38. Brainfever Bird / Common Hawk-Cuckoo (573-574)	*Hierococcyx varius* (Vahl, 1797)	R
39. Indian Cuckoo (576)	*Cuculus micropterus* Gould, 1838	R
40. Banded Bay Cuckoo (582-583)	*Cacomantis sonneratii* (Latham, 1790)	R
41. Indian Plaintive (Grey-bellied) Cuckoo (584)	*Cacomantis passerinus* (Vahl, 1797)	R
42. Drongo Cuckoo (588-589)	*Surniculus lugubris* (Horsfield, 1821)	R
43. Asian Koel (590-592)	*Eudynamys scolopacea* (Linnaeus, 1758)	R
44. Small Green-billed (Blue-faced) Malkoha (595)	*Phaenicophaeus viridirostris* (Jerdon, 1840)	R
45. Sirkeer Malkoha (596-598)	*Phaenicophaeus leschenaultii* (Lesson, 1830)	R
46. * Greater Coucal (600-602)	*Centropus sinensis* (Stephens, 1815)	R
XI. OWLS STRIGIDAE		
47. * Oriental Scops-Owl (616-618b)	*Otus sunia* (Hodgson, 1836)	R
48. Collared Scops-Owl (619-624)	*Otus bakkamoena* Pennant, 1769	R
49. Eurasian Eagle-Owl (625-627)	*Bubo bubo* (Linnaeus, 1758)	R
50. Brown Fish-Owl (631-632)	*Ketupa zeylonensis* (Gmelin, 1788)	R
51. * Jungle Owlet (636-637)	*Glaucidium radiatum* (Tickell, 1833)	R
52. Brown Hawk-Owl (642-645)	*Ninox scutulata* (Rames, 1822)	R
XII. NIGHTJARS CAPRIMULGIDAE		
53. Great Eared-Nightjar (668-669)	*Eurostopodus macrotis* (Vigors, 1831)	R
54. Common Indian Nightjar (680-681)	*Caprimulgus asiaticus* Latham, 1790	R
55. Franklin's (Savanna) Nightjar (682)	*Caprimulgus affinis* Horsfield, 1821	R
XIII. SWIFTS APODIDAE		
56. Indian Edible-nest Swiftlet (685)	*Collocalia unicolor* (Jerdon, 1840)	R
57. White-rumped Needletail-Swift (692)	*Zoonavena sylvatica* (Tickell, 1846)	R

58. Brown-backed Needletail-Swift (691)	*Hirundapus giganteus* (Temminck, 1846)	R
59. Asian Palm-Swift (707-708)	*Cypsiurus balasiensis* (J.E. Gray, 1829)	R
60. Alpine Swift (693-695)	*Tachymarptis melba* (Linnaeus, 1758)	R
61. House Swift (702-706)	*Apus affinis* (J.E. Gray, 1830)	R
XIV. TREE-SWIFTS HEMIPROCNIDAE		
62. Crested Tree-Swift (709)	*Hemiprocne coronata* (Tickell, 1833)	R
XV. TROGONS TROGONIDAE		
63. Malabar Trogon (710-712)	*Harpactes fasciatus* (Pennant, 1769)	R
XVI. KINGFISHERS ALCEDINIDAE		
64. Small Blue Kingfisher (722-724)	*Alcedo atthis* (Linnaeus, 1758)	R
65. Stork-billed Kingfisher (730-732)	*Halcyon capensis* (Linnaeus, 1766)	R
66. White-breasted Kingfisher (735- 738)	*Halcyon smyrnensis* (Linnaeus, 1758)	R
XVII. BEE-EATERS MEROPIDAE		
67. Blue-bearded Bee-eater (753)	*Nyctyornis athertoni* (Jardine & Selby, 1828)	R
68. Small Bee-eater (749-752)	*Merops orientalis* Latham, 1801	R
69. Chestnut-headed Bee-eater (744-745)	*Merops leschenaulti* Vieillot, 1817	R
XVIII. ROLLERS CORACIIDAE		
70. Indian Roller (755-757)	*Coracias benghalensis* (Linnaeus, 1758)	R
XIX. HOOPOES UPUPIDAE		
71. Common Hoopoe (763-766)	*Upupa epops* Linnaeus, 1758	R
XX. HORNBILLS BUCEROTIDAE		
72. * Malabar Grey Hornbill (768)	#*Ocyceros griseus* (Latham, 1790) .	R
XXI. BARBETS CAPITONIDAE		
73. Brown-headed Barbet (780-782)	*Megalaima zeylanica* (Gmelin, 1788)	R
74. White-cheeked Barbet (785)	*Megalaima viridis* (Boddaert, 1783)	R
75. Crimson-throated Barbet (790-791)	*Megalaima rubricapillus* (Gmelin, 1788)	R
76. Coppersmith Barbet (792)	*Megalaima haemacephala* (P.L.S. Muller, 1776)	R
XXII. WOODPECKERS PICIDAE		
77. Brown-capped Pygmy Woodpecker (851-854)	*Dendrocopos nanus* (Vigors, 1832)	R
78. Yellow-fronted (Yellow-crowned) Pied Woodpecker (847)	*Dendrocopos mahrattensis* (Latham, 1801)	R
79. Rufous Woodpecker (802-804)	*Celeus brachyurus* (Vieillot, 1818)	R
80. * Great Black / White-bellied Woodpecker (830)	*Dryocopus javensis* (Horsfield, 1821)	R
81. Small Yellow-naped Woodpecker /Lesser Yellownape (814-817)	*Picus chlorolophus* Vieillot, 1818	R
82. Lesser Golden-backed Woodpecker / Black-rumped Flameback (818-823)	*Dinopium benghalense* (Linnaeus, 1758)	R

83. Little Scaly-bellied Green (Streak-throated) Woodpecker (808)	*Picus xanthopygaeus* (J.E. Gray & G.R. Gray, 1846)	R
84. Common Golden-backed Woodpecker / Common Flameback (825-826)	*Dinopium javanense* (Ljungh, 1797)	R
85. Greater Golden-backed Woodpecker / Greater Flameback (860-863)	*Chrysocolaptes lucidus* (Scopoli, 1786)	R
86. Black-shouldered (White-naped) Woodpecker (858-859)	*Chrysocolaptes festivus* (Boddaert, 1783)	R
87. Heart-spotted Woodpecker (856)	*Hemicircus canente* (Lesson, 1830)	R
XXIII. PITTAS PITTIDAE		
88. Indian Pitta (867)	*Pitta brachyura* (Linnaeus, 1766)	W
XXIV. LARKS ALAUDIDAE		
89. Ashy-crowned Sparrow-Lark (878)	*Eremopterix grisea* (Scopoli, 1786)	R
XXV. SWALLOWS & MARTINS HIRUNDINIDAE		
90. Dusky Crag-Martin (914)	*Hirundo concolor* Sykes, 1833	R
91. Red-rumped Swallow (923-928)	*Hirundo daurica* Linnaeus, 1771	R
92. * Northern House-Martin (930)	*Delichon urbica* (Linnaeus, 1758)	W
XXVI. WAGTAILS & PIPITS MOTACILLIDAE		
93. Forest Wagtail (1874)	*Dendronanthus indicus* (Gmelin, 1789)	W
94. Grey Wagtail (1884)	*Motacilla cinerea* Tunstall, 1771	W
95. #Nilgiri Pipit (1870)	NT *Anthus nilghiriensis* Sharpe, 1885	R
XXVII. CUCKOO-SHRIKES, FLYCATCHER-SHRIKES, TRILLERS, MINIVETS, WOODSHRIKES CAMPEPHAGIDAE		
96. * Large Cuckoo-Shrike (1072-1075)	*Coracina macei* (Lesson, 1830)	R
97. Black-headed Cuckoo-Shrike (1078-1079)	*Coracina melanoptera* (Rtippell, 1839)	R
98. Small Minivet (1090-1095)	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	R
99. Scarlet Minivet (1080-1083)	*Pericrocotus flammeus* (Forster, 1781)	R
100. Pied Flycatcher-Shrike (1064-1066)	*Hemipus picatus* (Sykes, 1832)	R
101. Large Woodshrike (1067-1068)	*Tephrodornis gularis* (Rames, 1822)	R
102. Common Woodshrike (1069-1071)	*Tephrodornis pondicerianus* (Gmelin, 1789)	R
XXVIII. BULBULS & FINCHBILLS PYCNONOTIDAE		
103. Grey-headed Bulbul (1114)	*#Pycnonotus priocephalus* (Jerdon, 1839)	R
104. Black-crested Bulbul (1115-1117)	*Pycnonotus melanicterus* (Gmelin, 1789)	R
105. Red-whiskered Bulbul (1118-1122)	*Pycnonotus jocosus* (Linnaeus, 1758)	R
106. Red-vented Bulbul (1126-1132)	*Pycnonotus cafer* (Linnaeus, 1766)	R
107. #Yellow-throated Bulbul (1135)	VU *#Pycnonotus xantholaemus* (Jerdon, 1844)	R
108. White-browed Bulbul (1138-1139)	*Pycnonotus luteolus* (Lesson, 1841)	R
109. Yellow-browed Bulbul (1143-1145)	*Iole indica* (Jerdon, 1839)	R

110.* Black Bulbul (1148-1151)	*Hypsipetes leucocephalus* (P.L.S. Muller, 1776)	R
XXIX. IORAS, CHLOROPSIS/LEAFBIRD, FAIRY-BLUEBIRD IRENIDAE		
111.Common Iora (1097-1101)	*Aegithina tiphia* (Linnaeus, 1758)	R
112.Jerdon's Chloropsis (1107-1108)	*Chloropsis cochinchinensis* (Gmelin, 1788)	R
113.Gold-fronted Chloropsis (1103-1105)	*Chloropsis aurifrons* (Temminck, 1829)	R
114.Asian Fairy-Bluebird (1109, 1110)	*Irena puella* (Latham, 1790)	R
XXX. SHRIKES LANIIDAE		
115.Brown Shrike (949-950a)	*Lanius cristatus* Linnaeus, 1758	W
116.Bay-backed Shrike (939-940)	*Lanius vittatus* Valenciennes, 1826	R
117.Rufous-backed (Long-tailed) Shrike (946-948)	*Lanius schach* Linnaeus, 1758	R
XXXI. THRUSHES, SHORTWINGS, ROBINS, FORKTAILS, WHEATERS TURDINAE		
118.Blue-headed (Blue-capped) Rock-Thrush (1723)	*Monticola cinclorhynchus* (Vigors, 1832)	W
119.Malabar Whistling-Thrush (1728)	*Myiophonus horsfieldii* (Vigors, 1831)	R
120.Orange-headed Thrush (1733-1736)	*Zoothera citrina* (Latham, 1790)	R
121.Eurasian Blackbird (1751-1757)	*Turdus merula* Linnaeus, 1758	R
122.Oriental Magpie-Robin (1661-1664)	*Copsychus saularis* (Linnaeus, 1758)	R
123.White-rumped Shama (1665-1668)	*Copsychus malabaricus* (Scopoli, 1786)	R
124.Indian Robin (1717-1721)	*Saxicoloides fulicata* (Linnaeus, 1776)	R
125.Pied Bushchat (1700-1703)	*Saxicola caprata* (Linnaeus, 1766)	R
XXXII. BABBLERS, LAUGHINGTHRUSHES, BABAXES, BARWINGS, YUHINAS - TIMALIINAE		
126.#Grey-breasted Laughingthrush (1309-1311)	NT #*Garrulax jerdoni* Blyth, 1851	R
127.Spotted (Puff-throated) Babbler (1152-1159)	*Pellorneum ruficeps* Swainson, 1832	R
128.* Indian Scimitar-Babbler (1172-1177)	*Pomatorhinus horsfieldii* Sykes, 1832	R
129.Rufous (Tawny)-bellied Babbler (1219-1223)	*Dumetia hyperythra* (Franklin, 1831)	R
130.Black-headed (Dark-fronted) Babbler (1224-1227)	*Rhopocichla atriceps* (Jerdon, 1839	R
131.Yellow-eyed Babbler (1230-1232)	*Chrysomma sinense* (Gmelin, 1789)	R
132.(Indian) Rufous Babbler (1259-1260)	*Turdoides subrufus* (Jerdon, 1839)	R
133.Jungle Babbler (1261-1265)	*Turdoides striatus* (Dumont, 1823)	R
134.White-headed (Yellow-billed) Babbler (1267-1268)	*Turdoides affinis* (Jerdon, 1847)	R
XXXIII. GOLDCREST, PRINIAS, TESIAS, WARBLERS SYLVIINAE		
135.Franklin's (Grey-breasted) Prinia (1502-1505)	*Prinia hodgsonii* Blyth, 1844	R

136.Ashy Prinia (1515-1518)	*Prinia socialis* Sykes, 1832	R
137.Indian Great Reed (Clamorous) Warbler 1550-1552)	*Acrocephalus stentoreus* (Hemprich & Ehrenberg, 1833)	W
138.Blyth's Reed-Warbler (1556)	*Acrocephalus dumetorum* Blyth, 1849	W
139.Common Tailorbird (1535-1539)	*Orthotomus sutorius* (Pennant, 1769)	R
140.Greenish Leaf-Warbler (1602-1605)	*Phylloscopus trochiloides* (Sundevall, 1837)	W
141.Large-billed Leaf-Warbler (1601)	*Phylloscopus magnirostris* Blyth, 1843	W
142.* Western Crowned Warbler (1606)	*Phylloscopus occipitalis* (Blyth, 1845)	W
143.Orphean Warbler (1565)	*Sylvia hortensis* (Gmelin, 1789)	W
XXXIV. FLYCATCHERS MUSCICAPINAE		
144.Asian Brown Flycatcher (1407)	*Muscicapa dauurica* Pallas, 1811	W
145.Rusty-tailed Flycatcher (1409)	*Muscicapa ruficauda* Swainson, 1838	W
146.Brown-breasted Flycatcher (1408)	*#Muscicapa muttui* (Layard, 1854)	W
147.Red-throated Flycatcher (1411-1412)	*Ficedula parva* (Bechstein, 1792)	W
148.#Black-and-Orange Flycatcher (1427)	NT *#Ficedula nigrorufa* (Jerdon, 1839)	R
149.Verditer Flycatcher (1445)	*Eumyias thalassina* (Swainson, 1838)	W
150.#Nilgiri Flycatcher (1446)	NT *#Eumyias albicaudata* (Jerdon, 1840)	R
151.White-bellied Blue-Flycatcher (1435)	*#Cyornis pallipes* (Jerdon, 1840)	R
152.Blue-throated Flycatcher (1440)	*Cyornis rubeculoides* (Vigors, 1831)	W
153.Tickell's Blue-Flycatcher (1442-1443)	*Cyornis tickelliae* Blyth, 1843	R
154.Grey-headed (Canary) Flycatcher (1448-1449)	*Culicicapa ceylonensis* (Swainson, 1820)	R
XXXV. MONARCH-FLYCATCHERS & PARADISE-FLYCATCHERS MONARCHINAE		
155.Asian Paradise-Flycatcher (1460-1464)	*Terpsiphone paradisi* (Linnaeus, 1758)	W
156.Black-naped Monarch-Flycatcher (1465-1469)	*Hypothymis azurea* (Boddaert, 1783)	R
XXXVI. FANTAIL-FLYCATCHERS RHIPIDURINAE		
157.White-throated Fantail-Flycatcher (1454-1459)	*Rhipidura albicollis* (Vieillot, 1818)	R
XXXVII. TITS PARIDAE		
158.Great Tit (1790-1797) *(Grey Tit)*	*Parus major* Linnaeus, 1758	R
159.Black-lored Yellow Tit (1809-1811) *Yellow-cheeked Tit)*	*Parus xanthogenys* Vigors, 1831	R
XXXVIII. NUTHATCHES, WALLCREEPER SITTIDAE		
160.Velvet-fronted Nuthatch (1838)	*Sitta frontalis* Swainson, 1820	R
XXXIX. FLOWERPECKERS DICAEIDAE		
161.Thick-billed Flowerpecker (1892-1894)	*Dicaeum agile* (Tickell, 1833)	R
162.Tickell's (Pale-billed) Flowerpecker (1899-1900)	*Dicaeum erythrorhynchos* (Latham, 1790)	R
163.Plain Flowerpecker (1901-1903) *(Nilgiri*	*Dicaeum concolor* Jerdon, 1840	R

Flowerpecker)		
XL. SUNBIRDS & SPIDERHUNTERS NECTARINIIDAE		
164.Purple-rumped Sunbird (1907-1908)	*Nectarinia zeylonica* (Linnaeus, 1766)	R
165.Small (Crimson-backed) Sunbird (1909)	*Nectarinia minima* (Sykes, 1832)	R
166.Purple Sunbird (1916-1918)	*Nectarinia asiatica* (Latham, 1790)	R
167.Loten's Sunbird (1911-1912)	*Nectarinia lotenia* (Linnaeus, 1766)	R
168.Little Spiderhunter (1931)	*Arachnothera longirostra* (Latham, 1790)	R
XLI. WHITE-EYES ZOSTEROPIDAE		
169.Oriental White-eye (1933-1936)	*Zosterops palpebrosus* (Temminck, 1824)	R
XLII. FINCHES FRINGILLIDAE		
170.Common Rosefinch (2010-2013)	*Carpodacus erythrinus* (Pallas, 1770)	W
XLIII. MUNIAS (ESTRILDID FINCHES) ESTRILDIDAE		
171.White-rumped Munia (1967-1970) *(White-backed)*	*Lonchura striata* (Linnaeus, 1766)	R
172.Black-throated (Rufous-bellied) Munia (1971-1973)	*Lonchura kelaarti* (Jerdon, 1863)	R
173.Spotted (Scaly-breasted) Munia (1974-1975)	*Lonchura punctulata* (Linnaeus, 1758)	R
XLIV. SPARROWS & SNOWFINCHES PASSERINAE		
174.House Sparrow (1938-1939a)	*Passer domesticus* (Linnaeus, 1758)	R
175.Yellow-throated Sparrow (Chestnut-shouldered Petronia) (1948-1949)	*Petronia xanthocollis* (Burton, 1838)	R
XLV. STARLINGS & MYNAS STURNIDAE		
176.Grey-headed (Chestnut-tailed) Starling (987-989)	*Sturnus malabaricus* (Gmelin, 1789)	R
177.Brahminy Starling (994)	*Sturnus pagodarum* (Gmelin, 1789)	R
178.Rosy Starling (996)	*Sturnus roseus* (Linnaeus, 1758)	W
179.Common Myna (1006-1007)	*Acridotheres tristis* (Linnaeus, 1766)	R
180.Jungle Myna (1009-1011)	*Acridotheres fuscus* (Wagler, 1827)	R
181.* Southern Hill-Myna (1016)	*Gracula indica* (Cuvier, 1829)	R
XLVI. ORIOLES ORIOLIDAE		
182.Eurasian Golden Oriole (952-95?)	*Oriolus oriolus* (Linnaeus, 1758)	R
183.* Black-naped Oriole (954, 956-957)	*Oriolus chinensis* Linnaeus, 1766	W
184.Black-headed (hooded) Oriole (958-960a)	*Oriolus xanthornus* (Linnaeus, 1758)	R
XLVII. DRONGOS DICRURIDAE		
185.* Black Drongo (962-964)	*Dicrurus macrocercus* Vieillot, 1817	R
186.Ashy Drongo (965-966b)	*Dicrurus leucophaeus* Vieillot, 1817	W
187.White-bellied Drongo (967-969)	*Dicrurus caerulescens* (Linnaeus, 1758)	R
188.Bronzed Drongo (971)	*Dicrurus aeneus* Vieillot, 1817	R
189.Spangled Drongo (973)	*Dicrurus hottentottus* (Linnaeus, 1766)	R
190.Greater Racket-tailed Drongo (976-981)	*Dicrurus paradiseus* (Linnaeus, 1766)	R

XLVIII. WOODSWALLOWS/SWALLOW-SHRIKES ARTAMIDAE		
191.Ashy Woodswallow (982)	*Artamus fuscus* Vieillot, 1817	R
XLIX. CROWS, JAYS, TREEPIES, MAGPIES CORVIDAE		
192.Indian (Rufous) Treepie (1030a-1034)	*Dendrocitta vagabunda* (Latham, 1790)	R
193.White-bellied Treepie (1036)	*#Dendrocitta leucogastra* Gould, 1833	R
194.House Crow (1048-1051)	*Corvus splendens* Vieillot, 1817	R
195.Jungle Crow (1054-1057)	*Corvus macrorhynchos* Wagler, 1827	R

a. (225-256) - Numbers within brackets after the common names are the numbers given to species in Ripley's (1982) *Synopsis*, which was also followed in Ali & Ripley's Handbook.

b. * - An asterisk preceding the common name indicates cases of 'splits' or 'lumps', after recent taxonomic changes.

c. # - When preceding English name, denotes a species endemic to India.

d. # - When preceding scientific name, denotes a globally threatened or near-threatened species (Collar. et al. 1994).

e. R = resident

f. W = wintor visitor or migratory

g. CR - Critical (BirdLife International 2001).

h. EN - Endangered (BirdLife International 2001).

i. VU - Vulnerable (BirdLife International 2001).

j. NT - Near Threatened (BirdLife International 2001).

Appendix 4. Checklist of birds of Idukki

FAMILY / COMMON NAME / SCIENTIFIC NAME		STATUS
I. GREBES PODICIPEDIDAE		
1. Little Grebe (5)	*Tachybaptus ruficollis* (Pallas, 1764)	R
II. CORMORANTS/SHAGS PHALACROCORACIDAE		
2. Little Cormorant (28)	*Phalacrocorax niger* (Vieillot, 1817)	R
3. Indian Shag (27)	*Phalacrocorax fuscicollis* Stephens, 1826	R
4. Great Cormorant (26)	*Phalacrocorax carbo* (Linnaeus, 1758)	R
III. DARTERS ANHINGIDAE		
5. Darter (29)	NT #*Anhinga melanogaster* Pennant, 1769	R
IV. HERONS, EGRETS & BITTERNS ARDEIDAE		
6. Little Egret (49)	*Egretta garzetta* (Linnaeus, 1766)	R
7. Large Egret (45-46)	*Casmerodius albus* (Linnaeus, 1758)	R
8. Median Egret (47,48)	*Mesophoyx intermedia* (Wagler, 1829)	R
9. Cattle Egret (44)	*Bubulcus ibis* (Linnaeus, 1758)	R
10. Indian Pond-Heron (42-42a)	*Ardeola grayii* (Sykes, 1832)	R
11. Little Green Heron (38-41)	*Butorides striatus* (Linnaeus, 1758)	R
12. Black-crowned Night-Heron (52)	*Nycticorax nycticorax* (Linnaeus, 1758)	R
13. Chestnut Bittern (56)	*Ixobrychus cinnamomeus* (Gmelin, 1789)	R
14. Black Bittern (58)	*Dupetor flavicollis* (Latham, 1790)	R
V. SWANS, GEESE & DUCKS ANATIDAE		
15. Lesser Whistling-Duck (88)	*Dendrocygna javanica* (Horsfield, 1821)	R
VI. HAWKS, EAGLES, BUZZARDS, OLD WORLD VULTURES, KITES, HARRIERS ACCIPITRIDAE		
16. Black Baza (127-128a)	*Aviceda leuphotes* (Dumont, 1820)	I
17. Oriental Honey-Buzzard (129-130)	*Pernis ptilorhynchus* (Temminck, 1821)	R
18. Black-shouldered Kite (124)	*Elanus caeruleus* (Desfontaines, 1789)	R
19. Black Kite (132-134)	*Milvus migrans* (Boddaert, 1783)	R
20. Brahminy Kite (135)	*Haliastur indus* (Boddaert, 1783)	R
21. Greater Grey-headed Fish-Eagle (175-176)	NT #*Ichthyophaga ichthyaetus* (Horsfield, 1821)	R
22. * Crested Serpent-Eagle (196-200)	*Spilornis cheela* (Latham, 1790	R
23. Pallid (Pale) Harrier (190)	#*Circus macrourus* (S.G. Gmelin, 1770)	W
24. Crested Goshawk (144-146)	*Accipiter trivirgatus* (Temminck, 1824)	R
25. * Shikra (137-140)	*Accipiter badius* (Gmelin, 1788)	R
26. Common Buzzard (155-156)	*Buteo buteo* Linnaeus, 1758	W
27. Black Eagle (172)	*Ictinaetus malayensis* (Temminck, 1822)	R
28. Changeable Hawk-Eagle (160-162)	*Spizaetus cirrhatus* (Gmelin, 1788)	R

VII. OSPREY PANDIONIDAE		
29. Osprey (203)	*Pandion haliaetus* (Linnaeus, 1758)	W
VIII. FALCONS FALCONIDAE		
30. Common Kestrel (222-224)	*Falco tinnunculus* Linnaeus, 1758	R
31. Falcon sp.	*Falco sp.*	R
IX. PHEASANTS, PARTRIDGES, QUAILS PHASIANIDAE		
32. Jungle Bush-Quail (255-258)	*Perdicula asiatica* (Latham, 1790)	R
33. Painted Bush-Quail (262-263)	*Perdicula erythrorhyncha* (Sykes, 1832)	R
34. Red Spurfowl (275-277)	*Galloperdix spadicea* (Gmelin, 1789)	R
35. Grey Junglefowl (301)	*#Gallus sonneratii* Temminck, 1813	R
X. RAILS, CRAKES, MOORHENS, COOTS RALLIDAE		
36. White-breasted Waterhen (343-345)	*Amaurornis phoenicurus* (Pennant, 1769)	R
XI. PLOVERS, DOTTERELS, LAPWINGS CHARADRIIDAE		
37. Little Ringed Plover (379-380)	*Charadrius dubius* Scopoli, 1786	R
38. Kentish Plover (381-382)	*Charadrius alexandrinus* Linnaeus, 1758	W
39. Yellow-wattled Lapwing (370)	*Vanellus malabaricus* (Boddaert, 1783)	R
40. Red-wattled Lapwing (366-368)	*Vanellus indicus* (Boddaert, 1783)	R
XII. SANDPIPERS, STINTS, SNIPES, GODWITS & CURLEWS SCOLOPACIDAE		
41. Green Sandpiper (397)	*Tringa ochropus* Linnaeus, 1758	W
42. Wood Sandpiper (398)	*Tringa glareola* Linnaeus, 1758	W
43. Common Sandpiper (401)	*Actitis hypoleucos* Linnaeus, 1758	W
XIII. IBISBILL, AVOCETS & STILTS RECURVIROSTRIDAE		
44. Black-winged Stilt (430-431)	*Himantopus himantopus* (Linnaeus, 1758)	R
XIV. GULLS, TERNS & NODDIES LARIDAE		
45. River Tern (463)	*Sterna aurantia* J.E. Gray, 1831	R
46. Whiskered Tern (458)	*Chlidonias hybridus* (Pallas, 1811)	W
XV. PIGEONS & DOVES COLUMBIDAE		
47. Blue Rock Pigeon (516-517)	*Columba livia* Gmelin, 1789	R
48. #Nilgiri Wood-Pigeon (521)	VU *#Columba elphinstonii* (Sykes, 1833)	R
49. Spotted Dove (537-540)	*Streptopelia chinensis* (Scopoli, 1786)	R
50. Emerald Dove (542-544a)	*Chalcophaps indica* (Linnaeus, 1758)	R
51. Pompadour Green-Pigeon (496-500)	*Treron pompadora* (Gmelin, 1789)	R
52. Yellow-legged Green-Pigeon (503-505)	*Treron phoenicoptera* (Latham, 1790)	R
53. Green Imperial-Pigeon (506-508a)	*Ducula aenea* (Linnaeus, 1766)	R
54. Mountain Imperial-Pigeon (510-512)	*Ducula badia* (Hames, 1822)	R
XVI. PARAKEETS & HANGING-PARROTS PSITTACIDAE		
55. Indian (Vernal) Hanging-Parrot (566, 567)	*Loriculus vernalis* (Sparrman, 1787)	R
56. Rose-ringed Parakeet (549-550)	*Psittacula krameri* (Scopoli, 1769)	R

57. Plum-headed Parakeet (557-558)	*Psittacula cyanocephala* (Linnaeus, 1766)	R
58. Blue-winged Parakeet (564)	*Psittacula columboides* (Vigors, 1830)	R
XVII. CUCKOOS, MALKOHAS & COUCALS CUCULIDAE		
59. Pied Crested Cuckoo (570-571)	*Clamator jacobinus* (Boddaert, 1783)	R
60. Brainfever Bird / Common Hawk-Cuckoo (573-574)	*Hierococcyx varius* (Vahl, 1797)	R
61. Indian Cuckoo (576)	*Cuculus micropterus* Gould, 1838	R
62. Banded Bay Cuckoo (582-583)	*Cacomantis sonneratii* (Latham, 1790)	R
63. Indian Plaintive (Grey-bellied) Cuckoo (584)	*Cacomantis passerinus* (Vahl, 1797)	R
64. Drongo Cuckoo (588-589)	*Surniculus lugubris* (Horsfield, 1821)	R
65. Asian Koel (590-592)	*Eudynamys scolopacea* (Linnaeus, 1758)	R
66. Small Green-billed (Blue-faced) Malkoha (595)	*Phaenicophaeus viridirostris* (Jerdon, 1840)	R
67. * Greater Coucal (600-602)	*Centropus sinensis* (Stephens, 1815)	R
68. * Lesser Coucal (605)	*Centropus bengalensis* (Gmelin, 1788)	R
XVIII. OWLS STRIGIDAE		
69. * Oriental Scops-Owl (616-618b)	*Otus sunia* (Hodgson, 1836)	R
70. Collared Scops-Owl (619-624)	*Otus bakkamoena* Pennant, 1769	R
71. Brown Fish-Owl (631-632)	*Ketupa zeylonensis* (Gmelin, 1788)	R
72. * Jungle Owlet (636-637)	*Glaucidium radiatum* (Tickell, 1833)	R
73. Brown Hawk-Owl (642-645)	*Ninox scutulata* (Rames, 1822)	R
XIX. NIGHTJARS CAPRIMULGIDAE		
74. Indian Jungle (Grey) Nightjar (670-672a)	*Caprimulgus indicus* Latham, 1790	R
75. Common Indian Nightjar (680-681)	*Caprimulgus asiaticus* Latham, 1790	R
76. Franklin's (Savanna) Nightjar (682)	*Caprimulgus affinis* Horsfield, 1821	R
XX. SWIFTS APODIDAE		
77. Indian Edible-nest Swiftlet (685)	*Collocalia unicolor* (Jerdon, 1840)	R
78. White-rumped Needletail-Swift (692)	*Zoonavena sylvatica* (Tickell, 1846)	R
79. Brown-backed Needletail-Swift (691)	*Hirundapus giganteus* (Temminck, 1846)	R
80. Asian Palm-Swift (707-708)	*Cypsiurus balasiensis* (J.E. Gray, 1829)	R
81. Alpine Swift (693-695)	*Tachymarptis melba* (Linnaeus, 1758)	R
82. House Swift (702-706)	*Apus affinis* (J.E. Gray, 1830)	R
XXI. TREE-SWIFTS HEMIPROCNIDAE		
83. Crested Tree-Swift (709)	*Hemiprocne coronata* (Tickell, 1833)	R
XXII. TROGONS TROGONIDAE		
84. Malabar Trogon (710-712)	*Harpactes fasciatus* (Pennant, 1769)	R
XXIII. KINGFISHERS ALCEDINIDAE		
85. Small Blue Kingfisher (722-724)	*Alcedo atthis* (Linnaeus, 1758)	R
86. Stork-billed Kingfisher (730-732)	*Halcyon capensis* (Linnaeus, 1766)	R

87. White-breasted Kingfisher (735- 738)	*Halcyon smyrnensis* (Linnaeus, 1758)	R
88. Lesser Pied Kingfisher (719-720)	*Ceryle rudis* (Linnaeus, 1758)	R
XXIV. BEE-EATERS MEROPIDAE		
89. Blue-bearded Bee-eater (753)	*Nyctyornis athertoni* (Jardine & Selby, 1828)	R
90. Small Bee-eater (749-752)	*Merops orientalis* Latham, 1801	R
91. Blue-tailed Bee-eater (748)	*Merops philippinus* Linnaeus, 1766	W
92. Chestnut-headed Bee-eater (744-745)	*Merops leschenaulti* Vieillot, 1817	R
XXV. ROLLERS CORACIIDAE		
93. Indian Roller (755-757)	*Coracias benghalensis* (Linnaeus, 1758)	R
XXVI. HOOPOES UPUPIDAE		
94. Common Hoopoe (763-766)	*Upupa epops* Linnaeus, 1758	R
XXVII. HORNBILLS BUCEROTIDAE		
95. * Malabar Grey Hornbill (768)	*#Ocyceros griseus* (Latham, 1790) .	R
XXVIII. BARBETS CAPITONIDAE		
96. White-cheeked Barbet (785)	*Megalaima viridis* (Boddaert, 1783)	R
97. Crimson-throated Barbet (790-791)	*Megalaima rubricapillus* (Gmelin, 1788)	R
98. Coppersmith Barbet (792)	*Megalaima haemacephala* (P.L.S. Muller, 1776)	R
XXIX. WOODPECKERS PICIDAE		
99. Brown-capped Pygmy Woodpecker (851-854)	*Dendrocopos nanus* (Vigors, 1832)	R
100.Rufous Woodpecker (802-804)	*Celeus brachyurus* (Vieillot, 1818)	R
101.* Great Black / White-bellied Woodpecker (830)	*Dryocopus javensis* (Horsfield, 1821)	R
102.Small Yellow-naped Woodpecker /Lesser Yellownape (814-817)	*Picus chlorolophus* Vieillot, 1818	R
103.Little Scaly-bellied Green (Streak-throated) Woodpecker (808)	*Picus xanthopygaeus* (J.E. Gray & G.R. Gray, 1846)	R
104.Common Golden-backed Woodpecker / Common Flameback (825-826)	*Dinopium javanense* (Ljungh, 1797)	R
105.Lesser Golden-backed Woodpecker / Black-rumped Flameback (818-823)	*Dinopium benghalense* (Linnaeus, 1758)	R
106.Greater Golden-backed Woodpecker / Greater Flameback (860-863)	*Chrysocolaptes lucidus* (Scopoli, 1786)	R
107.Heart-spotted Woodpecker (856)	*Hemicircus canente* (Lesson, 1830)	R
XXX. PITTAS PITTIDAE		
108.Indian Pitta (867)	*Pitta brachyura* (Linnaeus, 1766)	W
XXXI. SWALLOWS & MARTINS HIRUNDINIDAE		
109.Dusky Crag-Martin (914)	*Hirundo concolor* Sykes, 1833	R
110.Common (Barn) Swallow (916-918)	*Hirundo rustica* Linnaeus, 1758	W
111.House (Pacific) Swallow (919-920)	*Hirundo tahitica* Gmelin, 1789	R

112.Red-rumped Swallow (923-928)	*Hirundo daurica* Linnaeus, 1771	R
XXXII. WAGTAILS & PIPITS MOTACILLIDAE		
113.Forest Wagtail (1874)	*Dendronanthus indicus* (Gmelin, 1789)	W
114.White Wagtail (1885-1890)	*Motacilla alba* Linnaeus, 1758	W
115.Large Pied (White-browed) Wagtail (1891)	*Motacilla maderaspatensis* Gmelin, 1789	R
116.Citrine Wagtail (1881-1883)	*Motacilla citreola* Pallas, 1776	W
117.Yellow Wagtail (1875-1880)	*Motacilla fiava* Linnaeus, 1758	W
118.Grey Wagtail (1884)	*Motacilla cinerea* Tunstall, 1771	W
119.* Paddyfield Pipit (1858-1860)	*Anthus rufulus* Vieillot, 1818	R
XXXIII. CUCKOO-SHRIKES, FLYCATCHER-SHRIKES, TRILLERS, MINIVETS, WOODSHRIKES CAMPEPHAGIDAE		
120.* Large Cuckoo-Shrike (1072-1075)	*Coracina macei* (Lesson, 1830)	R
121.Black-headed Cuckoo-Shrike (1078-1079)	*Coracina melanoptera* (Rtippell, 1839)	R
122.Small Minivet (1090-1095)	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	R
123.Scarlet Minivet (1080-1083)	*Pericrocotus flammeus* (Forster, 1781)	R
124.Pied Flycatcher-Shrike (1064-1066)	*Hemipus picatus* (Sykes, 1832)	R
125.Large Woodshrike (1067-1068)	*Tephrodornis gularis* (Rames, 1822)	R
126.Common Woodshrike (1069-1071)	*Tephrodornis pondicerianus* (Gmelin, 1789)	R
XXXIV. BULBULS & FINCHBILLS PYCNONOTIDAE		
127.Grey-headed Bulbul (1114)	*#Pycnonotus priocephalus* (Jerdon, 1839)	R
128.Black-crested Bulbul (1115-1117)	*Pycnonotus melanicterus* (Gmelin, 1789)	R
129.Red-whiskered Bulbul (1118-1122)	*Pycnonotus jocosus* (Linnaeus, 1758)	R
130.Red-vented Bulbul (1126-1132)	*Pycnonotus cafer* (Linnaeus, 1766)	R
131.White-browed Bulbul (1138-1139)	*Pycnonotus luteolus* (Lesson, 1841)	R
132.Yellow-browed Bulbul (1143-1145)	*Iole indica* (Jerdon, 1839)	R
133.* Black Bulbul (1148-1151)	*Hypsipetes leucocephalus* (P.L.S. Muller, 1776)	R
XXXV. IORAS, CHLOROPSIS/LEAFBIRD, FAIRY-BLUEBIRD IRENIDAE		
134.Common Iora (1097-1101)	*Aegithina tiphia* (Linnaeus, 1758)	R
135.Jerdon's Chloropsis (1107-1108)	*Chloropsis cochinchinensis* (Gmelin, 1788)	R
136.Gold-fronted Chloropsis (1103-1105)	*Chloropsis aurifrons* (Temminck, 1829)	R
137.Asian Fairy-Bluebird (1109, 1110)	*Irena puella* (Latham, 1790)	R
XXXVI. SHRIKES LANIIDAE		
138.Brown Shrike (949-950a)	*Lanius cristatus* Linnaeus, 1758	W
139.Rufous-backed (Long-tailed) Shrike (946-948)	*Lanius schach* Linnaeus, 1758	R

XXXVII. THRUSHES, SHORTWINGS, ROBINS, FORKTAILS, WHEATERS TURDINAE		
140.Blue-headed (Blue-capped) Rock-Thrush (1723)	*Monticola cinclorhynchus* (Vigors, 1832)	W
141.Malabar Whistling-Thrush (1728)	*Myiophonus horsfieldii* (Vigors, 1831)	R
142.Orange-headed Thrush (1733-1736)	*Zoothera citrina* (Latham, 1790)	R
143.Eurasian Blackbird (1751-1757)	*Turdus merula* Linnaeus, 1758	R
144.Indian Blue Robin (Bluechat) (1650, 1651)	*Luscinia brunnea* (Hodgson, 1837)	W
145.Oriental Magpie-Robin (1661-1664)	*Copsychus saularis* (Linnaeus, 1758)	R
146.White-rumped Shama (1665-1668)	*Copsychus malabaricus* (Scopoli, 1786)	R
147.Indian Robin (1717-1721)	*Saxicoloides fulicata* (Linnaeus, 1776)	R
148.Pied Bushchat (1700-1703)	*Saxicola caprata* (Linnaeus, 1766)	R
XXXVIII. BABBLERS, LAUGHINGTHRUSHES, BABAXES, BARWINGS, YUHINAS - TIMALIINAE		
149.* Wynaad Laughingthrush (1287)	*#Garrulax delesserti* (Jerdon, 1839)	R
150.Spotted (Puff-throated) Babbler (1152-1159)	*Pellorneum ruficeps* Swainson, 1832	R
151.* Indian Scimitar-Babbler (1172-1177)	*Pomatorhinus horsfieldii* Sykes, 1832	R
152.Black-headed (Dark-fronted) Babbler (1224-1227)	*Rhopocichla atriceps* (Jerdon, 1839	R
153.(Indian) Rufous Babbler (1259-1260)	*Turdoides subrufus* (Jerdon, 1839)	R
154.Jungle Babbler (1261-1265)	*Turdoides striatus* (Dumont, 1823)	R
155.White-headed (Yellow-billed) Babbler (1267-1268)	*Turdoides affinis* (Jerdon, 1847)	R
XXXIX. GOLDCREST, PRINIAS, TESIAS, WARBLERS SYLVIINAE		
156.Franklin's (Grey-breasted) Prinia (1502-1505)	*Prinia hodgsonii* Blyth, 1844	R
157.Ashy Prinia (1515-1518)	*Prinia socialis* Sykes, 1832	R
158.Blyth's Reed-Warbler (1556)	*Acrocephalus dumetorum* Blyth, 1849	W
159.Thick-billed Warbler (1549)	*Acrocephalus aedon* (Pallas, 1776)	W
160.Common Tailorbird (1535-1539)	*Orthotomus sutorius* (Pennant, 1769)	R
161.Greenish Leaf-Warbler (1602-1605)	*Phylloscopus trochiloides* (Sundevall, 1837)	W
162.Large-billed Leaf-Warbler (1601)	*Phylloscopus magnirostris* Blyth, 1843	W
163.* Western Crowned Warbler (1606)	*Phylloscopus occipitalis* (Blyth, 1845)	W
XL. FLYCATCHERS MUSCICAPINAE		
164.Asian Brown Flycatcher (1407)	*Muscicapa dauurica* Pallas, 1811	W
165.Rusty-tailed Flycatcher (1409)	*Muscicapa ruficauda* Swainson, 1838	W
166.Brown-breasted Flycatcher (1408)	*#Muscicapa muttui* (Layard, 1854)	W
167.#Black-and-Orange Flycatcher (1427)	NT *#Ficedula nigrorufa* (Jerdon, 1839)	R
168.Verditer Flycatcher (1445)	*Eumyias thalassina* (Swainson, 1838)	W

169.#Nilgiri Flycatcher (1446)	NT *#Eumyias albicaudata* (Jerdon, 1840)	R
170.White-bellied Blue-Flycatcher (1435)	*#Cyornis pallipes* (Jerdon, 1840)	R
171.Blue-throated Flycatcher (1440)	*Cyornis rubeculoides* (Vigors, 1831)	W
172.Tickell's Blue-Flycatcher (1442-1443)	*Cyornis tickelliae* Blyth, 1843	R
173.Grey-headed (Canary) Flycatcher (1448-1449)	*Culicicapa ceylonensis* (Swainson, 1820)	R
XLI. MONARCH-FLYCATCHERS & PARADISE-FLYCATCHERS MONARCHINAE		
174.Asian Paradise-Flycatcher (1460-1464)	*Terpsiphone paradisi* (Linnaeus, 1758)	W
175.Black-naped Monarch-Flycatcher (1465-1469)	*Hypothymis azurea* (Boddaert, 1783)	R
XLII. FANTAIL-FLYCATCHERS RHIPIDURINAE		
176.White-browed Fantail-Flycatcher (1451-1453)	*Rhipidura aureola* Lesson, 1830	R
XLIII. TITS PARIDAE		
177.Great Tit (1790-1797) *(Grey Tit)*	*Parus major* Linnaeus, 1758	R
178.Black-lored Yellow Tit (1809-1811) *Yellow-cheeked Tit)*	*Parus xanthogenys* Vigors, 1831	R
XLIV. NUTHATCHES, WALLCREEPER SITTIDAE		
179.Velvet-fronted Nuthatch (1838)	*Sitta frontalis* Swainson, 1820	R
XLV. FLOWERPECKERS DICAEIDAE		
180.Thick-billed Flowerpecker (1892-1894)	*Dicaeum agile* (Tickell, 1833)	R
181.Tickell's (Pale-billed) Flowerpecker (1899-1900)	*Dicaeum erythrorhynchos* (Latham, 1790)	R
182.Plain Flowerpecker (1901-1903) *(Nilgiri Flowerpecker)*	*Dicaeum concolor* Jerdon, 1840	R
XLVI. SUNBIRDS & SPIDERHUNTERS NECTARINIIDAE		
183.Purple-rumped Sunbird (1907-1908)	*Nectarinia zeylonica* (Linnaeus, 1766)	R
184.Small (Crimson-backed) Sunbird (1909)	*Nectarinia minima* (Sykes, 1832)	R
185.Purple Sunbird (1916-1918)	*Nectarinia asiatica* (Latham, 1790)	R
186.Loten's Sunbird (1911-1912)	*Nectarinia lotenia* (Linnaeus, 1766)	R
187.Little Spiderhunter (1931)	*Arachnothera longirostra* (Latham, 1790)	R
XLVII. WHITE-EYES ZOSTEROPIDAE		
188.Oriental White-eye (1933-1936)	*Zosterops palpebrosus* (Temminck, 1824)	R
XLVIII. FINCHES FRINGILLIDAE		
189.Common Rosefinch (2010-2013)	*Carpodacus erythrinus* (Pallas, 1770)	W
XLIX. MUNIAS (ESTRILDID FINCHES) ESTRILDIDAE		
190.White-rumped Munia (1967-1970) *(White-backed)*	*Lonchura striata* (Linnaeus, 1766)	R
191.Black-throated (Rufous-bellied) Munia (1971-1973)	*Lonchura kelaarti* (Jerdon, 1863)	R
192.Spotted (Scaly-breasted) Munia (1974-	*Lonchura punctulata* (Linnaeus, 1758)	R

1975)		
L. SPARROWS & SNOWFINCHES PASSERINAE		
193.House Sparrow (1938-1939a)	*Passer domesticus* (Linnaeus, 1758)	R
194.Yellow-throated Sparrow (Chestnut-shouldered Petronia) (1948-1949)	*Petronia xanthocollis* (Burton, 1838)	R
LI. WEAVERS PLOCEINAE		
195.Baya Weaver (1957-1959)	*Ploceus philippinus* (Linnaeus, 1766)	R
LII. STARLINGS & MYNAS STURNIDAE		
196.Grey-headed (Chestnut-tailed) Starling (987-989)	*Sturnus malabaricus* (Gmelin, 1789)	R
197.Brahminy Starling (994)	*Sturnus pagodarum* (Gmelin, 1789)	R
198.Rosy Starling (996)	*Sturnus roseus* (Linnaeus, 1758)	W
199.Common Myna (1006-1007)	*Acridotheres tristis* (Linnaeus, 1766)	R
200.Jungle Myna (1009-1011)	*Acridotheres fuscus* (Wagler, 1827)	R
201.* Southern Hill-Myna (1016)	*Gracula indica* (Cuvier, 1829)	R
LIII. ORIOLES ORIOLIDAE		
202.Eurasian Golden Oriole (952-95?)	*Oriolus oriolus* (Linnaeus, 1758)	R
203.* Black-naped Oriole (954, 956-957)	*Oriolus chinensis* Linnaeus, 1766	W
204.Black-headed (hooded) Oriole (958-960a)	*Oriolus xanthornus* (Linnaeus, 1758)	R
LIV. DRONGOS DICRURIDAE		
205.* Black Drongo (962-964)	*Dicrurus macrocercus* Vieillot, 1817	R
206.Ashy Drongo (965-966b)	*Dicrurus leucophaeus* Vieillot, 1817	W
207.White-bellied Drongo (967-969)	*Dicrurus caerulescens* (Linnaeus, 1758)	R
208.Bronzed Drongo (971)	*Dicrurus aeneus* Vieillot, 1817	R
209.Spangled Drongo (973)	*Dicrurus hottentottus* (Linnaeus, 1766)	R
210.Greater Racket-tailed Drongo (976-981)	*Dicrurus paradiseus* (Linnaeus, 1766)	R
LV. WOODSWALLOWS/SWALLOW-SHRIKES ARTAMIDAE		
211.Ashy Woodswallow (982)	*Artamus fuscus* Vieillot, 1817	R
LVI. CROWS, JAYS, TREEPIES, MAGPIES CORVIDAE		
212.Indian (Rufous) Treepie (1030a-1034)	*Dendrocitta vagabunda* (Latham, 1790)	R
213.White-bellied Treepie (1036)	*#Dendrocitta leucogastra* Gould, 1833	R
214.House Crow (1048-1051)	*Corvus splendens* Vieillot, 1817	R
215.Jungle Crow (1054-1057)	*Corvus macrorhynchos* Wagler, 1827	R

a. (225-256) - Numbers within brackets after the common names are the numbers given to species in Rlpley's (1982) *Synopsis,* which was also followed in Ali & Ripley's Handbook,

b. * - An asterisk preceding the common name indicates cases of 'splits' or 'lumps', after recent taxonomic changes.

c. # - When preceding English name, denotes a species endemic to India.

d. # - When preceding scientific name, denotes a globally threatened or near-threatened species (Collar. *et al.* 1994).

e. R = resident

f. W = wintor visitor or migratory

g. EN - Endangered (BirdLife International 2001).

h. VU - Vulnerable (BirdLife International 2001).

i. NT - Near Threatened (BirdLife International 2001).

Appendix 5. Checklist of birds of Mannavan shola

FAMILY / COMMON NAME / SCIENTIFIC NAME		STATUS
I. HAWKS, EAGLES, BUZZARDS, OLD WORLD VULTURES, KITES, HARRIERS ACCIPITRIDAE		
1. Eurasian Sparrowhawk (147-148)	*Accipiter nisus* (Linnaeus, 1758)	W
2. Changeable Hawk-Eagle (160-162)	*Spizaetus cirrhatus* (Gmelin, 1788)	R
II. PHEASANTS, PARTRIDGES, QUAILS PHASIANIDAE		
3. Grey Junglefowl (301)	*#Gallus sonneratii* Temminck, 1813	R
III. PIGEONS & DOVES COLUMBIDAE		
4. #Nilgiri Wood-Pigeon (521)	VU *#Columba elphinstonii* (Sykes, 1833)	R
5. Emerald Dove (542-544a)	*Chalcophaps indica* (Linnaeus, 1758)	R
6. Pompadour Green-Pigeon (496-500)	*Treron pompadora* (Gmelin, 1789)	R
7. Mountain Imperial-Pigeon (510-512)	*Ducula badia* (Hames, 1822)	R
IV. PARAKEETS & HANGING-PARROTS PSITTACIDAE		
8. Indian (Vernal) Hanging-Parrot (566, 567)	*Loriculus vernalis* (Sparrman, 1787)	R
9. Blue-winged Parakeet (564)	*Psittacula columboides* (Vigors, 1830)	R
V. CUCKOOS, MALKOHAS & COUCALS CUCULIDAE		
10. * Greater Coucal (600-602)	*Centropus sinensis* (Stephens, 1815)	R
VI. SWIFTS APODIDAE		
11. Indian Edible-nest Swiftlet (685)	*Collocalia unicolor* (Jerdon, 1840)	R
VII. TROGONS TROGONIDAE		
12. Malabar Trogon (710-712)	*Harpactes fasciatus* (Pennant, 1769)	R
VIII. KINGFISHERS ALCEDINIDAE		
13. White-breasted Kingfisher (735- 738)	*Halcyon smyrnensis* (Linnaeus, 1758)	R
IX. BEE-EATERS MEROPIDAE		
14. Chestnut-headed Bee-eater (744-745)	*Merops leschenaulti* Vieillot, 1817	R
X. BARBETS CAPITONIDAE		
15. White-cheeked Barbet (785)	*Megalaima viridis* (Boddaert, 1783)	R
16. Crimson-throated Barbet (790-791)	*Megalaima rubricapillus* (Gmelin, 1788)	R
XI. WOODPECKERS PICIDAE		
17. Brown-capped Pygmy Woodpecker (851-854)	*Dendrocopos nanus* (Vigors, 1832)	R
18. Common Golden-backed Woodpecker / Common Flameback (825-826)	*Dinopium javanense* (Ljungh, 1797)	R
19. Lesser Golden-backed Woodpecker / Black-rumped Flameback (818-823)	*Dinopium benghalense* (Linnaeus, 1758)	R
XII. SWALLOWS & MARTINS HIRUNDINIDAE		
20. Red-rumped Swallow (923-928)	*Hirundo daurica* Linnaeus, 1771	R

XIII. CUCKOO-SHRIKES, FLYCATCHER-SHRIKES, TRILLERS, MINIVETS, WOODSHRIKES CAMPEPHAGIDAE		
21. Black-headed Cuckoo-Shrike (1078-1079)	*Coracina melanoptera* (Rtippell, 1839)	R
22. Scarlet Minivet (1080-1083)	*Pericrocotus flammeus* (Forster, 1781)	R
23. Pied Flycatcher-Shrike (1064-1066)	*Hemipus picatus* (Sykes, 1832)	R
24. Large Woodshrike (1067-1068)	*Tephrodornis gularis* (Rames, 1822)	R
XIV. BULBULS & FINCHBILLS PYCNONOTIDAE		
25. Red-whiskered Bulbul (1118-1122)	*Pycnonotus jocosus* (Linnaeus, 1758)	R
26. Yellow-browed Bulbul (1143-1145)	*Iole indica* (Jerdon, 1839)	R
27. * Black Bulbul (1148-1151)	*Hypsipetes leucocephalus* (P.L.S. Muller, 1776)	R
XV. IORAS, CHLOROPSIS/LEAFBIRD, FAIRY-BLUEBIRD IRENIDAE		
28. Common Iora (1097-1101)	*Aegithina tiphia* (Linnaeus, 1758)	R
29. Gold-fronted Chloropsis (1103-1105)	*Chloropsis aurifrons* (Temminck, 1829)	R
30. Asian Fairy-Bluebird (1109, 1110)	*Irena puella* (Latham, 1790)	R
XVI. SHRIKES LANIIDAE		
31. Rufous-backed (Long-tailed) Shrike (946-948)	*Lanius schach* Linnaeus, 1758	R
XVII. THRUSHES, SHORTWINGS, ROBINS, FORKTAILS, WHEATERS TURDINAE		
32. Malabar Whistling-Thrush (1728)	*Myiophonus horsfieldii* (Vigors, 1831)	R
33. Eurasian Blackbird (1751-1757)	*Turdus merula* Linnaeus, 1758	R
34. #White-bellied Shortwing (1637-1638)	VU #*Brachypteryx major* (Jerdon, 1844)	R
35. Indian Blue Robin (Bluechat) (1650, 1651)	*Luscinia brunnea* (Hodgson, 1837)	W
36. Oriental Magpie-Robin (1661-1664)	*Copsychus saularis* (Linnaeus, 1758)	R
37. Pied Bushchat (1700-1703)	*Saxicola caprata* (Linnaeus, 1766)	R
XVIII. BABBLERS, LAUGHINGTHRUSHES, BABAXES, BARWINGS, YUHINAS - TIMALIINAE		
38. #Grey-breasted Laughingthrush (1309-1311)	NT #*Garrulax jerdoni* Blyth, 1851	R
39. * Indian Scimitar-Babbler (1172-1177)	*Pomatorhinus horsfieldii* Sykes, 1832	R
40. Black-headed (Dark-fronted) Babbler (1224-1227)	*Rhopocichla atriceps* (Jerdon, 1839	R
XIX. GOLDCREST, PRINIAS, TESIAS, WARBLERS SYLVIINAE		
41. Franklin's (Grey-breasted) Prinia (1502-1505)	*Prinia hodgsonii* Blyth, 1844	R
42. Blyth's Reed-Warbler (1556)	*Acrocephalus dumetorum* Blyth, 1849	W
43. Greenish Leaf-Warbler (1602-1605)	*Phylloscopus trochiloides* (Sundevall, 1837)	W
44. Large-billed Leaf-Warbler (1601)	*Phylloscopus magnirostris* Blyth, 1843	W
45. * Western Crowned Warbler (1606)	*Phylloscopus occipitalis* (Blyth, 1845)	W

XX. FLYCATCHERS MUSCICAPINAE		
46. Asian Brown Flycatcher (1407)	*Muscicapa dauurica* Pallas, 1811	W
47. Rusty-tailed Flycatcher (1409)	*Muscicapa ruficauda* Swainson, 1838	W
48. Brown-breasted Flycatcher (1408)	*#Muscicapa muttui* (Layard, 1854)	W
49. #Black-and-Orange Flycatcher (1427)	NT *#Ficedula nigrorufa* (Jerdon, 1839)	R
50. Verditer Flycatcher (1445)	*Eumyias thalassina* (Swainson, 1838)	W
51. #Nilgiri Flycatcher (1446)	NT *#Eumyias albicaudata* (Jerdon, 1840)	R
52. White-bellied Blue-Flycatcher (1435)	*#Cyornis pallipes* (Jerdon, 1840)	R
53. Grey-headed (Canary) Flycatcher (1448-1449)	*Culicicapa ceylonensis* (Swainson, 1820)	R
XXI. MONARCH-FLYCATCHERS & PARADISE-FLYCATCHERS MONARCHINAE		
54. Asian Paradise-Flycatcher (1460-1464)	*Terpsiphone paradisi* (Linnaeus, 1758)	W
55. Black-naped Monarch-Flycatcher (1465-1469)	*Hypothymis azurea* (Boddaert, 1783)	R
XXII. TITS PARIDAE		
56. Great Tit (1790-1797) *(Grey Tit)*	*Parus major* Linnaeus, 1758	R
57. Black-lored Yellow Tit (1809-1811) *Yellow-cheeked Tit)*	*Parus xanthogenys* Vigors, 1831	R
XXIII. NUTHATCHES, WALLCREEPER SITTIDAE		
58. Velvet-fronted Nuthatch (1838)	*Sitta frontalis* Swainson, 1820	R
XXIV. FLOWERPECKERS DICAEIDAE		
59. Thick-billed Flowerpecker (1892-1894)	*Dicaeum agile* (Tickell, 1833)	R
60. Tickell's (Pale-billed) Flowerpecker (1899-1900)	*Dicaeum erythrorhynchos* (Latham, 1790)	R
61. Plain Flowerpecker (1901-1903) *(Nilgiri Flowerpecker)*	*Dicaeum concolor* Jerdon, 1840	R
XXV. SUNBIRDS & SPIDERHUNTERS NECTARINIIDAE		
62. Small (Crimson-backed) Sunbird (1909)	*Nectarinia minima* (Sykes, 1832)	R
63. Little Spiderhunter (1931)	*Arachnothera longirostra* (Latham, 1790)	R
XXVI. WHITE-EYES ZOSTEROPIDAE		
64. Oriental White-eye (1933-1936)	*Zosterops palpebrosus* (Temminck, 1824)	R
XXVII. FINCHES FRINGILLIDAE		
65. Common Rosefinch (2010-2013)	*Carpodacus erythrinus* (Pallas, 1770)	W
XXVIII. STARLINGS & MYNAS STURNIDAE		
66. Jungle Myna (1009-1011)	*Acridotheres fuscus* (Wagler, 1827)	R
67. * Southern Hill-Myna (1016)	*Gracula indica* (Cuvier, 1829)	R
XXIX. ORIOLES ORIOLIDAE		
68. Eurasian Golden Oriole (952-95?)	*Oriolus oriolus* (Linnaeus, 1758)	R
XXX. DRONGOS DICRURIDAE		
69. Ashy Drongo (965-966b)	*Dicrurus leucophaeus* Vieillot, 1817	W

70. Greater Racket-tailed Drongo (976-981)	*Dicrurus paradiseus* (Linnaeus, 1766)	R
XXXI. CROWS, JAYS, TREEPIES, MAGPIES CORVIDAE		
71. Jungle Crow (1054-1057)	*Corvus macrorhynchos* Wagler, 1827	R

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Appendix 6 - Threatened birds of Kerala (Birdlife International, 2001)

CRITICALLY ENDANGERED (CR)

1. White-rumped Vulture *Gyps bengalensis*
2. Long-billed Vulture *Gyps indicus*

ENDANGERED (EN)

3. Rufous-breasted Laughingthrush *Garrulax cachinnans*

VULNERABLE (VU)

4. Spot-billed Pelican *Pelecanus philippensis*
5. Lesser Adjutant *Leptoptilos javanicus*
6. Greater Spotted Eagle *Aquila clanga*
7. Lesser Kestrel *Falco naumanni*
8. Wood Snipe *Gallinago nemoricola*
9. Spoon-billed Sandpiper *Eurynorhyncus pygmeus*
10. Nilgiri Wood-pigeon *Columba elphinstonii*
11. Yellow-throated Bulbul *Pycnonotus xantholaemus*
12. White-bellied Shortwing *Brachypteryx major*
13. Broad-tailed Grassbird *Schoenicola platyura*

NEAR THREATENED (NT)

14. Oriental Darter *Anhinga melanogaster*
15. Painted Stork *Mycteria leucocephala*
16. Black-headed Ibis *Threskiomis melanocephalus*
17. White-tailed Eagle *Haliaeetus albicilla*
18. Grey-headed Fish-eagle *Ichthyophaga ichthyaetus*
19. Cinereous Vulture *Aegypius monachus*
20. Pallid Harrier *Circus macrourus*
21. Great Snipe *Gallinago media*
22. Houbara Bustard *Chlamydotis undulata*
23. Beach Thick-knee *Esacus magnirostris*
24. Black-bellied Tern *Sterna acuticauda*
25. Malabar Pied-hornbill *Anthracoceros coronatus*
26. Great Hornbill *Buceros bicornis*
27. Nilgiri Pipit *Anthus nilghiriensis*
28. Grey-breasted Laughingthrush *Garrulax jerdoni*
29. Black-and-Orange Flycatcher *Ficedula nigrorufa*
30. Nilgiri Flycatcher *Eumyias albicaudata*