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ABSTRACT

The study was conducted in the Kole wetlands of Thrissur, Kerala, during November 1998 to April 2001. A total of 182 species of birds, belonging to 16 Orders and 47 Families were recorded. Among these, 24 species are new additions to the area. Of the 182 species, 44 were migratory species, and 34 waders. Passeriformes were the maximum represented species followed by Charadriiformes, Ciconiiformes and Falconiformes. There were 45 species of insectivores followed by 41 omnivores and 43 aquatic feeders. Little Egret (*Egretta garzetta)*, Cattle Egret (*Bubulcus ibis)*, Little Cormorant (*Phalacrocorax niger)*, Pond Heron (*Ardeola grayii)*, Median Egret (*Egretta intermedia)* and Whiskered Tern (*Chlidonias hybrida)* were the most abundant species in the Kole wetlands. Species richness (x = 120) and total number of birds (x= 5436) increased during the migratory period and decreased during the South-West monsoon.

Total number of birds varied from 35 to 8033 individuals in a month. Highest number of birds was observed during November and lowest in July whereas highest density was found in December (25,000 birds/ha). Little Egret was the dominant species and among the ducks, Garganey showed the highest density. Highest number of species was recorded in December and lowest in June. Species diversity index (H') ranged from 0.83 to 1.69 in the four study sites. High diversity indices of birds showed the conservation value of the wetlands. Among the four intensive study sites, highest number of birds was recorded from Kanjany. Total number of birds, monthly density and species richness declined during South-West monsoon season and increased during the migratory period (September to March). As varied microhabitats were available, both diving species and those species which rely on shallow waters, were sighted.

Whiskered Tern (*Chlidonias hybrida),* Wood Sandpiper (*Tringa glareola)*, Little Ringed Plover (*Charadrius dubius)*, and Redwattled Lapwing (*Vanellus indicus)* were the common waders. Critically endangered waders, namely Curlew (*Numenius arquata)*, Green Shank (*Tringa nebularia)* and Curlew Sandpiper (*Calidris testacea),* were also recorded. Species richness of waders varied from 7 to 23 and total number of birds varied from 2481 to 13948. Highest number of waders was recorded during November and December. Population fluctuations of seven migratory species are presented. Damage to paddy cultivation by birds and important conservation problems recorded from the area are also elucidated. Measures needed to contain the problems are discussed. The proposal to declare this wetlands as one of the Ramsar sites, if materialised, will save the migratory birds from indiscriminate poaching and the habitat also will be protected. The wetlands come under the Central Asian-Indian flyway of continental migrants and their conservation is important for the migratory birds.

1. INTRODUCTION

Wetlands are complex ecosystems with many interacting organisms. Wetlands are defined as areas of marsh, ponds, swamps, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including that of marine water the depth of which at low tide does not exceed six meters (IUCN, 1971). Wetlands are extremely important throughout the world for wildlife protection, recreation, pollution and sediment control, flood prevention and food production. Cowardin *et al*. (1979) define wetlands as 'the lands transitional between terrestrial and aquatic system where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the three attributes: 1) at least periodically, the land supports predominantly hydrophytes, 2) the substrate is predominantly undrained hydric soil and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. Although considerable amount of research on wetlands has been done in India, most of the information has come from Keoladio, Point Calimere, Chilka Lake and the Sunderbans or from specific regions such as Gujarat and Ladakh (Wolstencroft *et al*., 1989).

Wetlands in Kerala are distributed all along the coast and in the inlands. Prominent coastal wetlands in Kerala are Vellayani Kayal, Aakkulam–Veli backwater stretch, Kayamkulam Pozhi, Kumarakam, Mangalavanam, Kole wetlands, Purathur estuary, Manoorkayal, Chervarpur Kayal, Kadalundy estuary, Azhinijilam, Dharmadom estuary, Kattampalli, Ezhimala, Chempallikundu and Mangrove areas (Kurup, 1996). The important fresh water bodies are Sasthamkotta, Pookot, and Muriyad. Wetlands in Kerala are under extreme pressure due to the high population density of the State. According to Gopalan (1991), as much as two-third area of Vembanad Lake has been either reclaimed as land or converted into fields for agricultural and fishery activities. Wetlands in Kerala are mainly used for agriculture, pisciculture, reclamation for housing and industrial purposes, disposing the waste materials, discharging the industrial effluents and municipal waste water, wood seasoning, feeding waters for

ducks, dumping dredged soil, coir retting and for hunting and fishing (Balachandran *et al.,* 2002). Among the wetlands in Kerala, Kole wetland in Thrissur District occupies an important position.

Water birds are an important component of most of wetland environment, as these occupy several trophic levels in the food web of wetland nutrient cycles. Water birds are broadly defined as 'birds ecologically dependent on wetlands' and include recognized groups popularly known as wildfowl, waterfowl and shorebirds and waders. In addition to these groups, other species groups dependent on wetlands are passerines. Several wetlands in the coastal floodplains are important for the migratory waders and ducks. As the shorebirds use varied habitats like estuaries, riverbanks, paddy fields, etc. foraging and roosting sites are readily available. In the Asia-Pacific region, 243 species by virtue of their nature undertake annual migrations between the breeding areas and non-breeding grounds, along various flyways. Wetlands in Kerala come under Central Asian-Indian flyway (Anonymous, 1996). During their annual migrations, water birds halt at sites for very short periods to rest and feed and these, 'stepping stones' are essential for their survival. Trichur Kole fields are one of the regions with international importance. Conservation of migrating water birds is the collective responsibility of all countries in the flyway. Many species of wetland birds also play a role in control of agricultural pests, while some species are themselves considered pests of paddy. A wetland should be considered internationally important if,

a. it regularly supports 20,000 waterfowl or
b. it regularly forms particular number of individuals from particular groups of waterfowl, indicative of wetland species productivity or diversity or
c. it regularly supports one per cent of the individuals in a population of one species or subspecies of waterfowl.

The steady denudation of wetlands all over the world in the past culminated in holding the Ramsar Convention in 1971 and the Convention came into effect in 1975. The IUCN (1971) had originally selected 325 wetlands of international

importance under the convention and by June 1991, 527 sites were designated covering 32 M ha. Initially, two wetlands from India were designated as Ramsar sites, namely Chilka Lake and Keoladio National Park, Bharathpur. In 1990, four more sites were designated as Ramsar sites. No wetlands from Kerala have so far been included in the list of Ramsar sites. Details of wetlands in Kerala have been provided by Nayar and Nayar (1997). The behaviour of migratory ducks in the Kole region needs special mention. During daytime, these avoid paddy fields and take shelter in nearby reservoirs. At sunset, ducks return to paddy fields and feed on sown paddy.

The study was initiated in the month of November, 1998 and continued up to April, 2001 with the following objectives.

1. To determine the status and distribution of wetland birds in the Trichur Kole region,
2. To assess the seasonal fluctuation of wetland birds,
3. To find out the food and feeding habits with special emphasis on damage to the paddy cultivation, and
4. To identify and rate the conservation problems facing the wetland birds.

1.1. Study area

The Kole region is situated in the Thrissur and Malappuram Districts of Kerala State. It is located between 10^0 20' and 10^0 35'N latitude and between 76^0 11' and $76^0$66' E longitude (Fig. 1). The land is linked to the sea through drainage channels and backwaters. The total extent under paddy is 18602 ha, which is 2.35 percent of the gross rice cultivation area in the State. As the Kole wetlands are below sea level, the intrusion of salinity from the ocean is checked to enable paddy cultivation. A bund has been constructed at Enamakal with sluice gates, which are operated to drain floodwater during the South-West monsoon. Apart from this, two other structures called "Karanchira lock" and "Kotten Kottuvalvu regulator" also help in controlling the salinity of the wetlands. Majority of the farmers are small and marginal with holdings ranging from 0.2 to 0.7 ha. The farming societies are regulating the farming and

drainage activities, arrange the Government subsidies and many other services from various agencies. Government has shown considerable interest in the development of Kole wetlands, by constituting Kerala Land Development Corporation (KLDC) and Punja special office (James, 2002).

Paddy is cultivated only during the months of December to April in Karuvannur and Kecheri basins. At present, only one crop is raised during the summer season. During the rest of the year, the tract gets flooded. The name 'Kole' refers to the peculiar type of cultivation carried out from December to May and this Malayalam word indicates bumper yield of high returns, in case floods do not damage the crop (Johnkutty and Venugopal, 1993). A major portion of the wetland is flat and it remains submerged for about six months in a year, during June to November (Plates 1 and 2). These lands were formerly shallow lagoons, which gradually got silted up. Mainly two rivers, Keecheri and Karuvannur, bring flood waters into the wetland, which finally empty into the Arabian Sea. Rainfall is maximum during June followed by July and August. Most of the common alien weeds are found in the area, namely *Eichornia crassipes* and *Salvinia molesta.*

It is believed that the Vembanad-Kole land system has been formed by an uplifting of the shoreline subsequent to the advance and recession of coastal waters in the yesteryears (James *et al*., 1997). Kole land is saucer shaped low-lying tract margined by laterate hills in the western and eastern sides. The bottom of the wetland is formed by flavio-estuarine deposition. There are large quantities of fine to coarse sand deposits in the region. In some parts, black carbonaceous clay deposits containing plant parts were also recorded. The presence of deep sandy layers also shows that certain regions remained submerged in the recent geological past (Kurup and Varadachar, 1975).

Kole wetlands were under rice cultivation for the past 200 years. Large quantities of nutrients rich alluvial soils get deposited during the process of inundation making the wetland highly fertile for paddy cultivation. Human

interference into this wetland dates back to the early 18th centaury. Erstwhile Maharaja permitted to convert this wetland into paddy fields (Kerala Agricultural University, 1989).

Climate

There are two distinct seasons in the study area. The monsoon season starting from June to November and the dry summer spell from December to April. The period of South-West monsoon is from June to August and the area receives North-East monsoon showers during September to November. There is no clearly marked winter. Migratory season of the birds starts from September and ends in the middle of March (Fig. 2).

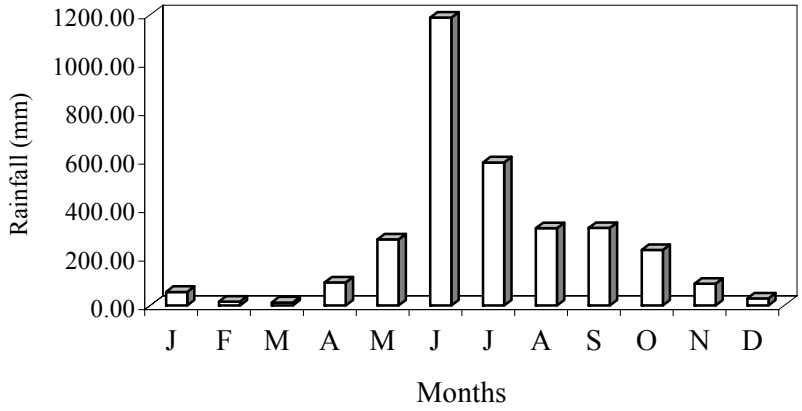

Fig. 2. Rainfall recorded in the Kole wetlands (1992 - 2000) *

* Source Irrigation Department, Govt. of Kerala

1.2. Review of Literature

Starting from the pioneering studies of Ali (1969), many workers have reported on the birds of wetlands in Kerala. Neelakantan (1980, 1990, 1991a, 1991b) and Neelakantan *et al*. (1993) reported many aspects of the wetland birds in Kerala over

a span of 40 years. Uthaman (1990a, 1990b) described the breeding of egrets and occurrence of Spotbill Duck in Kerala. In a detailed study carried out in Malabar Coast, ecology of wetland birds in the northern region of the State was elucidated by Kurup (1991c). Kurup also surveyed the birds of Purathur and Kadalundy estuaries (Kurup, 1991b) and recorded several species of birds occurring in the mangrove patches all along the Kerala cost (1996). Based on the available information, 76 species of birds are known to occur in the mangroves of Kerala. Nature Education Society, Thrissur (NEST, 1993a) published a list of birds seen in Kumarakam. Similarly, Mohandas *et al.* (1994) reported 57 species of birds occurring in the Asramam mangroves at Kollam and Jayson (1997) described the avifauna of different protected areas in Kerala. Shreekumar (2001) listed the species of birds of Vembanad Lake, Kerala after a census of one-week duration.

In addition to these, many workers recorded the presence of rare species of wetland birds in Kerala (Mathew and Shukkur, 1974). Kumar (1990) described the occurrence of Blacktailed Godwit. Namasivayam and Venugopalan (1990) and Kurup (1991a) recorded the presence of Masked Booby. In a detailed study, carried out in Malabar coast, ecology of wetland birds in the Northern region of the State was elucidated by Kurup (1991b) and Uthaman (1990a) reported the presence of many bird species in Kerala. During these period bird watchers surveyed Vembanad and Veli Lakes many times (NEST, 1993b). Srivasthava *et al.* (1995) studied the status and habitat of raptors of Periyar and also they reported on the birds of Periyar Tiger Reserve, Kerala (Srivasthava, *et al*., 1993). A detailed study on the birds of Mangalavanam spanning a year was conducted by Jayson and Easa (2000).

Studies on the birds of Kole wetlands were initiated in the early 1980s. According to Perennou (1990), out of the nine resident endangered waterfowls, four were seen in Kole wetlands. Jairaj and Kumar (1990) reported the presence of Spoonbill from the Kole wetlands. Ravindran (1992, 1993, 1995, 1999) noted the breeding of Purple Moorhen and the occurrence of the Glossy Ibis and Whitenecked Stork. Two short surveys of one-week duration each employing volunteer bird

watchers were carried out to census the birds during the migratory seasons of 1992 and 1993 (NEST, 1992, 1993a). The 1992 survey reported the occurrence of 146 species of birds and in 1993, 158 species of birds was recorded. Details of these surveys and the earlier census data were reported by Nameer (1993). Vembanad-Kole wetland system finds a place in the prioritised list of Important Birds Areas (IBA) in India (Rahmani *et al*., 2001). Apart from the above-mentioned short-term studies and recording of certain species, no detailed investigations were carried out on the structure and species composition of birds in the Thrissur Kole wetlands.

At national level, Mukherjee (1976) reported the food habits of water birds of the Sunderban, 24 Parganas District, West Bengal. Cattle egrets feeding in association with human workers were recorded by Menon (1981). Agoramoorthy and Mohnot (1986) described the migratory water birds around Jodhpur. Parasharya and Naik (1988) studied the breeding biology of the Indian Reef heron. Monthly variations in the diet of Cattle Egrets *Bubulcus ibis coromandus* in and around Chandigarh were analysed by Sodhi (1989). A study on the migration of Common Teal based on ring recoveries in India and USSR was reported by Ambedkar and Daniel (1990). Bhattacharjee (1990) described the status of waders and other water birds of Brahmaputra Valley, Assam. Conservation of water birds and wetlands in the East Asia flyway and the objectives of a flyway network were described by Mundkur (1991). Similarly water birds and substrate quality of the Pichavaram wetlands of southern India were described by Nagarajan and Thiyagesan (1996). Subaramanya (1996) studied the distribution, status and conservation of Indian heronries. Bhupathy *et al.* (1998) studied the population ecology of migratory waterfowl in Keoladio National Park, Bharathpur. Perennou (1989) elucidated the southern wintering range of some water birds.

Many authors have studied the different aspects of wetland birds in other countries. The food and feeding ecology of the Cattle Egrets was studied in South Africa by Siegfried (1971 and 1972). Similarly, Fogarty and Hetrick (1973) recorded

the summer foods of Cattle Egrets in North Central Florida. Guillet and Crowe (1985) described the patterns of distribution, species richness, endemism and guild composition of water-birds in Africa. Food habits of Cormorants were studied by Wilson and Wilson (1988). Dostine and Morton (1988) reported on the food and feeding habits of Cormorants on a tropical floodplain. Ambrose and Fazio (1989) showed the importance of conserving small wetlands in New England, New South Wales. Velasquez *et al*. (1992) surveyed the seasonal abundance, habitat selection and energy consumption of water birds at the Berg River estuary, South Africa. Engilis and Thane (1993) reported on the status and population trends of Hawaii's native water birds. Similarly, Klein *et al*. (1995) reported the effects of ecotourism on distribution of water birds in a wildlife refuge.

2. METHODS

The study was mainly based on direct observational methods (Altman, 1974). The whole area was surveyed on foot and vehicle. Birds were identified and counted with the help of telescope (15x – 45x), binoculars and standard field guides. The time of observation was from 0700 hrs to 1000 hrs. On an average 20 days were spent in the field in a month and no census was made during heavy rain.

2.1. Species composition of birds

Bird population was estimated using total count method (Hoves and Bakewell, 1989). In this method, representative blocks were identified and birds in blocks were counted using spotting scope. Birds were identified based on physical features with the help of field guides and reference books (Ali and Ripley, 1983; Grimmett *et al*., 1998). Four intensive study sites, namely Kanjany, Chettupuzha, Enamavu, and Parappur were selected depending on the diversity and population status of birds based on an initial survey and birds were censused in each month. During sampling, all birds seen were counted and the habitat in which birds were located were also recorded. Observations were also taken in other locations of the Kole wetlands such as Kanimangalam, Adat, Alapatt, Pullu, Punnayurkulam, Ponnani and Bharathapuzha estuary.

2.2. Species richness and abundance

Species richness, species composition and abundance of birds in each month in each intensive study site were calculated from the census data and field observations. The number of species recorded is considered as species richness. These indices provide easily understandable measures of diversity. Species richness as a yardstick of diversity was used in many earlier studies also. Species richness indices like Margalef Index (R1) and Menhinick Index (R2) were calculated using the formula given by Magurran (1988).

Margalef Index , $D_{mg} = (S-1) / 1n (N)$

[ln = $\log_e$]

Menhinick Index , $D_{mn} = S/(N)^{**} ½$

Where S=Number of species

and N = Total number of individuals summed over all species.

The total number of birds recorded is expressed as abundance of birds. The total number of birds recorded divided by number of counts conducted is expressed as the average number of birds and presented as abundance of birds.

2.3. Diversity of the bird community

For the assessment of species diversity in the area Shannon-Weiner Index, Simpson Index and Hill's diversity numbers N1 and N2 were calculated. Diversity and evenness indices were calculated using the programme "STATECOL"(Ludwig and Reynolds, 1988).

2.3.1. *Shannon-Weiner Index*

Shannon-Weiner Index of general diversity (H') is given as

$$H` = \frac{ni}{N} \log \frac{ni}{N}$$

$$H` = - \sum_{i=1} P_i \log P_i$$

Where ni = importance value for each species

N = total of importance values

Pi = importance probability for each species = ni

2.3.2. *Simpson's Index*

The following equation is used to calculate the Simpson's Index.

Lambda = (ni (ni-1)/(N (N-1))

where ni = the number of individuals in the i th species,

N = total number of individuals.

2.3.3. *Hill's diversity*

Hill's diversity N1 is calculated from Shannon-Weiner Index

$$N1 = eH^1$$

In addition, Hill's diversity N2 is calculated from Simpson's Index

$$N2=1/lambda$$

Diversity indices of all months and combined diversity index were also estimated.

2.3.4. *Evenness measures*

Two evenness measures namely, Shannon Evenness and Sheldon Evenness were calculated using the computer program SPDIVERS.BAS developed by Ludwig and Reynolds (1988). The following formulae were used for calculating two Evenness measures based on Shannon-Weiner Index and Simpson's Index.

i. Shannon Evenness (E1) = $\frac{H`}{\log (S)}$

where H` = Shannon-Weiner Index

S = Number of species

ii. Sheldon Evenness (E2) = $\frac{eH`}{S}$

2.4. Food and Feeding

Food and feeding behaviour was investigated using the observational method of Altman (1974). Birds were observed in the field directly to record the feeding behaviour. Four species of birds, namely Little Cormorant, Pond Heron, Black

Whiskered Tern and Open bill Stork, were observed in detail. Food items consumed by the birds were identified with the help of telescope (15x - 45x). The birds got habituated to the presence of observer while feeding within a distance of 100 m. Behavioural patterns such as time spent in sitting without motion, step rates, relative size of the prey items were estimated by comparison of prey length with various dimensions of the birds head and bill morphology (Recher and Recher, 1972). Apart from these, major food components of the birds were identified and estimated in the field. Benthic and macro fauna were collected from the Kole wetlands using different sampling methods and identified. Critical wetland habitat parameters like availability of food, depth of water and availability of different habitat niches were also monitored.

Benthic fauna: To assess the availability of polychaete worms in the mud flats, mud samples were collected from the intensive study sites and the invertebrates in the mud samples were separated and identified. The mud samples were collected from different locations every month by a Naturalist's dredge (size 32.14 cm, depth 32 cm) and the collected mud samples were sieved through a 0.5 cm sieve and the contents were filtered and preserved in 5% formaldehyde (Strin, 1981).

***Macro fauna*:** Macro fauna were collected from different locations, using quadrate method (1m x 1m). Prey items were identified to broad taxonomic categories such as crustaceans (Crabs and Prawns) and mollusks and fishes (Hafner *et al*., 1986). The collected specimens were preserved in 20 percent formaldehyde. Fishes in the Kole wetlands, a vital component of the food of the wetland birds, were collected and identified. The collected fish specimens were preserved in 10 percent formaldehyde. Amount of total fish caught from the Kole wetlands was estimated by collecting the fish landing data from the co-operative societies, which auctioned the fishes in the Kole wetlands.

***Crop damage and control measures*:** Crop damage by avifauna was studied during the months of September to January in the year 2000. Damage was estimated by direct observations. Fifty 1 m x 1 m quadrats were laid randomly at Kanjany, Enamavu, Parappur and Pullu. These plots were observed in different stages of

paddy cultivation namely sown paddy, seedlings, replanted seedlings, mature paddy, with flowers and fruiting. Number of paddy seedlings in a plot and the number of damaged seedlings in a plot due to trampling were recorded to estimate the severity of damage. Farmers employ different methods to scare away the birds destroying the crops. One of the methods was to display polythene bags of various colours on wooden stakes of about 1 m height. To evaluate the efficiency of this method 50 plots of 25 m x 25 m were selected randomly and number of birds in the plots with polythene bags and without polythene bags was recorded.

2.5. Conservation of Kole wetland birds

In order to identify the problems associated with conservation of birds and to assess the conservation awareness of the local community a structured questionnaire survey was carried out. Questionnaire survey was conducted from 4th April 2000 to 19th February 2001. Hundred and fifty-five individuals were interviewed to record the opinion of various categories of people concerned with the conservation of birds. Enamavu, Kanjany, Parappur, Pullu and Chettupuzha were visited and survey carried out. Different categories of people, namely farm workers, fishermen, farmers, shopkeepers, co-operative society managers, pump shed workers and those residing in the neighborhood were contacted for details. A sample of the questionnaire is appended (Appendix I). All the poaching incidents noticed were recorded in detail. Hunting practices prevalent in the region were also recorded. Farming practices that were detrimental to the existence of wetland and to the birds of the Kole wetlands were also recorded specifically. Apart from these, various protective measures employed by the farmers were surveyed. Rating of the threats facing the water birds was also attempted. Methods to resolve the conflicts between migratory ducks and paddy cultivators were worked out.

3. RESULTS

3.1. Species composition of birds

3.1. 1. *Occurrence of birds*

A total of 182 taxa of birds were recorded from the Kole wetlands. These belonged to 16 Orders and 47 Families. Out of these, 24 species were new records for the area and 44 species were trans-continental migrants. The maximum number of bird species was recorded from Kanjany (121) followed by Parappur (117), Enamavu (94) and Chettupuzha (71). Little Egret, Cattle Egret, Little Cormorant, Whiskered Tern, and Pond Heron were the most abundant species in the four intensive study sites. Habitat-wise classification revealed that 24.86 per cent of birds were dependent on aquatic habitats followed by waders 21.55 per cent and terrestrial birds 53.59 percent, which showed that Kole wetlands are an abode of many passerine species also. List of birds recorded from the Kole wetlands is given in Table 1. Feeding guild analysis was carried out based on the published information on food preference of birds (Ali and Ripley, 1983), which showed that maximum species were insectivores (45) followed by omnivores (41) and aquatic feeders (43) and others (Table 2). Seven species of birds were abundant in status, 99 species were common in occurrence, 62 species uncommon and 14 species were recorded only occasionally.

Table 1. List of birds recorded from the Kole wetlands

Sl. No	Common name	Scientific name	Abun-dance	Status
	Podicipidiformes			
	Podicipedidae			
1.	Little Grebe	*Tachybaptus ruficollis* (Pallas)	C	R
	Pelecaniformes			
	Pelecanidae			
2.	Spot-billed Pelican	*Pelecanus philippensis* Gmelin	O	R
	Sulidae			
3.	Masked Booby	*Sula dactylatra* Lesson	O	M
	Phalacrocoracidae			
4.	Little Cormorant	*Phalacrocorax niger* (Vieillot)	A	R
5.	Great Cormorant	*Phalacrocorax carbo* (Linnaeus)	C	LM

6.	Indian Shag	*Phalacrocorax fuscicollis* Stephens	O	LM
7.	Darter	*Anhinga melanogaster* Pennant	C	LM
	Fregatidae			
8.	Lesser Frigatebird	*Fregata ariel* (G.R. Gray)	O	S
	Ciconiiformes			
	Ardeidae			
9.	Grey Heron	*Ardea cinerea* Linnaeus	C	R
10.	Purple Heron	*Ardea purpurea* Linnaeus	C	R
11.	Little Green Heron	*Ardea striata*	O	R
12.	Pond Heron	*Ardeola grayii* (Sykes)	C	R
13.	Cattle Egret	*Bubulcus ibis* (Boddaert)	A	R
14.	Large Egret	*Casmerodius albus* (Linnaeus)	U	R
15.	Median Egret	*Mesophoyx intermedia* (Wagler)	A	R
16.	Little Egret	*Egretta garzetta* (Linnaeus)	A	R
17.	Western Reef-Egret	*Egretta gularis* (Bosc)	O	R
18.	Black-crowned Night-Heron	*Nycticorax nycticorax* (Linnaeus)	C	R
19.	Chestnut Bittern	*Ixobrychus cinnamomeus* (Gmelin)	U	R
20.	Yellow Bittern	*Ixobrychus sinensis* (Gmelin)	U	R
21.	Black Bittern	*Dupetor flavicollis* (Latham)	C	R
	Ciconiidae			
22.	Painted Stork	*Mycteria leucocephala* (Pennant)	O	LM
23.	Asian Openbill-Stork	*Anastomus oscitans* (Boddaert)	C	LM
24.	White-necked Stork	*Ciconia episcopus* (Boddaert)	U	R
25.	Oriental White Stork	*Ciconia boyciana* (Swinhoe)	U	M
26.	Black Stork	*Ciconia nigra* (Linnaeus)	U	M
	Threskiornithidae			
27.	Oriental White Ibis	*Threskiornis melanocephalus* (Latham)	C	LM
28.	Black Ibis	*Pseudibis papillosa* (Temminck)		R
29.	Eurasian Spoonbill	*Platalea leucorodia* Linnaeus	U	LM
	Anseriformes			
	Anatidae			
30.	Lesser Whistling-Duck	*Dendrocygna javanica* (Horsfield)	C	R
31.	Common Teal	*Anas crecca* Linnaeus	U	M
32.	Northern Pintail	*Anas acuta* Linnaeus	A	M

33.	Spot-billed Duck	*Anas poecilorhyncha* J.R. Forester	C	LM
34.	Gadwall	*Anas strepera* Linnaeus	C	M
35.	Gargany	*Anas querqudula* Linnaeus	C	M
36.	Northern Shoveller	*Anas clypeata* Linnaeus	C	M
37.	Ferruginous Pochard	*Aythya nyroca* (Guldenstadt)	C	M
38.	Cotton Teal	*Nettapus coromandelianus* (Gmelin)	C	LM
	Falconiformes			
	Accipitridae			
39.	Black-shouldered Kite	*Elanus caeruleus* (Desfontaines)	U	R
40.	Black Kite	*Milvus migrans* Sykes	C	R
41.	Brahminy Kite	*Haliastur indus* (Boddaert)	C	R
42.	Shikra	*Accepter badius* (Gmelin)	U	R
43.	Pallid Harrier	*Circus macrourus* (S.G. Gmelin)	U	M
44.	Pied Harrier	*Circus melanoleucos* (Pennant)	U	M
45.	Western Marsh Harrier	*Circus aeruginosus* (Linnaeus)	C	M
46.	Osprey	*Pandion haliaetus* (Linnaeus)	U	R
47.	Eurasian Sparrow Hawk	*Accipiter nisus* (Tickell)	U	M
48.	Oriental Honey-Buzzard	*Pernis ptilorhyncus* Lesson	U	LM
	Galliformes			
	Phasianidae			
49.	Grey Partridge	*Francolinus pondicerianus* (Gmelin)	U	R
50.	Red Spur Fowl	*Galloperdix spadicea* (Gmelin)	U	R
51.	Indian Peafowl	*Pavo cristatus* Linnaeus	U	R
	Gruiformes			
	Rallidae			
52.	Ruddybreasted Crake (Ruddy Crake)	*Porzana fusca* (Baker)	C	R
53.	Slaty-legged Crake	*Rallina eurizonoides* (Lafresnaye)	O	R
54.	Whitebreasted Waterhen	*Amaurornis phoenicurus* (Pennant)	C	R
55.	Water Cock	*Gallicrex cinerea*	U	M
56.	Common Moorhen	*Gallinula chloropus* (Linnaeus)	C	R
57.	Purple Moorhen	*Porphyrio porphyrio* (Linnaeus)	C	R

58.	Common Coot	*Fulica atra* Linnaeus	U	LM
	Charadriiformes			
	Jacanidae			
59.	Pheasant-tailed Jacana	*Hydrophasianus chirurgus* (Scopoli)	U	LM
60.	Bronze-winged Jacana	*Metopidius indicus* (Latham)	C	R
	Rostratulidae			
61.	Greater Painted-Snipe	*Rostratula benghalensis*	C	R
	Recurvirostridae			
62.	Black-winged Stilt	*Himantopus himantopus* (Vigors)	C	LM
63.	Pied Avocet	*Recurvirostra avosetta* Linnaeus	C	M
	Glareolidae			
64.	Small Indian Pratincole	*Glareola lactea* Temminck	C	LM
	Charadriidae			
65.	Red-wattled Lapwing	*Vanellus indicus* (Boddaert)	C	R
66.	Pacific Golden Plover	*Pluvialis fulva* (Gmelin)	U	M
67.	Lesser Sand Plover	*Charadrius mongolus* Pallas	U	M
68.	Little Ringed Plover	*Charadrius dubius* Scopoli	C	M
69.	Kentish Plover	*Charadrius alexandrinus* Linnaeus	U	LM
70.	Black-tailed Godwit	*Limosa limosa* (Linnaeus)	O	M
71.	Bar-tailed Godwit	*Limosa lapponica* (Linnaeus)	O	M
72.	Whimbrel	*Numenius phaeopus* (Linnaeus)	O	M
73.	Eurasian Curlew	*Numenius arquata* Linnaeus	C	M
74.	Common Redshank	*Tringa totanus* (Linnaeus)	C	M
75.	Marsh Sandpiper	*Tringa stagnatilis* (Bechstein)	C	M
76.	Common Greenshank	*Tringa nebularia* (Gunner)	C	M
77.	Green Sandpiper	*Tringa ochropus* Linnaeus	C	M
78.	Wood Sandpiper	*Tringa glareola* Linnaeus	C	M
79.	Terek Sandpiper	*Tringa terek* (Latham)	C	M
80.	Common Sandpiper	*Actitis hypoleucos* Linnaeus	C	M
81.	Ruddy Turnstone	*Arenaria interpres* (Linnaeus)		
82.	Great Knot	*Calidris tenuirostris* (Horsfield)	U	M
83.	Dunlin	*Calidris alpina* (Linnaeus)	U	M
84.	Curlew Sandpiper	*Calidris ferruginea* (Pontoppidan)	C	M
85.	Broad-billed Sandpiper	*Limicola falcinellus* (Pontoppidan)	C	M
86.	Common Snipe	*Gallinago gallinago* (Linnaeus)	C	M

87.	Pintail Snipe	*Gallinago stenura* (Bonaparte)	U	M
88.	Sanderling	*Calidris alba* (Pallas)	U	M
89.	Little Stint	*Calidris minuta* (Leisler)	C	M
90.	Temminck's Stint	*Calidris temminckii* (Leisler)	C	M
91.	Ruff	*Philomachus pugnax* (Linnaeus)	C	M
92.	Eurasian Woodcock	*Scolopax rusticola* Linnaeus	U	LM
	Laridae			
93.	Yellowlegged Gull	*Larus cachinnans* Pallas	C	M
94.	Brown-headed Gull	*Larus brunnicephalus* Jerdon	C	M
95.	Black-headed Gull	*Larus ridibundus* Linnaeus	C	M
96.	Whiskered Tern	*Chlidonias hybridus* (Pallas)	C	LM
97.	Caspian Tern	*Sterna caspia* Pallas	C	M
	Columbiformes			
	Columbidae			
98.	Blue Rock Pigeon	*Columba livia* Gmelin	C	R
99.	Spotted Dove	*Streptopelia chinensis* (Scopoli)	C	R
100	Eurasian Collared-Dove	*Streptopelia decaocta* (Frivaldszky)	U	R
	Psittaciformes			
	Psittacidae			
101	Roseringed Parakeet	*Psittacula krameri* (Scopoli)	U	R
102	Plum-headed Parakeet	*Psittacula cyanocephala* (Linnaeus)	U	LM
	Cuculiformes			
	Cuculidae			
103	Pied Crested Cuckoo	*Clamator jacobinus* (Boddaert)	U	LM
104	Brainfever Bird	*Hierococcyx varius* (Vahl)	U	LM
105	Indian Cuckoo	*Cuculus micropterus* Gould	C	R
106	Banded Bay Cuckoo	*Cacomantis sonneratii* (Latham)	C	LM
107	Asian Koel	*Eudynamys scolopacea* (Linnaeus)	C	R
108	Greater Coucal	*Centropus sinensis* (Stephens)	C	R
	Strigiformes			
	Tytonidae			
109	Barn Owl	*Tyto alba* (Scopoli)	C	R
	Strigidae			
110	Spotted Owlet	*Athene brama* (Temminck)	C	R
111	Mottled Wood-Owl	*Strix Ocellata* (Lesson)	U	R
	Apodiformes			
	Apodidae			

112	Alpine Swift	*Tachymarptis melba* (Linnaeus)	C	R
113	House Swift	*Apus affinis* (J.E. Gray)	C	R
114	Asian Palm Swift	*Cypsiurus balasiensis* (J.E. Gray)	C	R
	Coraciiformes			
	Alcedinidae			
115	Lesser Pied Kingfisher	*Ceryle rudis* (Linnaeus)	C	R
116	Small Blue Kingfisher	*Alcedo atthis* (Linnaeus)	C	R
117	Stork-billed Kingfisher	*Halcyon capensis* (Linnaeus)	C	R
118	Whitebreasted Kingfisher	*Halcyon smyrnensis* (Linnaeus)	C	R
119	Blackcapped Kingfisher	*Halcyon pileata* (Boddaert)	U	LM
	Meropidae			
120	Blue-tailed Bee-eater	*Merops philippinus* Linnaeus	C	LM
121	Small Bee-eater	*Merops orientalis* Latham	U	R
	Coraciidae			
122	Indian Roller	*Coracias benghalensis* (Linnaeus)	U	R
	Upupidae			
123	Common Hoopoe	*Upupa epops* Linnaeus	U	R
	Piciformes			
	Capitonidae			
124	Whitecheeked Barbet	*Megalaima viridis* (Boddaert)	C	R
	Picidae			
125	Goldenbacked Woodpecker	*Dinopium benghalense* (Linnaeus)	U	R
	Passeriformes			
	Hirundinidae			
126	Common Swallow	*Hirundo rustica* Linnaeus	C	LM
127	House Swallow	*Hirundo tahitica* Gmelin	C	R
128	Red-rumped Swallow	*Hirundo daurica* Linnaeus	C	LM
	Motacillidae			
129	Paddyfield Pipit	*Anthus rufulus* Vieillot	C	LM
130	Eurasian Tree Pipit	*Anthus trivialis* (Linnaeus)	U	M
131	Yellow Wagtail	*Motacilla flava* Linnaeus	O	LM
132	Citrine Wagtail	*Motacilla citreola* Pallas	U	M
133	Grey Wagtail	*Motacilla cinerea* Tunstall	U	M
134	Large Pied Wagtail	*Motacilla maderaspatensis* Gmelin	C	R
	Laniidae			
135	Brown Shrike	*Lanius cristatus* Linnaeus	U	M
	Oriolidae			
136	Eurasian Golden Oriole	*Oriolus oriolus* (Linnaeus)	U	LM

137	Black-headed Oriole	*Oriolus xanthornus* (Linnaeus)	U	R
	Dicruridae			
138	Black Drongo	*Dicrurus macrocercus* Vieillot	C	LM
139	Ashy Drongo	*Dicrurus leucophaeus* Vieillot	C	R
140	White-bellied Drongo	*Dicrurus caerulescens* (Linnaeus)	C	R
	Artamidae			
141	Ashy Wood Swallow	*Artamus fuscus* Vieillot	U	R
	Sturnidae			
142	Common Myna	*Acridotheres tristis* (Linnaeus)	C	R
143	Jungle Myna	*Acridotheres fuscus* (Wagler)	C	R
144	Grey-headed Starling	*Sturnus malabaricus* (Gmelin)	U	R
	Corvidae			
145	Indian Treepie	*Dendrocitta vagabunda* (Latham)	C	R
146	House Crow	*Corvus splendens* Vieillot	C	R
147	Jungle Crow	*Corvus macrorhynchos* Wagler	U	R
	Irenidae			
148	Common Iora	*Aegithina tiphia* (Linnaeus)	U	R
149	Gold-fronted Chloropsis	*Chloropsis aurifrons* (Temminck)		
150	Jerdon’s Chloropsis	*Chloropsis cochinchinensis* (Gmelin)	C	R
	Pycnonotidae			
151	Red-whiskered Bulbul	*Pycnonotus jocosus* (Linnaeus)	U	LM
152	Redvented Bulbul	*Pycnonotus cafer* (Linnaeus)	C	R
	Timaliinae			
153	White-headed Babbler	*Turdoides affinis* (Jerdon)	C	R
154	Common Babbler	*Turdoides caudatus* (Dumont)	O	R
155	Jungle Babbler	*Turdoides striatus* (Dumont)	C	R
156	Indian Rufous Babbler	*Turdoides subrufus* (Jerdon)	U	R
	Monarchinae			
157	Asian Paradise-Flycatcher	*Terpsiphone paradisi* (Linnaeus)	U	LM
	Sylviinae			
158	Streaked Fantail Warbler	*Cisticola juncidis* (Rafinesque)	C	R
159	Franklin's Prinia	*Prinia hodgsonii* Blyth	C	R
160	Plain Prinia	*Prinia inornata* Sykes	C	R
161	Ashy Prinia	*Prinia socialis* Sykes	C	R
162	Common Tailor Bird	*Orthotomus sutorius*	C	R

		(Pennant)		
163	Indian Great Reed-Warbler	*Acrocephalus stentoreus* (Hemprich & Ehrenberg)	U	R
164	Blyth's Reed Warbler	*Acrocephalus dumetorum* Blyth	U	LM
	Turdinae			
165	Oriental Magpie-Robin	*Copsychus saularis* (Linnaeus)	C	R
166	Indian Robin	*Saxicoloides fulicata* (Linnaeus)	U	R
167	Pied Bushchat	*Saxicola caprata* (Linnaeus)	U	R
168	Desert Wheatear	*Oenanthe deserti* (Temminck)	O	M
	Dicaeidae			
169	Tickell's Flowerpecker	*Dicaeum erythrorhynchos* (Latham)	C	R
170	Thick-billed Flowerpecker	*Dicaeum agile* (Tickell)	C	R
	Nectariniidae			
171	Purple-rumped Sunbird	*Nectarinia zeylonica* (Linnaeus)	C	R
172	Purple Sunbird	*Nectarinia asiatica* (Latham)	C	R
173	Loten's Sunbird	*Nectarinia lotenia* (Linnaeus)	U	R
	Ploceidae			
174	Black-breasted Weaver	*Ploceus benghalensis* (Linnaeus)	C	R
175	Baya Weaver	*Ploceus philippinus* (Linnaeus)	A	R
176	Streaked Weaver	*Ploceus manyar* (Horsfield)	C	R
	Estrildidae			
177	Red Munia	*Amandava amandava* (Linnaeus)	C	R
178	White-rumped Munia	*Lonchura striata* (Linnaeus)	U	R
179	White-throated Munia	*Lonchura malabarica* (Linnaeus)	C	R
180	Black-throated Munia	*Lonchura kelaarti* (Jerdon)	U	R
181	Spotted Munia	*Lonchura punctulata* (Linnaeus)	C	R
182	Blackheaded Munia	*Lonchura malacca* (Linnaeus)	A	R

A= Abundant, C = Common, U = Uncommon, O = Occasional,
R = Resident, M = Migrant, LM = Local Migrant

Table 2. Order and status of birds recorded from the Kole wetlands

Sl. No.	Order	Status			Feeding guild						
		R	M	Total	A	I	G	N/ F	C	F	O
1.	Podicipidiformes	01	--	01	1	--	--	--	--	--	--
2.	Pelecaniformes	02	05	07	7	--	--	--	--	--	--
3.	Ciconiiformes	15	06	21	21	--	--	--	--	--	--
4.	Anseriformes	01	08	09	9	--	--	--	--	--	--
5.	Falconiformes	05	05	10	--	--	--	--	10	--	--
6.	Galliformes	03	--	03	--	--	3	--	--	--	--
7.	Gruiformes	05	02	07	--	3	3	--	--	--	1
8.	Charadriiformes	03	36	39	--	2	--	--	--	--	37
9.	Columbiformes	03	--	03	--	--	3	--	--	--	--
10.	Psittaciformes	01	01	02	--	--	--	--	--	2	--
11.	Cuculiformes	03	03	06	--	--	--	--	--	6	--
12.	Strigiformes	03	--	03	--	--	--	--	3	--	--
13.	Apodiformes	03	--	03	--	3	--	--	--	--	--
14.	Coraciiformes	07	02	09	5	4	--	--	--	--	--
15.	Piciformes	02	--	02	--	2	--	--	--	--	--
16.	Passeriformes	43	14	57	--	36	9	5	--	2	5
	Total	**100**	**82**	**182**	**43**	**50**	**18**	**5**	**13**	**10**	**43**

A = Aquatic feeders, I = Insectivores, G = Granivores, N/F = Nectar and Frugivores, C = Carnivores, F = Frugivores, O = Omnivores, R = Resident, M = Migrant

3.1.2. *Resident birds*

Out of the 182 species recorded, 100 were resident birds. These species of birds did not perform annual migration to other regions and were recorded in all the months of the year (Plate 3). Forty-three species of resident birds were from the order Passeriformes.

3.1.3. *Migratory species*

Total number of migratory species was 82 and among these trans-continental migrants were 44 in number. Thirty-six species were local migrants performing only local movements. Migratory species like Common Sandpiper, Wood Sandpiper, Little Stint were seen in hundreds. These are arriving primarily from Europe and Central Asia. Average monthly abundance of selected waders is as follows 1. Wood Sandpiper (675); 2. Common Sandpiper (271); 3. Little Stint (1432); 4. Little Ringed Plover (650); 5. Curlew Sandpiper (509).

Among the migratory species, 33 were Waders, nine Ducks, three Gulls and two Terns. Passeriformes were highest followed by Charadriiformes, Ciconiiformes and Falconiformes. Trans-continental migratory species recorded from the wetland are given in Table 3. Migrants are classified into three categories such as abundant, common and rare based on the numbers of individuals observed. (A = Abundant (more than 1000 individuals); C = Common (more than 500 - 1000 individuals) ; R = Rare (below 500 individuals). Masked Booby and Desert Wheatear were the only two migrants in the Rare category.

Table 3. Trans-continental migratory species recorded from the Kole wetlands

Sl. No	Common name	Scientific name	Abundance
1.	Masked Booby	*Sula dactylatra*	R
2.	White Stork	*Ciconia ciconia*	C
3.	Black Stork	*Ciconia nigra*	C
4.	Common Teal	*Anas crecca*	A
5.	Northern Pintail (Pintail)	*Anas acuta*	A
6.	Gadwall	*Anas strepera*	A
7.	Bluewinged Teal (Gargany)	*Anas querqudula*	A
8.	Shoveller	*Anas clypeata*	C
9.	Ferruginous Pochard (White-Eyed Pochard)	*Aythya nyroca*	A
10.	Pallid Harrier (Pale Harrier)	*Circus macrourus*	C
11.	Pied Harrier	*Circus melanoleucos*	C

12.	Western Marsh Harrier (Marsh Harrier)	*Circus aeruginosus*	C
13.	Eurasian Sparrow Hawk (Sparrow Hawk)	*Accipiter nisus*	C
14.	Pied Avocet (Avocet)	*Recurvirostra avosetta*	A
15.	Mongolian Sand Plover (Lesser Sand Plover)	*Charadrius mongolus*	A
16.	Little Ringed Plover	*Charadrius dubius*	A
17.	Ringed Plover	*Charadrius hiaticula*	C
18.	Blacktailed Godwit	*Limosa limosa*	C
19.	Bartailed Godwit	*Limosa lapponica*	C
20.	Whimbrel	*Numenius phaeopus*	C
21.	Curlew	*Numenius arquata*	C
22.	Common Redshank	*Tringa totanus*	C
23.	Marsh Sandpiper	*Tringa stagnatilis*	A
24.	Common Greenshank	*Tringa nebularia*	A
25.	Green Sandpiper	*Tringa ochropus*	A
26.	Wood Sandpiper (Spotted Sandpiper)	*Tringa glareola*	A
27.	Terek Sandpiper	*Tringa terek*	A
28.	Common Sandpiper	*Tringa hypoleucos*	A
29.	Eastern Knot	*Calidris tenuirostris*	C
30.	Curlew Sandpiper	*Calidris testacea*	C
31.	Broadbilled Sandpiper	*Limicola falcinellus*	C
32.	Common Snipe (Fantail Snipe)	*Gallinago gallinago*	C
33.	Pintail Snipe	*Gallinago stenura*	C
34.	Sanderling	*Calidris alba*	C
35.	Little Stint	*Calidris minuta*	A
36.	Temminck's Stint	*Calidris temminckii*	A
37.	Ruff	*Philomachus pugnax*	C
38.	Yellow legged Gull (Herring Gull)	*Larus argentatus*	A
39.	Brownheaded Gull	*Larus brunnicephalus*	A
40.	Blackheaded Gull	*Larus ridibundus*	A
41.	Caspian Tern	*Hydroprogne caspia*	A
42.	Desert Wheatear	*Oenanthe deserti*	R
43.	Citrine Wagtail (Yellowheaded Wagtail)	*Motacilla citreola*	C
44.	Grey Wagtail	*Motacilla cinerea*	C

A = Abundant; C = Common; R = Rare *

* Classification of birds is based on the numbers of individuals observed.
A = Abundant (more than 1000 individuals)
C = Common (more than 500 - 1000 individuals)
R = Rare (below 500 individuals)

3.1.4. *Waders*

Waders constitute an important group of wetland birds. These depend on shallow waters, normally available from September onwards. Occurrence of waders in the four intensive study sites is presented in Table 4. Species such as Little Ringed Plover, Wood Sandpiper, Redwattled Lapwing and Whiskered Tern were recorded from all the sites in two study seasons (1998-1999 and 1999- 2000). But Eastern Knot was sighted only from Kanjany.

Table 4. Species of waders recorded from the intensive study areas in the Kole wetlands (1998-1999, 1999-2000)

No.	Species	Chettup-uzha	Kanjany	Enamavu	Parappur
1.	Pheasant-tailed Jacana	P	-	-	-
2.	Bronzewinged Jacana	P	P	P	-
3.	Small Indian Pratincole	-	P	-	-
4.	Blackwinged Stilt	-	P	-	P
5.	Pied avocet	-	P	-	-
6.	Redwattled Lapwing	P	P	P	P
7.	Little Ringed Plover	P	P	P	P
8.	Kentish Plover	-	-	-	P
9.	Black-tailed Godwit	-	P	-	-
10.	Curlew	-	P	-	-
11.	Redshank	-	P	P	-
12.	Marsh Sandpiper	-	P	-	P
13.	Green Shank	-	P	P	P
14.	Green Sandpiper	-	P	-	P
15.	Wood Sandpiper	P	P	P	P

16.	Common Sandpiper	P	P	P	P
17.	Curlew Sandpiper	-	P	-	P
18.	Broadbilled Sandpiper	-	P	-	P
19.	Eastern Knot	-	P	-	-
20.	Common Snipe	-	P	P	P
21.	Pintail Snipe	-	P	-	-
22.	Sanderling	-	-	-	P
23.	Little Stint	-	P	-	P
24.	Temminck's Stint	-	P	P	P
25.	Ruff	-	P	-	-
26.	Whiskered Tern	P	P	P	P
	Total	**7**	**23**	**10**	**16**

P= Present, - = Not recorded

3.1.5. *Rare species recorded from the Kole wetlands*

Many rare species of birds were recorded during the period of study. Spotbilled Pelican, which is a globally threatened species, and the endemic species Rufous Babbler, are two of them. Description of other species is given below.

Black Stork: Black stork was recorded at Kanjany on 4.1.2000 (Plate 4). The species was sighted feeding in the mudflats along with a flock of eight Whitenecked Stork, Little Egret and Median Egret. Painted Stork, Openbilled Stork and White Stork were also recorded during the study. The sighted Black Stork was an immature bird with dark brown head, neck and upper breast. Tip of each wing feather was pale in colour. Mantle was dull with brownish black, under parts white and beak and legs were yellowish. The species is a rare winter visitor to the Thrissur Kole wetland.

Lesser Frigate Bird: Lesser Frigate Bird was recorded from Guruvayur in June 2000. Local people noticed the bird, was brought to our attention, due to the

unfamiliarity of the species. After examining, the bird was identified as an adult female of Lesser Frigate Bird. It had black head and red eye rings, black throat and white breasts extending into a complete collar around the neck. The bird remained active for a week in Trichur zoo and after death, it was stuffed and preserved in the Zoo.

Northern Shoveller: A flock of 28 Northern Shoveller was recorded on 15.12.1999 along with a group of 1656 Garganey (Bluewinged Teal). Twenty individuals were sighted again in the same place on 21.12.1999 and after which the birds were not sighted in the locality, because the area was drained for growing paddy.

3.1.6. *Discussion*

In the previous census carried out in 1992, a total of 23,605 birds were recorded from the Kole wetlands including 50 species of water birds and four raptors (NEST, 1992). About 54,000 birds, including 48 species of wetland birds and four raptors were recorded during the subsequent census carried out in 1993 (NEST, 1993 a). Before this study was initiated, only 158 species of birds were recorded from the Kole lands of Thrissur. During this survey, 24 species of birds were supplemented as new additions to the existing list. Some land birds, which were recorded previously, were not spotted during this survey. During the study, the birds were observed 5041 times and 425847 birds were counted. Many species were migrants and they utilised the wetland from September to March. Three critically endangered waders, namely Curlew, Green shank and Curlew sandpiper, were also recorded from the region. The significance of Kole wetlands in Kerala and in the national context is obvious from Table 5.

Table 5. Comparison of number of wetland bird species found in Kole wetlands with Kerala and India

Sl. No.	Order	Family	No. of wetland bird species in India	No. of wetland bird species in Kerala	No. of wetland bird species in Kole
1.	Gaviiformes	Gavidae	2	-	-
2.	Podifipediformes	Podicipedidae	5	2	1
3.	Pelecaniformes	Pelacanidae	3	1	1
		Phalacrocoracidae	4	4	4
4.	Ciconiiformes	Ardeidae	24	15	13
		Ciconiidae	9	6	5
		Threskiornithidae	4	4	3
		Phoenicopteridae	2	1	-
5.	Anseriformes	Anatidae	45	12	9
6.	Gruiformes	Gruidae	7	-	-
		Rallidae	23	9	7
		Heliornithidae	1	-	-
7.	Charadriiformes	Jacanidae	2	2	2
		Haematopodidae	1	1	-
		Charadriidae	63	37	28
		Rostratulidae	1	1	1
		Recurvirostridae	3	2	2
		Dromadidae	1	1	-
		Burhinidae	4	2	-
		Glareolidae	6	3	1
		Laridae	35	21	5
Total			**245**	**124**	**82**

The sighting of Black Stork from Kole wetlands of Thrissur is the first record of the species from the coastal plains of Kerala (Plate 4). Ali (1969) has not reported Black Stork from Kerala, but later Kurup (1989) reported the species from Thekkady in Periyar Tiger Reserve. Other than this, previous records of the Black Stork were from Parambikulam and Walayar in Palakkad District and Chamaravattam in Malappuram District (Neelakantan *et al*., 1993). In the same way, only some sighting details of Lesser Frigate Bird were reported previously from Kerala. Ferguson (1904) recorded Lesser Frigate Bird from Trivandrum and Ali (1969) has not reported the species from Kerala during his surveys. Faizi (1985)

reported the species from Quilon based on a museum specimen. This is the first report of the species from central Kerala and from the Kole wetlands of Thrissur and may be an accidental straggler landed in the coastal zone due to the heavy South-West monsoon winds prevalent in the months of June.

Sighting of Northern Shoveller was few in Kerala. Zacharias and Gaston (1993) have reported the species from Wayanad. Ali (1969) and Neelakantan *et al.* (1993) have not reported the species from Kerala and according to Zacharias and Gaston (1993), Ali omitted the species. Sighting of this species is the second area specific report of the species from Kerala and confirms the earlier observation of Ali and Ripley (1983) that Northern Shoveller was found in small parties in association with Garganey. As the Kole wetlands are is coming under 'Central Asian – Indian flyway' protection of migratory species needs high priority. Kole wetlands are an ideal habitat for migratory and resident birds, especially for the continental migrants and the region supported 66 percent of the wetland birds species found in Kerala and 33 percent of the wetland bird species recorded in India (Table 5). This wetland also supports waders, besides the well-known wetlands such as Chilka Lake, Pulicat Lake and Great Vedaranyam swamp. During the period of study, the number of migratory ducks visiting the wetland decreased compared to the past years. Recording of 44 species of migrants (Plate 5) in the Kole wetlands shows the significance of the area as a wintering ground for migratory birds.

3.2. Species richness and abundance of birds

Species richness and abundance of birds in the Kole wetlands varied in different months. Arrival of migrant birds from September to March augmented not only the number of species but also the total number of birds.

3.2.1. *Abundance of birds*

Total number of birds varied from 35 to 8033 individuals in a month. Highest number of birds was recorded during the month of November 2000 and lowest during June 1999 (Table 6). However, when all the months are taken together, highest number of birds was observed during November and lowest in July. During South-West monsoon (June, July and August) total number of birds was comparatively less.

Table 6. Total number of birds recorded in the Kole wetlands in different months

Years	Months											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
1998	--	--	--	--	--	--	--	--	--	--	414	891
1999	690	918	378	348	150	35	72	147	355	3071	7860	5843
2000	2721	918	1403	1200	1232	265	97	294	2772	2725	8033	3934
2001	1705	5266	5072	6211	--	--	--	--	--	--	--	--
Mean	**1705**	**2367**	**2284**	**2586**	**691**	**150**	**84**	**220**	**1563**	**2898**	**5436**	**3556**

-- = no data recorded

3.2.2. *Density of birds in the Kole wetlands*

Highest number of birds was recorded from Kanjany followed by Enamavu and other study sites and lowest number of birds was recorded from Arimpur. Compared with other locales, occurrence of birds was very high at Kanjany (Fig. 3). All the sites

showed similar pattern of abundance of birds in different months. During the months of June to August number of birds was very low in all the study sites. As in the case of total number of birds, density of birds was also high during December followed by January (Fig. 4). During December and January, more than 20,000 birds per ha were observed. Lowest density was observed during August. Among the egrets, Little Egret has the highest density followed by Little Cormorant, Cattle Egret, Median Egret, Pond Heron and other birds. Density of egrets and other selected 27 species of birds recorded from the Kole wetlands is given in Table 7.

More than 35000 egrets per ha were observed in the Kole wetlands, which showed the abundance of this species in the region. Densities of bird species from the same group are given in Table 7.

Table 7. Density of egrets and other allied species in the Kole wetlands

Sl. No.	Common name	Density (Individuals per ha)
1.	Little Egret	35023
2.	Little Cormorant	28642
3.	Cattle Egret	21612
4.	Median Egret	18165
5.	Pond Heron	15124
6.	Purple Moorhen	3192
7.	Openbill Stork	2328
8.	Large Egret	1911
9.	Grey Heron	916
10.	White Ibis	902
11.	Night Heron	692
12.	Purple Heron	282
13.	Reef Heron	216
14.	Whitebreasted Waterhen	139
15.	Darter	84
16.	Whitenecked Stork	43
17.	Ruddy Crake	32
18.	Yellow Bittern	30
19.	Water Cock	15
20.	Chestnut Bittern	12
21.	Indian Moorhen	7

22.	Spotbilled Pelican	6
23.	Spoonbill	3
24.	Masked Booby	3
25.	White Stork	3
26.	Indian Shag	1
27.	Little Green Heron	1

3.2.3. *Species richness of birds*

Species richness of birds varied in different months. Maximum number of species was recorded during the month of December 1999 (97) and lowest during the month of June 1999 (15) (Table 8). Number of species increased during the migratory period and decreased during the South-West monsoon.

Table 8. Species richness of birds in the Kole wetlands of Kerala in different months

Years	Months											
	J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
1998	--	--	--	--	--	--	--	--	--	--	32	34
1999	49	46	51	40	33	15	23	25	38	71	61	97
2000	49	39	64	43	49	39	31	34	76	56	70	67
2001	55	56	64	61	--	--	--	--	--	--	--	--

-- = no data collected

3.2.4. *Population fluctuation of resident birds*

3.2.4.1. Egrets: Egrets form one of the foremost groups of the birds recorded from the Kole wetlands. Large flocks of egrets in white plumage provided a splendid appearance to the Kole wetlands. However, not all the species of egrets were represented in equal numbers. Relative abundance of different species of egrets and allied species recorded from the Kole wetlands is given in Table 9.

Table 9. Dominance and abundance of Egrets and other allied species recorded from the Kole wetlands

Sl. No.	Common name	No. of birds recorded	Domination %
1.	Little Egret	47744	27.07
2.	Little Cormorant	39045	22.14
3.	Cattle Egret	29462	16.70
4.	Median Egret	24762	14.04
5.	Pond Heron	20617	11.69
6.	Purple Moorhen	4351	2.47
7.	Openbill Stork	3174	1.79
8.	Large Egret	2605	1.48
9.	Grey Heron	1249	0.71
10.	White Ibis	1230	0.71
11.	Night Heron	943	0.54
12.	Purple Heron	384	0.22
13.	Reef Heron	294	0.17
14.	Whitebreasted Waterhen	190	0.11
15.	Darter	115	0.06
16.	Whitenecked Stork	58	0.03
17.	Ruddy Crake	43	0.02
18.	Yellow Bittern	41	0.02
19.	Water Cock	21	0.01
20.	Chestnut Bittern	16	0.009
21.	Indian Moorhen	9	0.005
22.	Spotbilled Pelican	8	0.004
23.	Spoonbill	4	0.002
24.	Masked Booby	4	0.002
25.	White Stork	4	0.002
26.	Indian Shag	2	0.001
27.	Little Green Heron	1	0.0005
Total		**176376**	**100.00**

Out of the 54 species of egrets and allied species considered, Little Egrets represented 27 per cent of the birds. This was followed by Little Cormorant (22%), Cattle Egrets (16%) and others. Among the egrets, Little Egrets was the highest (45.66%) followed by Cattle Egret, Median Egret and Large Egret (Table 10).

Table 10. Relative abundance of different species of Egrets recorded from the Kole wetlands (n=30)

Species	No. of birds	Percentage
Little egret	47744	45.66
Cattle egret	29462	28.17
Median egret	24762	23.68
Large egret	2605	2.49
Total	**104573**	**100**

The population of Little Egrets varied in different months. Highest populations of Little Egrets were observed in the month of November followed by December and October. During the months of June and July, no Little Egrets were observed (Fig. 5). Another common bird of the wetland was Little Cormorant. Population of little Cormorant also fluctuated in each month. Highest number of this species was observed in the month of October followed by November and December. During June and July the population of Little Cormorant was very low (Fig. 6). Median Egret (Fig. 7) and Cattle Egret (Fig. 8) also followed the identical pattern of abundance. Highest numbers of the Median Egret were seen in the month of November and December.

3.2.4.2. Pond Heron: In the case of Pond Heron, highest number of birds was seen in the month of December followed by November. Population of Pond Herons were also absent during the months of June and July (Fig. 9).

3.2.4.3. Ducks: Among the ducks, Garganey (60) and Pintail (26) were abundant whereas others were only few in numbers. Out of the nine ducks, Shoveller was lowest in abundance. Relative abundance of different species of ducks recorded from the Kole wetlands is given in Table 11.

Table 11. Relative abundance of different species of ducks recorded from the Kole wetlands

Sl. No.	Common name	Status	Total number	Dominance (%)
1.	Garganey	M	21513	60.72
2.	Pintail	M	9204	25.98
3.	Lesser Whistling Teal	R	2071	5.85
4.	Common Teal	M	1319	3.72
5.	Gadwall	M	473	1.33
6.	White Eyed Pochard	R	335	0.95
7.	Cotton Teal	R	263	0.74
8.	Spotbilled Duck	R	189	0.53
9.	Shoveller	M	60	0.17
	Total		**35427**	**99.99**

3.2.5. *Population fluctuation of waders*

The population estimates recorded for the 34 wader species are presented in Table 12. Whiskered Tern, Wood Sandpiper, Little Stint, Little Ringed Plover, Curlew Sandpiper, Common Sandpiper and Curlew were higher in abundance at Kanjany. Among these Whiskered Tern was maximum followed by Wood Sandpiper and Little Stint. Lowest species richness of waders was recorded from Chettupuzha and highest at Kanjany (Fig.10). Highest number of waders was documented from Kanjany followed by Parappur, Chettupuzha and Enamavu.

Table 12. Number of waders recorded in the two migratory seasons studied (1998- 1999, 1999-2000)

Sl. No	Species	Chettupuzha	Kanjany	Enamavu	Parappur	Total	Domination %
1.	Whiskered Tern	4146	47171	14339	10639	76295	60.05
2.	Wood Sandpiper	739	8060	2718	1573	13090	10.31
3.	Little Stint	0	6685	4546	1006	12237	9.63
4.	Little Ringed Plover	596	3975	417	603	5591	4.40
5.	Curlew Sandpiper	0	2197	691	338	3226	2.54
6.	Common Sandpiper	122	1154	889	590	2755	2.19
7.	Eurasian Curlew	328	1338	610	0	2276	1.79

8.	Small Indian Pratincole	0	2231	22	0	2253	1.77
9.	Ruff	0	1367	235	14	1616	1.27
10.	Marsh Sandpiper	263	900	30	34	1227	0.96
11.	Red-wattled Lapwing	123	397	174	333	1027	0.81
12.	Green Sandpiper	2	215	584	113	914	0.72
13.	Temminck's Stint	0	453	242	125	820	0.64
14.	Lesser Sand Plover	42	244	468	0	754	0.59
15.	Broad-billed Sandpiper	0	25	191	213	429	0.34
16.	Pacific Golden Plover	16	330	0	0	346	0.27
17.	Black-winged Stilt	06	291	15	29	341	0.27
18.	Caspian Tern	0	315	0	0	315	0.25
19.	Common Greenshank	28	143	22	83	276	0.22
20.	Black-tailed Godwit	154	34	36	0	224	0.18
21.	Sanderling	0	198	0	24	222	0.17
22.	Dunlin	0	0	162	0	162	0.13
23.	Pheasant-tailed Jacana	11	0	148	0	159	0.12
24.	Bronze-winged Jacana	21	1	64	0	86	0.06
25.	Kentish Plover	0	26	6	30	62	0.05
26.	Pied Avocet	0	58	0	0	58	0.05
27.	Greater Painted-Snipe	0	52	2	0	54	0.04
28.	Ruddy Turnstone	0	0	53	0	53	0.04
29.	Common Redshank	0	39	7	4	50	0.04
30.	Bar-tailed Godwit	0	32	14	0	46	0.04
31.	Common Snipe	0	26	2	6	34	0.03
32.	Pintail Snipe	0	30	0	0	30	0.02
33.	Great Knot	0	16	0	0	16	0.01
34.	Whimbrel	0	0	10	0	10	0.007
Total		**6597**	**78003**	**26697**	**15757**	**127054**	**100.00**

Most of the waders reached in early September and distributed into different parts for feeding. Among the waders Common Sandpiper, Little Ringed Plover, Little Stint, Eastern Knot preferred mudflats, whereas Blackwinged Stilt, Curlew, Red Shank and Green Shank settled in shallow waters.

3.2. 5.1.Terns: The population of terns was highest, occupying 60 per cent compared to other migratory species (Table 12). Several of these were present in the Kole wetlands even during April and May, but breeding was not confirmed. Highest number of terns was observed during the months of November (29,063) followed by December, September and October (Fig. 11).

3.2.5.2. Green Shank and Red Shank: The population of Green Shank and Red Shank was in small groups of 2 to 19 individuals at Kanjany. These birds were reported as regular migrants to the Kadalundy estuary and in Bharathapuzha River (Kurup, 1991b).

3.2.6. *Discussion*

Species richness showed high values, which is comparable to other wetlands in Kerala (Kurup, 1996; Jayson and Easa, 2000) among the species of birds recorded, 44 were migrants. Higher diversity indices even during the monsoon months showed the conservation value of the wetlands. All the egret species showed uniform pattern of population fluctuation. Presence of 34 species of waders showed the worthiness of the wetland for migratory birds. According to Kurup (1991 c), many Tern species are breeding in the main land and a few breed in the Lakshadweep Islands also. Among the waders, Wood Sandpiper was the second dominant species. Balachandran (1995) reported that the species was arriving at Gulf of Mannar Marine National Park only in small numbers. Among the four study sites, highest number of Wood Sandpiper was recorded from Kanjany. Abundance of Blacktailed Godwit, Eastern Knot and Marsh Sandpiper were high in the Kole wetlands compared to other wetlands in Kerala and other States (Hoffmann, 1983; Mahapatra and Rao, 1990; Balachandran, 1995). Vast extent of mudflats available at Kole

wetlands was the prime habitat for waders. According to Moser and Summer (1987) waders are attracted to mudflats because these support high densities of invertebrate prey.

The waders showed high species richness, abundance and diversity, which are comparable to other wetlands in Kerala (Kurup, 1995; Jayson and Easa, 2000). The region supported waders similar to the known habitats such as Chilka Lake, Pulicat Lake and Great Vedaranyam swamp. Availability of mudflats is known to contribute to the high diversity of waders (Weller, 1994). Habitat alteration, poaching, and over fishing are the factors, which threaten the existence of waders in the Kole wetlands.

Highest number of birds was recorded during November. This showed the influx of birds into the region due to the trans-continental migration. Lowest abundance of birds was during the months of June and July when migratory species were absent. Even the few resident birds moved away to avoid heavy rain. As the whole wetland lay inundated during this period availability of food was also low. Only the diving species like, Little Cormorant and Indian Darter preferred the area during the months of South-West monsoon. Among the four intensive study sites, highest number of birds was recorded from Kanjany. The geographic position of Kanjany is in the middle of the Kole wet lands. Apart from this, highest abundance of macrofauna was also recorded from Kanjany (Refer section 3.5 on food and feeding). The same pattern of population fluctuation was observed in all the four sites. The density of 23,233 birds/ha recorded in the month of December is comparable with other wetlands in India and high abundance of egrets was remarkable. Occurrence of 97 species of birds in a month is commendable, which showed the importance of the Kole wetlands for the migratory birds.

3.3. Diversity of the bird community

3.3.1. *Diversity indices*

Indices based on the proportional abundance of species are the best approach to measure diversity. Most widely used diversity indices like Shannon index of diversity, Simpson's Index of diversity and Hill's numbers N1 and N2 have been determined. Bird community indices estimated for the birds in the Kole wetlands is given in Table 13. Species richness indices R1 and R2 showed high values for the wetland birds of Kole. Shannon index of 3.11 for the whole wetland also indicates the high diversity of birds. Similar values were obtained for the Hill's numbers N1 and N2. When the study periods are taken together, more than 120 species were recorded during the month of December (Fig. 12). Highest diversity index (H') was recorded from Parappur (1.69) followed by Kanjany (1.47), Enamavu (1.38) and Chettupuzha (0.83). Diversity indices were high in the months of December and July. However, other months also showed equally elevated diversity indices. October and February registered lowest values (Fig. 13).

Table 13. Bird community diversity indices in the Kole wetlands

Species Richness index R1	Species Richness index R2	Shannon index H'	Simpson's index λ	Hill's Number N1	Hill's Number N2	Evenness index E1	Evenness index E2
13.96	0.27	3.11	8.14	22.38	12.27	0.60	0.12

3.3.2. Diversity indices of birds in the migratory period

Compared to the total diversity indices, the diversity index during the migratory seasons was low. Other diversity indices were also low during this period. Diversity indices of birds during the months of migration are given in Table 14. Among the three years, highest diversity was obtained during the second year. Species richness was also high during the second year.

Table 14. Diversity indices of birds during the three migratory seasons

Years	Species Richness R1	Species Richness R2	Shannon index H`	Simpson's λ	Hill's Number N1	Hill's Number N2	Evenness index E1	Evenness index E2
1998-1999	9.00	0.61	2.57	0.14	13.05	7.32	0.57	0.14
1999-2000	11.33	0.83	3.07	0.09	21.52	11.68	0.62	0.16
2000-2001	10.54	0.30	2.89	0.10	17.94	10.35	0.59	0.14

3.3.3. Evenness indices

Two of the evenness measures are based on Shannon diversity and Simpson diversity. This index measures the evenness of species-abundance, is complimentary to the diversity index concept, and is a measure of how the individuals are appropriated among the species. The ratio of observed diversity to maximum diversity is taken as measure of evenness (E). Two different evenness measures were calculated, namely Shannon Evenness (E1) and Sheldon Evenness (E2). Evenness indices of bird community recorded in different months are given in Table 15. Highest evenness was obtained during the months of July and June.

Table 15. Evenness indices of bird community

In Kole wetlands during different months

Months	E1	E2
January	0.65	0.21
February	0.53	0.13
March	0.63	0.18
April	0.60	0.17

May	0.64	0.24
June	0.72	0.35
July	0.80	0.49
August	0.65	0.26
September	0.57	0.14
October	0.46	0.09
November	0.55	0.13
December	0.63	0.17

3.3.4. *Discussion*

Species richness of an area is dependent on the availability of food, climate, evolutionary history and predation pressure. Diversity indices are dependent on two factors, species richness and evenness. It is directly correlated with the stability of the ecosystem and will be higher in the biologically controlled systems and will be low in polluted ecosystem. In the Kole wetlands diversity indices showed higher values. As the evenness measures also showed high values, it could be concluded that species are uniformly presented by individuals. A number of hypotheses have been forwarded to explain the reasons for the characteristic diversity profiles of different habitats. Habitat heterogeneity, in addition to the area, is an important determinant of species richness. Shannon index obtained for the area is comparable with other wetlands. Even though the total number of birds and species richness reduced during South-West monsoon, diversity indices did not show this change. Second study season also showed high diversity index values. Evenness indices indicated higher values during June and July when the abundance of the birds was lowest.

3.4. Seasonal changes of the community

Seasonal fluctuation in the abundance of a species is considered as an adaptive phenomenon evolved through ages to derive maximum advantage from the ambient environmental conditions (Koen, 1992). Seasonal changes of the bird community at Kole wetlands are presented in this chapter. The distinct seasons were monsoon and summer from June to November and December to May respectively. Occurrence of birds in each month obtained from the census data was used for the seasonality analysis. Monthly changes and seasonal changes of the community were analysed. Species of birds recorded in each month during the study period is given in Table 16.

Table 16. Distribution of birds in different months in the Kole wetlands of Thrissur

No	Common name	J	F	M	A	M	J	J	A	S	O	N	D
1.	Little Grebe	P	P	P	P	P	P	P	P	P	P	-	P
2.	Spotbilled Pelican	-	-	-	-	-	-	-	-	-	-	P	P
3.	Masked Booby	-	-	-	-	-	-	-	-	-	-	P	-
4.	Little Cormorant	P	P	P	P	P	P	P	P	P	P	P	P
5.	Large Cormorant	P	P	P	P	-	-	P	P	P	P	P	P
6.	Indian Cormorant	-	-	-	-	-	-	-	P	-	-	-	-
7.	Indian Darter	P	P	P	P	-	-	-	P	P	P	P	P
8.	Frigate bird	-	-	-	-	-	P	-	-	-	-	-	-
9.	Grey Heron	P	P	P	P	-	-	P	-	P	P	P	P
10.	Purple Heron	P	P	P	P	P	P	P	P	P	P	P	P
11.	Little Green Heron	-	-	-	-	-	-	-	-	P	-	-	-
12.	Pond Heron	P	P	P	P	P	P	P	P	P	P	P	P
13.	Cattle Egret	P	P	P	P	P	P	-	P	-	P	P	P
14.	Great Egret (Large Egret)	-	P	-	P	P	-	-	-	P	-	-	-
15.	Intermediate Egret (Smaller Egret)	P	P	P	P	P	-	-	P	P	P	P	P
16.	Little Egret	P	P	P	P	P	-	-	P	P	P	P	P
17.	Western Reef Egret (Indian Reef Heron)	P	-	P	P	-	-	-	-	-	P	P	P
18.	Blackcrowned Night Heron (Night Heron)	P	P	-	-	-	-	-	-	-	-	-	-
19.	Cinnamon Bittern (Chestnut Bittern)	-	-	P	P	P	-	-	-	P	-	-	P
20.	Yellow Bittern	P	P	P	P	P	P	-	P	P	-	P	-
21.	Black Bittern	P	P	P	P	P	P	P	P	-	P	P	-

22.	Painted Stork	P	-	-	-	-	-	-	-	-	-	-	P
23.	Asian Openbill Stork (Openbill Stork)	P	P	P	P	P	-	-	-	-	-	P	P
24.	Woollynecked Stork (Whitenecked Stork)	-	-	P	P	P	-	-	-	-	-	P	P
25.	White Stork	P	-	-	-	-	-	-	-	-	-	P	P
26.	Black Stork	P	-	-	-	-	-	-	-	-	-	-	-
27.	Blackheaded Ibis (White Ibis)	-	-	P	P	P	-	-	-	P	P	P	P
28.	Black Ibis	-	-	-	-	-	-	-	-	P	P	P	-
29.	Eurasian Spoonbill (Spoonbill)	-	-	-	-	-	-	-	-	-	-	-	P
30.	Lesser Whistling Teal	P	-	P	P	P	P	P	P	P	P	-	P
31.	Common Teal	-	-	P	-	-	-	-	-	P	P	-	P
32.	Northern Pintail	P	-	P	-	-	-	-	-	-	-	P	P
33.	Spotbilled Duck	-	P	P	P	-	-	-	-	-	-	-	P
34.	Gadwall	-	-	-	P	-	-	-	-	-	-	P	P
35.	Bluewinged Teal (Gargany)	-	P	P	P	-	-	-	-	-	-	P	-
36.	Shoveller	-	P	-	-	-	-	-	-	-	-	-	P
37.	Ferruginous Pochard (White-Eyed Pochard)	-	-	-	-	-	-	-	-	-	-	P	-
38.	Cotton Pygmy Goose (Cotton Teal)	-	-	P	P	P	P	P	P	-	P	-	-
39.	Blackwinged Kite	P	P	P	P	P	-	-	-	-	-	P	P
40.	Black Kite (Pariah Kite)	P	-	-	-	-	-	-	P	P	P	P	P
41.	Brahminy Kite	P	-	P	P	P	-	P	-	P	P	P	-
42.	Shikra	-	-	-	-	-	-	P	-	-	-	-	P
43.	Pallid Harrier (Pale Harrier)	-	P	P	-	-	-	-	-	-	P	-	-
44.	Pied Harrier	P	P	P	-	-	-	-	-	-	-	P	P
45.	Western Marsh Harrier (Marsh Harrier)	P	P	P	P	P	-	-	-	P	P	P	P
46.	Osprey	-	-	-	-	-	-	-	-	-	-	P	P
47.	Eurasian Sparrow Hawk (Sparrow Hawk)	-	-	P	-	-	-	-	-	-	-	P	-
48.	Oriental Honey Buzzard (Honey Buzzard)	-	-	P	-	P	-	-	-	-	-	-	-
49.	Grey Partridge	-	-	P	P	-	-	-	-	-	-	-	-
50.	Red Spur Fowl	P	-	-	-	-	-	-	-	P	P	-	-
51.	Common Peafowl	-	-	-	-	-	-	-	-	P	P	-	P
52.	Ruddybreasted Crake (Ruddy Crake)	P	P	P	P	P	P	-	-	-	-	-	-
53.	Banded Crake	P	P	P	-	P	-	-	-	-	-	-	-
54.	Whitebreasted Waterhen	P	P	P	P	P	P	P	-	-	P	P	P
55.	Water Cock	-	-	P	P	P	P	-	-	-	-	P	P

56.	Common Moorhen (Indian Moorhen)	-	-	P	-	-	-	P	-	-	-	-	-
57.	Purple Swamphen (Purple Moorhen)	P	P	P	P	P	P	P	P	P	P	P	P
58.	Coot	-	-	-	-	P	P	-	-	P	-	-	-
59.	Pheasant-Tailed Jacana	-	-	P	P	P	-	-	P	-	P	P	
60.	Bronzewinged Jacana	P	-	P	P	P	-	P	-	P	-	P	P
61.	Painted Snipe	P	P	-	P	P	-	-	-	-	-	-	-
62.	Blackwinged Stilt	P	P	P	P	-	-	-	-	-	P	P	P
63.	Pied Avocet	-	-	-	-	-	-	-	-	-	-	P	P
64.	Small Indian Pratincole	P	-	-	-	-	-	-	-	P	P	P	P
65.	Redwattled Lapwing	P	P	P	P	P	P	P	P	P	P	P	P
66.	Eastern Golden Plover	P	P	-	-	-	-	-	-	-	-	P	P
67.	Mongolian Sand Plover (Lesser Sand Plover)	-	-	-	-	-	-	-	-	P	P	P	P
68.	Little Ringed Plover	P	P	P	P	-	-	-	-	P	P	P	P
69.	Kentish Plover	-	-	-	-	-	-	-	-	P	P	-	-
70.	Blacktailed Godwit	-	-	-	-	-	-	-	-	P	P	P	-
71.	Bartailed Godwit	-	P	-	-	-	-	-	-	P	-	-	P
72.	Whimbrel	-	-	-	-	-	-	-	-	P	P	-	P
73.	Curlew	P	P	-	-	-	-	-	-	P	-	P	P
74.	Common Redshank	P	P	-	-	-	-	-	-	P	P	P	P
75.	Marsh Sandpiper	P	P	-	-	-	-	-	-	-	-	P	P
76.	Common Greenshank	P	P	P	P		-	-	-		P	P	P
77.	Green Sandpiper	P	P	P	P		-	-	-	P	P	P	P
78.	Wood Sandpiper	P	P	P	P	P	-	-	-	P	P	P	P
79.	Terek Sandpiper	-	-	-	-	-	-	-	-	-	-	P	P
80.	Common Sandpiper	P	P	P	P	-	-	-	P	P	P	-	-
81.	Turnstone	-	-	-	-	-	-	-	-	P	-	-	-
82.	Eastern Knot	-	-	-	-	-	-	-	-	-	P	P	-
83.	Dunlin	-	-	-	-	-	-	-	-	P	P	-	-
84.	Curlew Sandpiper	-	P	-	-	-	-	-	-	P	P	P	P
85.	Broadbilled Sandpiper	-	-	-	-	-	-	-	-	P	P	P	P
86.	Common Snipe (Fantail Snipe)	P		P	P	-	-	-	-	-	-	P	P
87.	Pintail Snipe	P	-	P	-	-	-	-	-	-	-	-	P
88.	Sanderling	-	-	-	-	-	-	-	-	-	-	-	P
89.	Little Stint	P	P	-	-	-	-	-	-	P	P	P	P
90.	Temminck's Stint	P	-	-	-	-	-	-	-	P		P	P
91.	Ruff	P	P	-	-	-	-	-	-	P	P	P	
92.	Woodcock	-	-	-	-	-	-	-	-	-	-	-	P
93.	Yellowlegged Gull (Herring Gull)	P	-	-	-	-	-	-	-	-	-	-	P
94.	Brownheaded Gull	P	-	-	-	-	-	-	-	-	-	P	P
95.	Blackheaded Gull	P	-	-	-	-	-	-	-	-	-	P	P

96.	Indian Whiskered Tern	P	P	P	P	P	P	P	P	P	P	P	P
97.	Caspian Tern	-	-	-	-	-	-	-	-	P	-	-	-
98.	Rock Pigeon (Blue Rock Pigeon)	P		P	P	-	-	-	-	P	-	-	P
99.	Indian Spotted Dove	P	P	P	P	-	-	P	-	P	P	P	P
100.	Eurasian Collared Dove (Indian Ring Dove)	-	-	-	P	-	-	-	-	-	P	-	P
101.	Roseringed Parakeet	-	P	-	P	-	-	-	-	-	-	-	P
102.	Plumheaded Parakeet (Blossom Headed Parakeet)	-	-	-	P	-	-	-	-	P	-	P	P
103.	Pied Cuckoo (Pied Crested Cuckoo)	-	-	P	P	-	-	-	P	-	-	-	-
104.	Common Hawk Cuckoo	-	-	-	-	P	-	-	-	-	P	-	-
105.	Indian Cuckoo	-	P	P	P		-	-	-	-	-	-	P
106.	Banded Bay Cuckoo (Indian Baybanded Cuckoo)	-	-	-	-	-	-	-	-	-	-	-	P
107.	Asian Koel	P	P	P	P	-	-	-	-	-	P	P	P
108.	Greater Coucal (Crow Pheasant)	P	P	P	P	P	P	P	P	-	P	P	P
109.	Barn Owl	P	P	-	-	-	-	-	-	-	-	-	-
110.	Spotted Owlet	-	-	-	-	P	-	-	-	-	-	-	P
111.	Mottled Wood Owl	P	P	-	-	-	-	-	-	-	-	-	P
112.	Indian Alpine Swift	-	-	P	-	-	-	-	-	-	-	-	-
113.	Little Swift (Indian House Swift)	-	-	-	-	-	-	-	-	-	P	P	P
114.	Palm Swift	-	-	P	-	-	-	-	P	-	-	-	-
115.	Lesser Pied Kingfisher	P	P	P	P	P	P	P	P	P	P	P	P
116.	Common Kingfisher (Small Blue Kingfisher)	P	P	P	P	P	P	P	P	P	P	P	P
117.	Browhneaded Storkbilled Kingfisher	P	P	P	P	P	P	P	P	P	P	P	P
118.	Whitethroated Kingfisher (Whitebreasted Kingfisher)	P	P	P	P	P	P	P	P	P	P	P	P
119.	Blackcapped Kingfisher	P		P	P	-	-	-	-	-	-	P	P
120.	Bluetailed Bee-Eater	P	P	P	-	P	P	-	-	-	P	P	P
121.	Little Green Bee-Eater	-	P	P	-	-	P	P	P	P	P	P	P
122.	Indian Roller	P	-	P	P	P	P	P	-	P	P	P	P
123.	Hoopoe	P	-	-	-	-	-	-	-	-	-	P	P
124.	Whitecheeked Barbet (Small Green Barbet)	-	P	-	P	P	P	P	-	P	-	-	P
125.	Blackrumped Flameback (Goldenbacked Woodpecker)	P	P	P	-	P	P	-	-	P	-	-	P
126.	Barn Common Swallow (Common Swallow)	P	P	P	-	-	-	-	-	-	-	P	P

127.	House Swallow	P	-	P	-	-	-	-	-	-	P	P	P
128.	Indian Redrumped Swallow	P	P	P	P	-	-	-	-	-	-	P	P
129.	Brown Shrike	P	P	P	-	-	-	-	-	-	-	-	-
130.	Eurasian Golden Oriole (Indian Golden Oriole)	P	P	P	P	P	P	-	-	P	-	-	P
131.	Blackhooded Oriole (Blackheaded Oriole)	P	P	P	-	-	P	-	-	P	P	P	-
132.	Black Drongo	P	P	P	P	P	P	P	P		P	P	P
133.	Ashy Drongo (Grey Drongo)	-	-	P	P	-	-	P	-	P	P	-	P
134.	Whitebellied Drongo	P	P	P	-	-	-	-	-	-	P	P	P
135.	Ashy Wood Swallow (Ashy Swallow Shrike)	P	P	P	-	P	P	P	P	P	P	-	-
136.	Common Myna	P	P	P	P	P	P	P	P	P	P	P	P
137.	Jungle Myna	P	P	P	-	P	P	P	P	P	P	P	-
138.	Grey Headed Myna	-	-	-	-	-	P	P	P	P	-	-	-
139.	Rufous Tree Pie (Tree Pie)	P	P	P	P	P	P	P	P	P	P	P	P
140.	House Crow	P	P	P	P	P	P	P	P	P	P	P	P
141.	Largebilled Crow (Jungle Crow)	P	-	P	-	-	-	-	-	-	-	-	-
142.	Common Iora	P	-	-	-	-	-	-	-	-	-	-	P
143.	Goldenfronted Chloropsis	-	-	P	-	-	-	-	-	-	-	-	-
144.	Bluewinged Leaf Bird (Goldmantled Chloropsis)	-	-	-	-	-	-	-	-	-	-	-	P
145.	Redwhiskered Bulbul	P	P	-	P	-	-	-	-	-	-	-	-
146.	Redvented Bulbul	-	P	P	P	P	P	P	P	P	P	P	-
147.	Yellowbilled Babbler (Whiteheaded Babbler)	P	P	P	P	-	P	-	-	P		P	P
148.	Common Babbler	-	-	-	-	P	P	-	-	P	P	P	P
149.	Jungle Babbler	-	P	P	P	-	-	-	-	-	-	-	-
150.	Rufous Babbler	P	-	-	P	-	-	-	-	-	-	-	P
151.	Asian Paradise Flycatcher (Paradise Flycatcher)	-	-	-	-	-	-	-	-	-	-	-	P
152.	Zitting Cisticola (Streaked Fantail Warbler)	-	P	-	-	-	-	-	P	P	-	P	-
153.	Greybreasted Prinia (Franklin's Wren Warbler)	-	-	-	P	-	-	-	-	-	-	-	-
154.	Plain Prinia (Indian Plain Wren Warbler)	-	P	P	P	-	-	-	P	P	P	-	P
155.	Ashy Prinia (Ashy Wren Warbler)	P	P	P	P	P	P	P	P	P	P	P	P
156.	Common Tailor Bird	P	P	P	P	P	-	-	P	P	P	P	P
157.	Clamorous Warbler (Great Reed Warbler)	P	P	P	P	P	P	P	-	-	-	P	P
158.	Blyth's Reed Warbler	-	-	-	-	-	-	-	-	-	-	P	-

159.	Magpie Robin	-	-	-	-	-	-	-	-	-	P	-	P
160.	Pied Bushchat	P	-	-	-	-	-	-	-	-	P	-	P
161.	Desert Wheatear	P	-	P	P	-	-	-	-	P	P	-	-
162.	Indian Robin	-	-	-	-	P	P	-	-	P	P	-	-
163.	Paddy Field Pipit	-	-	P	P	-	-	-	-	-	P	P	P
164.	Tree Pipit	-	-	-	-	-	-	-	-	-	P	P	P
165.	Yellow Wagtail	P	P	P	P	-	-	-	-	-	P	-	-
166.	Citrine Wagtail (Yellowheaded Wagtail)	P	-	-	-	-	-	-	-	-	-	P	P
167.	Grey Wagtail	P	-	-	-	-	-	-	-	-	-	P	P
168.	Large Pied Wagtail	-	-	P	P	-	-	-	P	P	-	P	P
169.	Palebilled Flowerpecker (Tickell's Flowerpecker)	-	-	-	-	-	-	-	-	P	-	P	-
170.	Thickbilled Flowerpecker	-	-	P	P	-	-	-	-	-	-	-	-
171.	Purplerumped Sunbird	-	-	P	-	-	-	-	-	P	-	-	P
172.	Purple Sunbird	P	-	-	-	-	-	-	-	P	P	-	P
173.	Longbilled Sunbird	-	-	P	-	-	-	-	-	-	-	-	-
174.	Yellowthroated Sparrow	P	-	-	-	-	-	-	-	-	-	-	-
175.	Baya Weaver (Common Weaver Bird)	P	P	P	P	P	-	-	-	P		P	P
176.	Streaked Weaver	P	P	P	P	-	-	-	-	-	-	-	P
177.	Red Avadavat (Red Munia)	P	P	-	P	-	-	-	P	P	P	P	P
178.	Whiterumped Munia (Whitebacked Munia)	-	P	P	-	-	-	-	-	P	-	-	-
179.	Whitethroated Silverbill (Whitethroated Munia)	P	P	P	-	P	-	-	-	-	-	P	P
180.	Blackthroated Munia (Rufousbellied Munia)	-	P	P	P	-	-	-	P	P	P	P	-
181.	Scalybreasted Munia (Spotted Munia)	-	P	P	P	P	P	-	-	P	-	-	-
182.	Blackheaded Munia	P	P	P	P	P	P	-	P	P	P	P	P

P = Present; - = Not recorded

The total number of birds, monthly density and species richness of birds declined during the South-west monsoon (June to August) and increased in the migratory season (September to March). With the arrival of trans-continental migrants during the month of October, all the bird community parameters increased. Total population of birds in the area fluctuated during different months. During the months of South-West monsoon, common bird species recorded from the area were the Little Cormorant and Cotton Teal, which were resident birds. However, with the approach of winter in the northern hemisphere during October, migratory species like ducks and

terns arrived in large numbers. During the paddy-harvesting season in summer Granivores like Munias, Bee-eaters, Weaverbirds and Roseringed Parakeets congregated in huge numbers.

3.4.1. *Population fluctuations of certain migratory species*

Population changes of seven migratory species namely Curlew, Curlew Sand Piper, Common Sand Piper, Whiskered Tern, Little Stint, Little Ringed Plover, and Wood Sandpiper were analysed in detail and presented here. All these species were sighted from September to March in each year.

In the case of Curlew Sandpiper highest number of birds was recorded during December and January (Fig. 14). In the 1999-2000 migratory season more than 1200 birds were sighted from the intensive study sites. Higher number of Curlews was observed during November to December (Fig. 15). More than 700 individual birds were recorded in the 2000-2001 migratory season. In the first year and the third year, presence of Common Sandpiper was very low. During the second year, highest number of Common Sandpiper was observed during the month of December (Fig. 16). Maximum number of Little Ringed Plovers was observed in the month of November during both the seasons (Fig. 17). More than 2000 Little Ringed Plover were observed during the second migratory period. Little Stint was recorded in highest numbers during the month of November in two study seasons (Fig. 18). As in the other migratory birds, Wood Sandpiper was observed during the migratory period of September to March. Highest number of birds was observed during November and December (Fig. 19). Whiskered Terns were present in thousands in the Kole wetlands. During November and December months, highest number of Whiskered Terns was recorded. Monthly mean numbers indicated an average of 7000 Whiskered Terns during November and December (Fig.20).

3.4.2. *Roosting behaviour*

Limited observations were carried out to record the roosting behaviour and locations of the birds found in the Kole wetlands. Four species of wetland birds were

found roosting in coconut groves in different part of the Kole wetlands. Pond Heron, Little Egret, Little Cormorant, and Night Heron were roosting in different localities near the Kole fields. Roosting sites of birds were recorded from Manakkodi, Puthenmedu (Enamavu Kadavu), Kanjany (Night Heron), Adat, Anthikadu and Pulampuzha Kadavu. Number of birds recorded in each month from different roosting sites is given in Table 17. Highest number of birds was seen during the months of January, February and December. Little Egret and Little Cormorant were sighted in highest numbers in the roost.

Table 17. Number of birds recorded from the roosting sites in different months

Months	Pond Heron	Little Egret	Little Cormorant	Night Heron	Total
October '99	42	--	148	--	190
November '99	44	--	151	--	195
December '99	450	5850	550	--	6850
January 2000	490	7014	540	121	8165
February 2000	394	5938	672	132	7136
March 2000	412	524	528	114	1578
April 2000	380	458	721	200	1759
May 2000	313	424	606	214	1557
June 2000	292	312	610	56	1270
July 2000	--	--	--	52	52

-- = No data available

3.4.3. *Discussion*

Depending on the season of the year the species composition of birds varied. Availability of microhabitats and various food sources were the determining factor, which controlled the seasonal changes of the bird species. Migratory species showed an

increase in population size during the months of November, December and January. Presence of around 700 Curlews in a month is worth mentioning. Protection of these roosting sites is also essential to conserve the wetland birds.

3.5. Food and feeding

One of the problems encountered by the farmers of the Kole wetlands is the damage to the paddy cultivation by different species of birds. In order to understand the impact of birds on the paddy cultivation, food and feeding behaviour of birds were studied. Aspects like food, feeding behaviour and feeding ecology of selected species of birds were studied as described in methods.

3.5.1. *Feeding behaviour*

Little Cormorant: Little cormorant was the common bird seen in the wetlands. The chief method of feeding of these species was by diving and catching the fishes from the canals. During the South-West monsoon season, when the whole region is inundated the Little Cormorants were seen everywhere diving for fishes. However, during summer when the water is restricted to the canals all the birds were concentrated near the canals. This species preferred the prey size of 12 cm (Fig. 21).

Pond Heron: Pond Heron is another common bird seen in the area. They were feeding singularly in the shallow waters and mainly fed on fishes. This species most preferred pray size was of 7 cm in length (Fig. 22).

Black Whiskered Tern: This migratory species from the lower reaches of the Himalayas were feeding in the canals in flocks. During summer, these were seen following a peculiar formation to hunt the fishes in the canals. These searched for the fishes in a pattern starting from one end of the canal to another end. Then these will come back to the starting point again and does this combing operation again. The feeding was observed until dark. After spotting a fish, the bird dived deep into the water, catching it from the water, and fed on it while in flight. Large flocks of Whiskered Terns were sighted above the canals when the water is low.

Prey size preference of selected piscivorous birds recorded from the Kole wetlands is given in Table 18. Openbill Stork preferred snails (Fig. 23). Preferred water depth of different species of water birds is given in the Table 19. The data showed that

the wetlands are being used by deep water divers like cormorants to shallow water feeders like Pond Heron and Cattle Egrets. This showed the availability of a variety of microhabitats.

Table 18. Prey size preference of piscivorous birds recorded from the Kole wetlands.

Sl. No.	Species	Size (cm)
1.	Cattle Egret	<15
2.	Little Egret	<10
3.	Median Egret	<15
4.	Pond Heron	<15
5.	Little Cormorant	<20
6.	Large Cormorant	<20
7.	Night Heron	<15

Table 19. Preferred water depth requirement of the selected water birds

Sl. no.	Species	Water depth (cm)
1.	Pond Heron	0 - 10
2.	Cattle Egret	0 - 10
3.	Little Egret	10 - 20
4.	Median Egret	10 - 30
5.	Whitebreasted Waterhen	10-30
6.	Purple Heron	< 40
7.	Indian Moorhen	10 - 50
8.	Night Heron	10 - 60
9.	Openbill Stork	10 - 50
10.	Black Stork	10 - 50
11.	Painted Stork	10 - 50
12.	Purple Moorhen	50 - 100
13.	Spotbilled pelican	50 - 100
14.	Common Teal	50 - 150
15.	Gadwall	50 - 150
16.	Garganey	50 - 150
17.	Shoveller	50 -150
18.	Coot	50 - 150
19.	Little Cormorant	100 - 250
20.	Large Cormorant	100 - 250

Blackwinged Kite: Blackwinged Kite was observed capturing a Wood Sandpiper from the paddy field on 6 January 2000. After capturing the prey the Kite landed on a nearby bund. The Wood Sandpiper was alive and the Kite tried to kill the prey. Close observation revealed the following facts. The Kite started removing the feathers from the wings and feeding on flesh and bones and it took 35 minutes for completely consuming the prey. The Wood Sandpiper was caught from a flock of birds numbering around 50.

3.5.2. *Availability of prey items*

Polychaete worms : Highest abundance of polychaete worms was found at Parappur followed by Chettupuzha, Enamavu, Anthikadu and Manaloor (Table 20). Enamavu, Chettupuzha, Parappur and Anthikadu (Kanjany) (Table 21) recorded highest occurrence of macro fauna followed by Ayyappan Kole (Kanjany).

Table 20. Abundance of Polychaete and earth worms in the mud samples collected from the intensive study sites

	Kanjany						Enamavu		Parappur		Chettupuzha	
Sl. No.	Manaloor Padavu		Anthikadu		Ayyappan Kole							
	PW	EW	PW	EW	PW	EW	PW	EW	PW	EW	PW	EW
1	4	1	1	1	1	-	3	-	3	1	3	1
2	-	-	3	-	4	-	4	-	2	2	2	2
3	-	-	2	1	5	-	8	-	1	1	1	1
4	-	-	1	1	3	-	1	-	8	-	8	-
5	2	-	-	1	1	-	2	-	9	-	9	-
6	-	-	1	-	8	-	1	-	12	1	12	1
7	3	1	1	-	9	-	3	1	3	-	3	-
8	-	-	-	-	1	-	1	2	2	-	2	-
9	2	-	-	-	-	-	0	-	4	-	4	-
10	1	-	-	-	1	1	2	-	0	-	0	-
11	-	-	1	-	2	-	1	3	1	-	1	-
12	8	-	-	-	-	-	3	-	0	-	0	-
13	-	-	1	-	-	-	0	-	2	1	2	-
14	1	-	-	-	-	-	9	-	1	-	1	1

15	2	-	1	-	1	-	12	1	8	-	8	-
16	-	-	2	-	1	-	1	-	9	-	9	-
17	1	-	1	-	-	-	2	-	12	-	12	-
18	3	-	3	-	-	-	0	-	23	-	23	-
19	4	-	2	1	2	-	1	-	14	-	14	-
20	-	-	1	-	3	-	1	-	1	-	1	-
Total	**31**	**2**	**21**	**5**	**42**	**1**	**64**	**7**	**115**	**6**	**115**	**6**

PW= Polychaete worms **EW= Earth Worms**

Macro fauna

Table 21. Abundance of macro fauna in the intensive study sites

Sl. No.	Kanjany				Chettupuzha		Enamavu		Parappur	
	Anthikadu		Ayyappan Kole							
	Snail	Crab	Snail	Crab	Snail	Crab	Snail	Crab	Snail	Crab
1	12	1	24	-	14	1	178	15	-	1
2	25	-	23	-	-	3	1	-	35	2
3	13	-	13	4	13	-	2	-	15	4
4	1	-	12	5	21	-	21	-	12	3
5	2	-	10	2	24	1	31	2	26	-
6	13	2	26	3	28	-	8	-	8	-
7	8	1	13	-	23	-	14	-	13	-
8	24	1	161	-	146	9	3	-	29	-
9	17	2	126	-	76	1	28	-	31	-
10	46	-	76	-	12	1	15	1	18	1
11	31	-	82	-	3	1	16	2	15	2
12	21	-	91	12	4	-	23	-	24	3
13	31	-	146	10	5	1	18	1	12	4
14	11	2	12	10	8	1	39	-	-	1
15	8	4	23	1	13	6	44	8	31	1
16	17	-	136	1	8	12	1	-	28	-
17	39	1	-	6	6	1	3	-	19	-
18	2	1	11	-	2	1	15	1	17	-

19	3	5	8	-	8	1	8	1	36	-
20	8	1	6	2	31	1	24	-	28	-
Total	**332**	**20**	**999**	**56**	**445**	**41**	**492**	**31**	**397**	**22**

Fishes: Thirteen species of fishes were collected from the Kole wetlands during the period. These were obtained from the fishermen and from the pump sheds where fishing was done during the time of draining water. Following fishes were collected from the Kole wetlands, namely 1) *Xenetodon cancila* 2) *Garra mullya* 3) *Chanda thomassi* 4) *Etroplus suratensis* 5) *Etroplus maculates* 6) *Chela clupoides* 7) *Macropodus cupanus* 8) *Mastacembellus guntheri* 9) *Rasbora daniconius* 10) *Hyporamphus xanthopterus* 11) *Puntius filamentosus* 12) *Mystus gulio* and 13) *Puntis pinnauratus.* Fish in each block under various cooperative societies is auctioned every year. The amount of auction varied from Rs.50,000 to Rs.1,00000/- . At the time of pumping water to the canals, large fishes were caught from the paddy fields, when the level of water is lowest. Small fishes were trapped while pumping, using filters in the exhaust pipes. By this way, even small sized fishes were caught from each block and people caught fish when the canal dried up. Black whiskered terns mostly preyed on fish in the canals. Crows fed on the dead fishes also. The practice of feeding thousands of ducks (Plate 6) brought from other places brings competition between birds and ducks for food.

3.5.3 *Damage to paddy cultivation by birds*

Birds are inflicting some damage to paddy cultivation. Main species engaged in crop damage are egrets, teals, munias, weaverbirds, Blue Rock Pigeon and parakeets. Sown paddy grains, was consumed by teals and Blue Rock Pigeon before sprouting. Ducks and Weaverbirds were destroying the sown paddy from the fields. At the time of sowing the paddy was fed by the migratory ducks coming in large flocks. During the study period, the number of migratory ducks arriving in the Kole wetlands was low compared to yesteryears, when these were coming as huge flocks resembling dark clouds. Egrets cause damage by trampling the paddy while searching for food in the paddy fields. When paddy ripens, parakeet, weaverbirds and munias cause heavy crop

depredation by feeding on the immature bunches of paddy. Little egret, Median egret and Cattle egret were feeding on grains in the ripened fields. Munias and Weaverbirds destroyed paddy during the flowering and harvest seasons.

Farmers employed firecrackers, small rockets and sound produced from different objects to scare away the ducks. Paddy was trampled by different species of egrets, while feeding on the insects and other fauna in the paddy fields. Number of paddy seedlings damaged in sample plots is given in Table 22. The analysis showed that egrets trampled 62 per cent of the paddy seedlings. When the crop is ripe, weaverbirds, parakeets, munias and pigeons came and fed on the panicles of paddy. As observed in other places Parakeets also damage the crop by cutting and taking away large bunches of paddy.

Table 22. Crop damage by egrets during different stages of paddy

Sl. No.	No. of paddy seedlings in a plot	No. of paddy seedlings damaged in a plot
1	60	18
2	45	9
3	65	9
4	45	20
5	51	29
6	60	52
7	43	35
8	52	28
9	41	30
10	54	8
11	28	15
12	32	7
13	56	14
14	64	21
15	60	42
16	65	28
17	43	18
18	52	21
19	56	32
20	72	12
21	52	44
22	55	42

23	65	57
24	28	22
25	32	20
26	60	45
27	43	32
28	52	44
29	56	42
30	72	50
31	43	34
32	41	32
33	44	24
34	60	54
35	65	44
36	45	30
37	60	43
38	43	24
39	65	54
40	54	47
41	32	30
42	43	32
43	56	45
44	43	31
45	56	32
46	76	37
47	56	33
48	45	42
49	48	46
50	52	44

3.5.4. *Preventive measures of crop damage*

Preventive measures adopted by the farmers include, scaring devices, tapes of audio and video cassettes spread on erected poles to frighten the intruding birds (Plate 9). Similarly, polythene bags were also displayed to scare away the crop raiding birds. The efficiency of polythene bags to drive away the crop depredating birds was evaluated and results are given in Table 23. Results showed that the method of employing polythene bags is not effective to threaten the birds from the paddy fields. No significant difference is observed between the plots having the polythene bags and plots not having the polythene bags ($Z=1.54$, $P=<0.01$). Apart

from the above, crackers and rockets were also used to scare away the birds. The reflected light from the tape frightened the birds and avoided such fields. One problem reported by the farmers is the habituation of birds to the scare mechanisms. Birds were accustomed with the repelling mechanisms within a short period.

Table 23. Evaluation of polythene bags as bird scares

Sl. no.	No. of polythene bags employed in a plot	No. of birds recorded in the plots with polythene bags	No. of birds recorded in the plots with out polythene bags
1	17	32	47
2	12	66	36
3	23	36	56
4	14	28	72
5	32	53	58
6	18	64	62
7	14	72	92
8	12	14	14
9	21	22	26
10	36	42	49
11	42	51	74
12	10	18	32
13	12	72	24
14	8	64	16
15	14	18	28
16	24	56	54
17	12	42	36
18	10	24	28
19	9	31	14
20	6	42	46
21	23	72	28
22	36	14	74
23	43	22	32
24	12	51	28
25	10	64	36
26	14	42	49
27	24	32	92
28	10	45	62
29	9	43	66
30	6	56	62
31	12	12	46
32	36	35	47

33	21	12	48
34	24	34	56
35	12	12	26
36	32	65	74
37	14	14	54
38	23	42	28
39	12	73	14
40	14	53	46
41	15	36	28
42	17	66	36
43	7	32	28
44	24	51	49
45	14	18	92
46	8	42	62
47	12	31	72
48	10	42	56
49	36	56	36
50	24	22	47
	Mean	**40.72**	**46.76**

3.5.5. *Discussion*

As varied microhabitats were available, both diving birds and those species, which depended on shallow waters, were sighted from the wetland. Food and feeding studies showed that sufficient prey is available in the wetlands. Small fish in the form of fry is caught from the wetlands in large quantity. This should be restricted because some of the species will grow into larger size. The availability of small fishes will boost the food resources of piscivorous birds. According to Ali and Ripley (1983), locust, grasshopper, crickets, other insects, lizards, field rats, mice, young and sickly birds are the recorded food items of Black Winged Kite. Blackwinged Kite feeding on a migratory species like Wood Sandpiper is not reported so far and it is an addition to the list of prey items of Black Winged Kite. Damage to the cultivation by birds is a menace faced by the farmers. Scaring away the birds is the best solution to resolve the crop damage problems created by the birds. More studies are needed to evaluate different scaring mechanisms and to evolve suitable measures to protect the paddy from the crop raiding birds.

3.6. Conservation problems

In the recent past, significant progress has been made in the conservation of birds of Kerala. Due to public awareness, many individuals and non-governmental organisations came forward with the appeal of conservation of migratory birds visiting the Kole wetlands. Several factors, which are threatening the conservation of the Kole wetlands and birds, have been identified during the period of study.

3.6.1. Conservation awareness of people

As described in the methods a questionnaire survey was carried out to assess the conservation problems and other related issues. Hundred and fifty-five people were contacted for collecting information.

Profile of the respondents: Majority of the people surveyed were having education above upper primary school level (66) followed by those people having above lower primary level (53) and 32 respondents above higher secondary. Only four respondents were illiterate. Among the respondents, 136 reported that birds were harming paddy cultivation, whereas 12 felt no damage due to the birds and seven people did not know anything about this problem.

Opinion of the respondents: Eighty-eight people replied that poaching was prevalent in the region whereas 64 respondents reported negatively. Majority (85) stated only medium level of poaching. Fifty-two reported low level of killing of birds and only two high and one respondent very high level poaching. Details of hunting recorded from the Kole wetlands are reported in the Table 24.

Table 24. Details of poaching reported from the Kole wetlands

Sl. No	Category of poachers	No. of respondents	Preferred species of birds	No. of respondents
1	Farmers	08	Egrets	118
2	People from out side	114	Ducks	01
3	Youngsters	02	Egrets and Little cormorant	11

4	Workers	02	Egrets and Ducks	11
5	No idea	28	Egrets, Storks and Little cormorant	01
6	Farmers and outside people	01	No idea	13

Approximate number of birds killed per day in a locality was assessed in this survey. Hundred and thirty-seven people reported that 0-20 birds were killed in their neighbourhood at a stretch whereas others (11) reported 10-25 birds were usually slaughtered and seven reported that more than 25 birds were executed per day. Other animals killed by poachers were Mongoose, Otter and Jungle Cat. Mongooses were caught using noose and Jungle Cat with shotguns. Many (138) knew about the migratory nature of birds coming to the Kole wetlands and only few (6) were ignorant of this fact. Most of the people (116) were aware about the harmful effect of poaching on migratory birds. Many people reported that the best way to stop poaching is by enforcing the laws strictly (76), whereas 57 were of the opinion that education will reduce the problem. Twenty-two people did not know anything.

Poaching of birds was primarily for food (140) and for sale (9) by professional hunters and for spending time (1). Except 3, all the interviewed were non-vegetarians, and except 5, all the contacted people consumed fish. Sea fish was the most preferred item (111) whereas few were interested in fresh water fish (14). Most of them (144) used various types of nets for fishing. Many people (103) were of the opinion that fish in the form of fingerling need not be caught, whereas some (52) supported catching the small fish also. Majority (131) were aware of the negative effect of excessive use of pesticides and only few (8) were ignorant of this. Eighty-six respondents reported that there was no change in the pattern of crop damage by birds when compared with the earlier periods. However, 57 were of the opinion that the damage is drastically reduced presently. Eleven respondents reported that there is an increase in the incidences of damage. Majority (83) have no suggestion about the reasons for change in the bird numbers, but 61 reported that there is a reduction in the number of birds coming to the Kole lands compared with the earlier years. Some people (10) were of the opinion that as the food availability of birds was reduced, crop damage incidences also reduced.

Burning of grass on the bunds was carried out by farmers in each year (132 respondents) and only few people were not attempting it (20 respondents). Everyone (111) knew that burning of grass would destroy the eggs and nests of resident birds. However, some people reported that they were not aware about this. Main reason for burning the grass was to remove the excessive growth of grass (123), but 20 people were of the opinion that burning was carried out purposefully to stop the growth of grass. Only some (35) were aware that certain species of birds are extinct, whereas 88 respondents have no idea about this fact. Forty-five were of the view that conservation of migratory birds is highly essential whereas 86 reported it as an excellent proposition. Seventeen people thought that it was not needed and seven people don't know anything about the conservation of birds. Majority of local people (141) knew that it is beneficial to conserve the birds and only 6 thought negatively. Many (61) people were of the view that manure obtained from the birds are important whereas 68 people were of the view that insect control is the main benefit derived from the birds, while others have no opinion.

3.6.2. *Rating of conservation problems*

Poaching of birds: Poaching of birds for food is the major problem faced by these wetlands as in other wetlands of Kerala. This was done using shotguns, air guns and poison and in certain cases, poaching was by professional gunmen with the cooperation of farmers. In such cases, half of the killed birds were given to the owner of the land/farmer. Group of youngsters from far away places also arrived in vehicles and killed the migratory and resident birds. Another method used by the local people to slaughter the birds was to feed the flock of egrets with small fishes stuffed with insecticide. After consuming the poison, the dead birds were gathered from the paddy fields and consumed after removing the viscera. During the period of study, 34 cases of poaching were recorded, out of which nine cases were by shooting and 25 cases were by poisoning. Poisoning was mainly to catch Pond Heron, Egrets and Night Heron.

In one typical incident of poaching, one middle aged man was observed firing shots on Little Cormorant. He killed 12 Little Cormorants and concealed them in weeds. According to him, he used to sell such birds to the local hotels for earning some extra cash. One Curlew was recovered on 19th October 2000 in injured condition with gunshots from Enamavu. The bird was treated at the College of Veterinary and Animal Sciences at Mannuthy but died on 21st October 2000.

Burning of grass: Burning of grass in the dykes is another practice, which is harmful to the bird populations. Nestlings and eggs of resident birds are destroyed due to this practice. Fire created in the bunds during the summer months affected the breeding of species like Weaverbird, Warblers and Tailorbird.

Fishing: Fishing is a common practice of the local people and usually carried out using nets of small mesh size. Catching of small fry from the wetlands is a series problem, which reduces the food availability of birds. Using small mesh sized net, the farmers catch all the small fry and process it as duck feed. This practice must be stopped and the small fish should be allowed to grow. For catching fish, only the nets with large mesh size should be allowed.

Pesticides: Heavy dose of insecticides are sprayed to protect the paddy from insect and pest attack and it was recorded that 15 commercial brands of pesticides and herbicides were used in the paddy fields. It is already known that heavy use of pesticides will cause mortality of birds.

Reclamation of wetlands: Wetlands are filled for various purposes like raising coconut gardens and for building houses. Roads are aligned through the Kole wetlands as it is considered as wasteland and paddy cultivation is not bringing high profits (Plate 7). The link road proposed from Pulikkakadavu to Thrissur if materialised will destroy the continuity of wetlands and large tracts of area will succumb to house plots and building construction. An environmental impact analysis should be conducted before constructing the road. Reclamation of land for coconut cultivation is another threat causing the shrinkage of the wetlands. Due to this

practice, wetlands are converted to dry lands, which are of no use to the water birds. In addition to this, some areas are excavated for clay and soil for making country bricks. Due to this water goes deep and is of no use to the waders, which prefer shallow waters.

Infestation of weeds: *Eichornia* was growing as a weed in the main canals of the wetlands. Due to this, the water spread of the wetlands was not available to the birds for feeding (Plate 9).

As observed in the Kole wetlands increasing development pressures affected wetlands throughout Asia. Mining activities, water pollution, inadequate protected area management, and lack of adequate Environmental Impact Assessment procedures were identified as major problems. With respect to wetlands in protected areas, highlighted issues included lack of awareness and training, lack of policy and enforcement of protection measures. Water resources were identified as a key resource in the future development of countries, and the need for policy and legislative review and amendment with respect to wetlands and water resources is required, along with the need to incorporate water resource management into sustainable development and wetland conservation policy (D'Cruz, 1997).

4. CONCLUSIONS

Kole wetlands showed high species richness, abundance and diversity of wetland birds. As Kole wetlands are serving as "Stepping stone" for the trans-continental migrants, urgent measures are needed to protect this wetland ecosystem for the conservation of transcontinental migratory birds. The wetlands can be protected only with the active participation of landowners, as the whole area is privately owned. Farmers should be made aware that conserving this wetland for paddy cultivation and for conservation of the migratory birds are for their betterment. In addition to the wetland birds, insectivorous species like Drongo, Bee-eaters and Swallows are also found in good numbers in this wetland ecosystem. The proposal to declare this wetlands, as one of the Ramsar Sites in India, if materialised, will save the migratory birds from indiscriminate poaching and the habitat also will be protected.

4.1. Action plan for conservation

4.1.1. Conservation of Habitat

Based on the study following action plan for the conservation of birds and Kole wetlands is suggested.

1. Strict protection for birds in the Kole wetlands should be enforced. For this a forest picket station should be maintained at Enamavu regulator during the bird migratory season, during September to March. A guard or forester with a motorcycle will be able to patrol the Kole wetlands from this central location.
2. Specific projects and programme for the conservation of the Kole wetland ecosystem should be initiated.
3. All the development activities, which have a bearing on the Kole wetland ecosystem should be regulated, screened, and monitored.

4. Plans and proposals of all Government Departments that concern the future of the Kole wetland ecosystem (eg. Link road from Pulikkakadavu to Thrissur) should be evaluated in a holistic way.
5. Uncontrolled fires on the bunds should be prevented.
6. Warning boards showing details of punishment for poaching of birds and other animals should be displayed.
7. Permanent nets employed in the canals for fishing should be removed for allowing unhindered flow of water.
8. Laws to stop catching the small fishes from the Kole wetlands should be strictly enforced.
9. Local NGOs, which are involved in the conservation of birds, should be encouraged and grants awarded.

4.1.2. *Research and Monitoring*

10. Annual water bird surveys should be undertaken.
11. Research on migration strategies of water birds should be carried out.
12. Suitable plans for the development of fish resources should be implemented.

4.1.3. *Education, Information and Awareness*

13. Awareness camps on the importance of migratory birds coming to the wetlands should be conducted. Farmer groups from the Kole wetlands should be given preference for attending the Nature education classes at Peechi Wildlife Sanctuary.

14. Mass awareness should be created and an Interpretation Centre at Enamavu Bund should be set up. Information on the birds visiting the area can be displayed as lists and charts with photographs. A watch tower can be built for observing the birds with telescopes. By doing this people coming to the region can watch the birds without much disturbance to the birds. Local Panchayath or District Tourism Promotion Council can do this.

15. An information bulletin should be prepared on the Kole wetlands and migratory birds coming to the locality.

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* Original not seen

7. Appendix 1

Proforma used for collecting socio- economic status
and conservation attitudes of farmers.

Questionnaire survey on conservation of birds

(Project/KFRI/303/98)

Schedule No.:

Date :

Time :

A. Identification details

1. Name of the area :

B. Profile of the respondent

2. Name of the respondent :

3. Age :

4. Sex : Male/Female

5. Religion : Hindu/Christian/Muslim/Others

6. Caste : SC/BC/OBC/Others

7. Education : LPS/UPS/HSC or VHS/Illiterate

8. Occupation : Cultivation/Farm labour/Motor shed Worker/Fisherman/Shop keeper/ Society people/Neighbours

C. Crop damage

1. Do you face any problem by the birds to the cultivation?

a. Yes b. No c. Don't know

If yes, give details

Birds	Type of damage	Season
Teals		
Egrets		
Munias		
Weaver birds		
Parakeet		
Pigeon		
Others		

2. How much is the approximate damage?

a. Don't know b. 5 % c. 10 % d. 15 % e. 20 % f. Negligible

3. What are the preventive measures used against the crop damage?

Preventives measures	Bird species

4. While comparing with the past how is the present situation of crop damage by birds?

a. No change b. Reduced c. Increased d. Others

5. If there is a change, what is the possible reason?

6. What Government can do to solve this problem?

D. Poaching

7. Is there any poaching on the birds in your area?

a. Yes b. No c. Don't know

8. How you asses the current situation of poaching

a. Not applicable b. Very high c. High d. Medium d. Low e. Don't know

9. What are the methods used for poaching?

a. Not applicable b. Air gun c. Furadan d. Shot gun e Nets

10. Who is engaged in poaching?

a. Farmers b. People from outside area c. Youngsters d. Workers e. Don't know

11. What are the preferred species for poaching?

a. Egrets b. Ducks c. Storks d. Waders e. Little cormorant f. Don,t know

12. Approximate number of birds killed per day.

13. What are the other species of animals poached?

a. Mongoose b. Otter c. Snakes d. Others

14. Do you know that, this area is having birds coming from other countries?

a. Yes b. No c. Don't know

15. Do you know that the poaching will affect the migratory birds?

a. Yes b. No c. Don't know

16. How can be poaching prevented ?

a. By law b. By education c. Don't know

17. Do you know that poaching is punishable with 6 months imprisonment?

a. Yes b. No c. Don't know

18. What is the objective of poaching?

a. Time pass b. food c. To reduce the crop damage d. Professional hunters

e. Don't know

19. How many people are engaged in poaching in your area?

20. Are you a vegetarian or Non vegetarian?

21. What are the pets kept in your house?

a. Yes b. No c. Don't know

22. If yes, what are the bird species?

E. Fishing

23. Do your family members consume fish?

a. Yes b. No c. Don't know

24. If yes, what type of fish you prefer?

a. Sea fish from market b. Fresh water fish

25. What are the methods used for fishing?

a. Net b. Fish poison c. Trap d. Others

26. What is your opinion about catching small fry?

a. Essential b. Not needed

27. Do you know that the heavy dosage of pesticides will destroy the bird fauna?

a. Yes b. No c. Don't know

F. Fire

28. Is burning done every year?

a. Yes b. No c. Don't know

29. Are you aware that the burning will destroy the bird nests and eggs?

a. Yes b. No c. Don't know

30. What is the reason for burning?

a. Clearing the grass for way b. For reducing birds c. Others

31. Do you know that the migratory birds coming from other countries stay 3 to 4 months in Thrissur Kole wetland?

a. Yes b. No c. Don’t know

32. Are you aware that some of the bird species are extinct?

a. Yes b. No c. Don’t know

33. What is your opinion about conserving the birds in this wetland?

a. Highly essential b. Good c. Not needed d. Don’t know

34. Is there any benefit derived from birds?

a. Yes b. No c. Don’t know

35. If yes, what is the use?

a. Manure b. Insect control c. Others

Appendix 2

Abundance of each species sighted at Kole wetlands

Sl. No.	Common Name	Total Number
01.	Indian Whiskered Tern	85089
02.	Little Egret	47744
03.	Little Cormorant	39045
04.	Cattle Egret	29462
05.	Baya Weaverbird	26190
06.	Median Egret	24762
07.	Garganey	21513
08.	Pond Heron	20617
09.	Wood Sandpiper	13215
10.	Little Stint	12261
11.	Pintail	9204
12.	Blackheaded Munia	8299
13.	Blackheaded Gull	6889
14.	Little Ringed Plover	6406
15.	Brownheaded Gull	4602
16.	Spotted Munia	4458
17.	Purple Moorhen	4351
18.	Curlew Sandpiper	3312
19.	Openbill Stork	3174
20.	Common Sandpiper	3056
21.	Large Cormorant	2706
22.	Larger Egret	2605
23.	Indian Redrumped Swallow	2357
24.	Curlew	2344
25.	Small Indian Pratincole	2253
26.	Ruff	2103
27.	White Throated Munia	2098
28.	Lesser Whistling Teal	2071
29.	Common Swallow	2062
30.	Little Grebe	1884
31.	Lesser Sand Plover	1464
32.	Common Teal	1319
33.	Marsh Sandpiper	1275
34.	House Swallow	1258
35.	Grey Heron	1249
36.	White Ibis	1230
37.	Redwattled Lapwing	1141
38.	Streaked Weaverbird	1103
39.	Ashy Wren Warbler	1084
40.	Whitebreasted Kingfisher	969
41.	Night Heron	943
42.	Green Sandpiper	935
43.	Temminck's Stint	820
44.	Common Myna	746
45.	Red Spurfowl	746
46.	Black Drongo	731
47.	Red Munia	731
48.	Rufous Bellied Munia	724
49.	Black Winged Stilt	653
50.	Green Shank	612
51.	Coot	560
52.	Gadwall	473
53.	Bluetailed Bee-eater	453
54.	Broadbilled Sandpiper	441
55.	Small Blue Kingfisher	388
56.	Purple Heron	384
57.	Golden Plover	346
58.	Spotbilled Duck	335
59.	Pheasant Tailed Jacana	334
60.	Jungle Myna	322
61.	Caspian Tern	315
62.	Reef Heron	294
63.	Pied Kingfisher	272
64.	Cotton Teal	263
65.	Black Tailed Godwit	238
66.	Sanderling	222
67.	Dunlin	216
68.	Palm Swift	214
69.	Whitebreasted Waterhen	190
70.	Marsh Harrier	189
71.	Storkbilled Kingfisher	174
72.	Indian Alpine Swift	158
73.	Ashy Swallow Shrike	150
74.	Indian Spotted Dove	145
75.	Whitebellied Drongo	141
76.	Paddy Field Pipit	138
77.	Whiteheaded Babbler	136
78.	Tailor Bird	129
79.	Honey Buzzard	126

80.	Bronzewinged Jacana	121
81.	Pariah Kite	120
82.	Tree Pie	119
83.	Darter	115
84.	Plain Wren Warbler	110
85.	Common Babbler	110
86.	Small Green Bee-eater	101
87.	House Swift	101
88.	Blue Rock Pigeon	99
89.	Redvented Bulbul	85
90.	White Eyed Pochard	82
91.	Spotted Owlet	81
92.	Great Reed Warbler	78
93.	Avocet	70
94.	House Crow	69
95.	Grey Headed Myna	68
96.	Shoveller	60
97.	Bartailed Godwit	60
98.	Whitenecked Stork	58
99.	Kentish Plover	56
100.	Painted Snipe	54
101.	Yellow Wagtail	52
102.	Redshank	50
103.	Crow Pheasant	47
104.	Brahminy Kite	46
105.	Herring Gull	45
106.	Ruddy Crake	43
107.	Yellow Bittern	41
108.	Pintail Snipe	41
109.	Turnstone	41
110.	Indian Roller	38
111.	Glossy Ibis	38
112.	Black Bittern	36
113.	Whimbrel	34
114.	Fantail Snipe	34
115.	Barn Owl	28
116.	Blackwinged Kite	26
117.	Blackheaded Oriole	25
118.	Eastern Knot	24
119.	Blackcapped Kingfisher	23
120.	Indian Golden Oriole	23
121.	Terek Sandpiper	22
122.	Water Cock	21
123.	Purplerumped Sunbird	21
124.	Streaked Fantail Warbler	19
125.	Small Green Barbet	18
126.	Large Pied Wagtail	17
127.	Chestnut Bittern	16
128.	Indian Cuckoo	16
129.	Redwhiskered Bulbul	16
130.	Purple Sunbird	16
131.	Goldenbacked Woodpecker	15
132.	Jungle Crow	15
133.	Ashy Drongo	15
134.	Desert Wheatear	14
135.	Blossom Headed Parakeet	13
136.	Sparrow Hawk	12
137.	Rufous Babbler	12
138.	Brown Shrike	12
139.	Common Iora	10
140.	Indian Robin	10
141.	Tree Pipit	10
142.	Indian Moorhen	9
143.	Pied Bush chat	9
144.	Spotbilled Pelican	8
145.	Pied Harrier	8
146.	Franklin's Ashy Grey Wren Warbler	8
147.	Whitebacked Munia	8
148.	Pea Fowl	8
149.	Pale Harrier	7
150.	Osprey	6
151.	Banded Crake	6
152.	Roseringed Parakeet	6
153.	Magpie Robin	6
154.	Ringed Dove	6
155.	Paradise Flycatcher	6
156.	Asian Koel	6
157.	Yellow headed Wagtail	6
158.	Painted Stork	5
159.	Hoopoe	5
160.	Masked Booby	4
161.	White Stork	4
162.	Spoonbill	4
163.	Shikra	4
164.	Common Hawk Cuckoo	4
165.	Large Cuckoo Shrike	4
166.	Jerdon Chloropsis	4
167.	Blyth's Reed Warbler	4
168.	Grey Partridge	4

169.	Wood Cock	4
170.	Goldmantled Chloropsis	4
171.	Pied Crested Cuckoo	3
172.	Tickell's Flowerpecker	3
173.	Yellow Throated Sparrow	3
174.	Indian Shag	2
175.	Thickbilled Flowerpecker	2
176.	Loten's Sunbird	2
177.	Mottled Wood Owl	2
178.	Indian Baybanded Cuckoo	2
179.	Little Green Heron	1
180.	Lesser Frigate Bird	1
181.	Black Stork	1