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Study on Eco-ornithological characteristics of Pelicans along with diversity components and community based management of Bird species at Kokkare bellur, Karnataka, India

H. G. Ravishankar[a]*, Govindharajalu Madhuramozhi[a] & G. Panduranga Murthy[b]
[a]PG and Research Department of Zoology, ADM College for Women, Bharathidasan University, Tamil Nadu, India
[b]Hamsa Research Foundation, Tumakuru, Karnataka, India

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Abstract- The elements responsible for the diversity of Pelican (*Pelecanus philippensis*) a migratory bird species along with altitudinal inclinations are deliberated to be as very important conditions of ornithological aspects in their ecological and biogeographical research. In the study, the data has been congregated on diversity of birds with an emphasis on Pelican at Kokkare bellur, Karnataka and also analyzed Community based Management of Pelicans along with diversity components. The study area, Kokkare bellur Bird Sanctuary is situated in Mandya District of Karnataka provides an important ground for a diverse range of birds. The study was specifically focused on Pelican and the associated bird species concomitant with the different altitudinal inclines in the total habitat structure followed by adjacent agricultural land area in the diversity components of Kokkare bellur. The baseline survey was carried out from October, 2017 to May, 2020 to document the diversity of Pelicans and a number of associated bird's species. Altogether 140 species of Birds belonging to 15 families were recorded from the study area. Among recorded species Ardeidae dominated the list with eight species followed by Motacillidae and Rallidae with four species, Scolopacidae, Anatidae, Alcedinidae and Hirundinidae with two species each, Ciconiidae, Phalacrocoracidae, Anhingidae, Laridae, Recurvirostridae, Podicipedidae, Accipitridae and Apodidae with one species each were recorded. Out of 140 species 74 were Resident, 31 Migratory and 24 were Resident migratory. Species diversity and abundance of birds were observed more during December to March of each year. The composition of birds in major feeding guilds in the study area showed that the insectivore guild was the most common with 35.09% species, followed by carnivore (23.82%), omnivore (14.30%), herbivore (11.53%) and piscivore (9.5%). The discovery of other species after the painted stork and pelican, among a wide variety of birds, highlights the importance of Kokkare bellur Sanctuary as an important area for bird habitat in Karnataka. However, anthropogenic activities are major threats to the ecology of this landscape. Besides, some groups of people are involved in community management and taking some applicable measures for avoiding the mortality of these birds from the stumbling blocks of diversity area.

Key words: Kokkare bellur, Eco-ornithological aspects, Pelicans, Diversity components, Community Management

INTRODUCTION

A contemporary geological history, diverse climate types and physical and idiosyncratic topographic features are most responsible for the occurrence of varied biological resources in the diversified regions. The fauna and flora of the country are scattered from the highest elevated peaks/areas to the lowest and hottest places of the biodiversity regions. Birds are some of the most prominent

*Corresponding author :
Phone: +91 9845717461
E-mail: ravishankar.hg@rediffmail.com

species of the earth's biodiversity and are sensitive to environmental changes. Birds as a group serve as excellent indicators for assessment The effects of urbanization on biodiversity because they are distinct in both natural and urban settings are of interest to people and indicate the quality and availability of different types of housing. In addition, birds are important for maintaining the balance of many ecosystems by providing various ecological services. The diversity of birds in different land-use types and their feeding circles in different parts of India were investigated to elucidate the effects of disturbance and habitat modification. Birds fulfill many ecological functions in their habitats. For instance, they are bio-indicators of healthy ecosystems.[1,2] Birds have been studied extensively to test the diversity patterns at the global level.[3-5] Individual species respond differently to the habitat characteristics and analyzing impacts on species richness alone may obscure more nuanced community responses.[6,7]

One such characteristic area called Kokkare bellur is focused in the present study where data on bird diversity and population followed by diversity components are still not known. The vegetation coverage and habitat structure in this area have been declining due to the development of unusual interferences and livestock populations, expansion of agriculture, settlement, and pollution in the surrounding towns. The natural habitat losses due to anthropogenic factors are likely to strictly affect the avifauna and other wild animals living in and around the Kokkare bellur regions. However, the degree of damage on the avifauna is not known. Therefore, an attempt has been made to identify relative abundance, species composition, ecoornithological features of Pelicans along with diversity components distribution of bird species in the study area.

'*Kokkare bellur'* (KB), is usually shortened by the colloquial usage and is a prominent village in Maddur taluk of Mandya district of Karnataka, India. The village is named after the Painted Stork (*Ibis leucocephalus*) called "Kokkare" in Kannada language. It is duly recognized as bird sanctuary (12°13'N, 77°0'E) and situated near Maddur between the cities of Mysore and Bangalore. Apart from Painted Storks the Spot billed Pelicans, are also found here. Both are classified as "near threatened category" in IUCN Red List of 2009. The village is one of the renowned breeding sites existing in India.

The village is located 800 metres (2,600 ft) to the west of the Shimsha River and the area is in the vicinity of the village offers large water bodies in the form of several large tanks such as the Tailur Kere ('Kere' means "tank"), the Maddur Kere and the Sule Kere that sustain food needs (particularly, fishes and shell fishes) of the pelicans and other birds. The village setting at Kokkare bellur has nesting trees in the form of *Ficus* (*F religiosa*, *F bengalensis*) and Tamarind (*Tamarindus indica*) trees respectively. The Mandya district, where the village is located, has extensive agricultural fields with sugarcane as a major crop. During the season of migration of birds, large colonies of Spot-billed Pelicans and Painted Storks are seen nesting followed by breeding mostly in tamarind trees.[8]

Nobody quite knows why the storks and pelicans, both exclusively fish eaters; persist in breeding at Kokkare bellur, which is several kilometers from any substantial bodies, what is certain is that both species have been coming here to breed for many generations- according to village legend, for hundreds of years. Hence, the name of the bellur village area has been substantiated as Stork village, in kannada language it is Kokkare (Stork) bellur, means stork. A British naturalist has written in The Birds of India, recorded the village more than a century ago, and a commemorative stone in the village appears to refer to the settlement's existence several centuries back.[9]

The uniqueness in 'Kokkare bellur' is the long established bonding between the Spot-billed Pelicans and the villagers who have adopted this bird as their heritage, since they consider the birds as harbingers of good luck and prosperity to the village. The benefits derived by the villagers from these birds are basically in the form of phosphorus and potassium rich manure obtained from the bird droppings (also known as Guano). Further, over the years, the popularity of this uniqueness has also attracted tourists to the village to watch birds. The intensive study on flora and fauna of Salim Ali Bird sanctuary was started in 1996. Subsequently, Sugathan and Aby (1996) reported 270 species of birds from the sanctuary and at present, the sanctuary supports 327 species of birds with its unique diversity components.

On account of review of previous research reports, the above avifaunal studies impress upon the need for the inventory of avifaunal diversity of other such habitats especially in terms of conservation and management aspects.

Kokkare bellur village area was found to be very important study area which has been declared as substantial Pelican diversity area of Asia among the other Sanctuaries coming under Asian Wetland Bureau and IUCN (1988). The village area has also been declared as a Pelican sanctuary by Tourism division of Karnataka Government. This area is explicitly known as 'Stork village'. By taking into consideration of Birds: Pelicans, storks and other species with an out-line of Managerial issues and comprehensive listings of the different bird species (available during the course of base-line survey), the study has been undertaken.

The objectives of the study are as follows:

- To conduct base line survey for documentation of Bird species at Kokkare bellur, Mandya district of Karnataka, India.
- To establish Data base on available Bird species during the course of study and survey.
- To analyze & interpretation on Diversity, Density of documented Bird species
- To admit behavioural study of Pelican Bird species with special reference to Migration, Probing, and its density in the diversity area etc.
- To assess the community participation for formulating explicit strategies towards effective management and recommendations for the betterment of the diversity with conservation aspects.

MATERIALS & METHODS

Description of Study Area

The study area ia a part of characteristic region for which a system of protected areas is being designed, and is in itself part of the beta diversity of the Pelicans and Stork of the diversity area called Kokkare belluru, Madduru taluk, Mandya district, Karnataka, India (Fig.1).

Kokkare bellur village is bounded on the south side by the Shimsha River although it is some distance away. Within a 100 km radius of the village lie numerous irrigation tanks principally *SuleKere, MalavalliKere, KoppeKere, Marehalli Kere, Shetty Kere, and Karanji Kere respectively* which are important feeding grounds for the birds nesting at Kokkare bellur. The avian diversity in an area is not static but changes seasonally. The vegetation increases the species richness of birds and shows that season can profoundly affect such indicators. During the winter season, birds are supposed to be less detected due to lower activity and presences (migratory species).The trees shed their leaves during winter and begin to grow again and flower in spring. The ecological definition of spring relates to biological indicators such as the blossoming of a range of plant species, the activities of birds. Many flowering plants bloom at this time of each year. So spring is the typical breeding season for most bird species. Thus we can predict that birds are supposed to be more detected during the breeding (spring) season than the winter season.

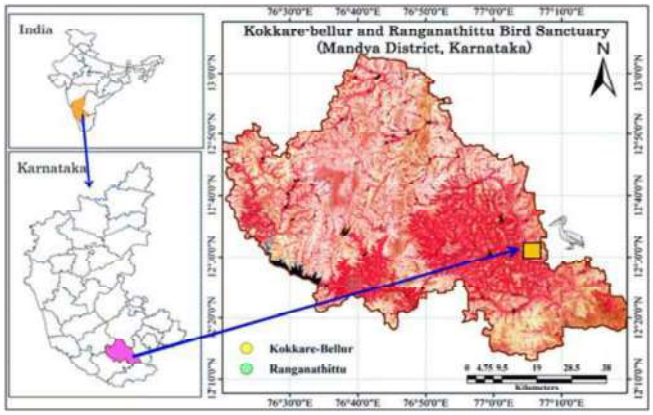


Fig. 1- Geographical location of Study area: Kokkare bellur, Karnataka, India

Data Collection

The data on bird's diversity at Kokkare bellur was collected for a period of two consecutive years (2017 to 2019) with a regular survey. The different sites were carefully chosen based on the heterogeneity of the habitat and its integration as principal components of the Pelican biosphere reserve. The study was categorized into promising segments, like, Shimsha river basin, Lakes and Wetland connected with agricultural lands for the purpose of this research study**.** The premeditated transect route was walked throughout the study sites characterized by less forest including all field boundaries within the sites. The line transects was used to collect data on bird species diversity, distribution and abundance in the study areas.[10]

Further, an analytical technique called 'Point count' was efficiently employed from a fixed location within a fixed time interval (~ 5 to 10 minutes) to identify and enumerate the birds in the early morning from 07:00-10:00 AM and 04:00-06:00PM in the late afternoon flora total of five hours in a day following in each fragment.[11] In this method, a suitable vantage point was selected and all visible birds were counted.

Then, the percentage of the coverage was marked and block counts were applied to count the birds. Each site was divided into many sections and each section was counted. To minimize disturbance during enumeration, a waiting period of 3 to 5 minutes prior to counting was applied following.[10-12] Direct observation (A7Alpha-IV Camera with 7008x4672 field glasses) was made on the type of habitat and local conservation status for each species following.[10,13] Birds were identified based on physical features with the help of colored field guides and reference books.[14] Birds observed and heard within 50 m radius were recorded from a fixed point in a center.[15] Additional information was obtained from interview of organized questionnaires to local people with the help of one field assistant conversant with the local language acting as a translator. The baseline survey Questionnaire survey was accomplished from 18thFeb-21stMar, 2018-19.

The magnitude of key villagers included in the ornithological perception study was also determined by their day to day involvement in the Pelican reserve. In view of that, a group of Pelican association (locally called, Hejjarle Balaga) in the village living adjacent to Pelican reserve were also encompassed. A total of 40 local people, each representing a different household were interviewed during base line survey. The well-organized Questionnaires are particularly suitable tools for approaching studies of local knowledge, attitude and practice of ecological processes and conservation of avian diversity.[10,16] The current village registers of the study site formed the sampling pool and households were randomly selected. The household heads or other permanently resident adults (≥18 years) were targeted as the respondents and took part in the interviews in each respondent's residence. The local villagers living adjacent to the Pelican reserve were asked about the perceived socio-economic damage caused by birds, extent of endemic and migratory bird poaching, threatening factor of avian habitat and their overall ecology. One elderly person called Lingegowda (named as Pelican man) and Manu (a dynamic creature for nature conservation) were interacted exclusively to gather first-hand information regarding community participation in Pelican conservation and management during the survey at Pelican reserve. Likewise, the link between avian conservation and the people with traditional indigenous cultural implication were surveyed. In addition, the Socio-economic survey for the assessment of anthropogenic pressure & creation of conservation awareness on birds at Kokkare bellur, Karnataka was also executed (Appendix-1).

Data Analysis

The collected data from the base line survey were at first entered in excelling datasheet and then Shannon–Wiener diversity indices were calculated. After the assemblage all result data, all the information statistics were entered into SPSS software package of new version for analysis. Subsequently, the data were analyzed using descriptive Statistics, Chi-square test and one-way ANOVA. Chi-square analyses were used to determine the relationship between site and the number of bird species recorded at each point count. T-tests were used to compare the mean bird species diversity of the selected five sites from the biosphere reserve. P-values of less than 0.05 were considered to be statistically significant. The diversity was also measured by species number and Shannon index (H) were used.[17] This was in a hypothesis that, all species are represented in a sample and they are randomly sampled. This takes into account evenness as well as number of species.

It was estimated as $H = -\Sigma (Pi * \ln (Pi))$ where Pi = is a proportion of the total number of birds belonging to species I and summation is over all species.

Equitability (Evenness) index is calculated using the formula:

$E = H / \ln(S) = H / Hmax$

Where, E = Shannon-Wiener Evenness Index
H = Shannon-Wiener Diversity Index
S = total number of species in the sample
ln = natural logarithm

The species observed for 25% more of the study periods were considered as residential species and only those birds were considered for analysis.[18,19] The bird species observed once in one of the sites were considered as coincidental visitors and excluded from the analysis.The relationships between the avian richness and environmental variables were established as per the above mentioned standard equational approach.

Baseline Survey & Density assessment

The study is based on both by self-sighting the birds with special reference to diversity, density and breeding behavior using high resolution binoculars and with the help of published lists of 'Bird Sanctuary' authorities. The field observations were systematically carried-out during winter season (October to March) of the years 2017 and 2021 (Fig.2, Bird Calendar). Base-line survey was

conducted periodically by walking on the fixed routes through entire study area. The birds and their behavior were mostly observed during the most active period of the day *i.e.,* from 6: 30 am- 10:30 am and from 5: 30 pm to 7: 30pm.

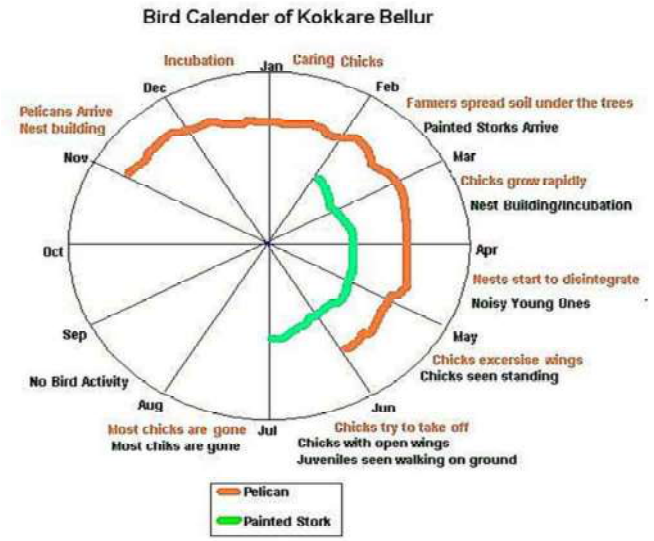


Fig. 2- Base-line survey was conducted according to the above calendar

The conservation status of the bird species was assessed according to the Wildlife Protection Act, 1972, CITES (2002) and IUCN (2010)[26]. Data on threat factors were collected by direct observation and personal interviews with local people.

Field methods

Field data were obtained using the "point counts" method, which is a count from a fixed location, for a fixed time period. (Fig. 3). This method is suitable for studying highly visible, and/or vocal bird species, in a wide variety of habitats. However, observations were also made during other timings according to the convenience. Field characteristics and the number of birds and their young-ones were counted and the same were entered in the data sheets. The identification of birds was done using field guide manuals/books and only those species with confirmed identity are reported in the respective reports.[20,21] The checklist was systematically prepared using standardized common & scientific names of the birds of Indian sub-continent by following the procedure given by Manakand & Pittie (2001)[22].

In addition, opportunistic records were also collected during other time periods of the day. Birds seen were recorded along with habitat type, season and frequency of sightings of a particular species. Photographs were taken whenever possible. Identification of birds was done using field guides.[21,23]

Residential status of the birds as resident, winter visitor and summer visitor has been assigned strictly with reference to the study area on the basis of presence or absence method. The status of the recorded bird species was established on the basis of frequency of sightings following Kumar & Gupta (2009)[24]. Feeding guilds were classified on the basis of direct observations and available literature.[21] The status of the birds is categorized as Very Common (VC), Common (C), Rare (R), Uncommon (Uc), Resident (r), Breeding (B), Vagrant (V), Wintering (W) and the threatened status is also taken according to the IUCN (2008)[25].

Fig. 3- Pelican at Nesting spot & cluster approach

RESULTS & DISCUSSION

The present report is based on the observation made from 2017 to 2019 with a regular visit in every month. The structure of birds communities recorded at Kokkare bellur (KB) was varied. The diversity of colonial birds at different Avian Sites is recorded and the changed species of data were comparatively analyzed. The comparative analysis was made on different species of the colonial birds recorded in nesting at some of the sites (Table 1). The relative abundance of bird's species in an area usually related to the availability of main life requirements (food, water and shelter) as well as suitable weather conditions.

Comparative abundance of Resident bird species

The data on resident wild bird species numbers were presented in Table 2 at Pelican Reserve, Kokkare Belur (PRKB). Thus, the different species were recorded at PRKB, in a descending order: House sparrow, Hooded crow, Rock dove, Palm dove, Little egret and Cattle egret.

Their numbers were the highest as follows:1766, 695, 339, 411, 649, and 536 individuals, respectively. Their relative abundances were 0.217, 0.121, 0.131,0.101, 0.122 and 0.091, respectively. The lowest number of birds was eight individuals with relative abundance of 0.001, for black-winged kite. The Black-crowned night heron number was found to be lowest with 11 individuals and relative abundance of 0.012 was recorded.[27,28]

Hence, full protection to the existing habitats should be given with special attention during the migratory period. This study also presents that, the characteristic habitats and pools support a great diversity of birds in village inhabitation and semi-urban area adjacent to the river Shimsha with inclined vegetative structure.[29,30]

Table 1.Different species of colonial birds recorded nesting at some of the sites- a comparative analysis

SL. No.	Species	Different Avian Sites				
		DZ[a]	Bhav[b]	SNP[c]	KDGNP[d]	KKB[e]
1.	Darter	(–)	–	–	+	–
2.	Little Cormorant	+	+	-	+	+
3.	Indian Cormorant	+	-	+	+	-
4.	Great Cormorant	(–)	-	-	+	-
5.	Little Egret	+	-	-	+	+
6.	Western Reef Heron	(–)	+	(–)	(–)	(–)
7.	Great Egret	(–)	+	-	+	+
8.	Intermediate Egret	+	-	-	+	+
9.	Cattle Egret	+	+	+	+	+
10.	Indian Pond Heron	+	+	(+)	(+)	+
11.	Black-crowned Night Heron	+	+	+	+	+
12.	Black-headed Ibis	+	+	+	+	+
13.	Eurasian Spoonbill	(–)	+	–	+	–
14.	Dalmatian Pelican	(–)	–	–	–	–
15.	Spot-billed Pelican	(–)	–	–	–	+
16.	Painted Stork	+	+	+	+	+
17.	Asian Open bill	(–)	+	+	+	+

+ recorded, (+) presumed to be present though not mentioned in the reference cited, (“) known to be absent from the site, – denotes that presence/absence data was not available in the source cited.
[a]DZ (Delhi Zoo), Urfi (1997); [b]Bhav (Gardens in Bhavnagar city), Parasharya and Naik (1990)
[c]SNP (Sultanpur National Park), Urfi *et al.* (2007); [d]KDGNP (Keoladeo Ghana National Park), Ali and Vijayan (1983)
[e]KKB (Kokkarebellur), Manu and Jolly (2000)

Comparative abundance of Migratory bird species

The data was validated the numbers and relative abundance of migratory wild bird species in Pelican Reserve, KB. In the PRKB, the resulting species were recorded in a descending order: White wagtail, Blue-cheeked bee-eater, Lesser white-throat, Blue-throat, and Kingfisher. Their numbers were the highest as follows: 201, 102, 81, 64, and 46 individuals, respectively. Their relative abundances were 0.360,0.164, 0.113, 0.079, and 0.065, respectively. The lowest number of birds was six individuals with relative abundance of 0.013, for chiffchaff (Table 2).

Table 2. Comparative abundance of Resident and Migratory bird species

SL. No.	Type of Bird species (Number in sample)	Present in numbers	Relative abundance (Pi)
Resident bird species			
1	House sparrow	1766	0.217
2	Hooded crow	695	0.121
3	Rock dove	339	0.131
4	Palm dove	411	0.101
5	Little egret	649	0.122
6	Cattle (Large) egret	536	0.091
Migratory bird species			
1	Painted Stork	906	0.668
2	White wagtail	201	0.360
3	Blue-cheeked bee-eater	102	0.164
4	Lesser white-throat	81	0.113
5	Blue-throat	64	0.079
6	Kingfisher	46	0.069

Avian diversity in the Pelican Reserve, KB

A list of birds recorded from Kokkare bellur and their common names, residence status, feeding habit and threatened is reported in Table 1. The study reveals 140 species of birds belonging to 15 families (Table 3 and Graph 1).

Among the fifteen families, Ardeidae dominated the list with eight species followed by Motacillidae and Rallidae with four species, Scolopacidae, Anatidae, Alcedinidae and Hirundinidae with two species each, Ciconiidae, Phalacrocoracidae, Anhingidae, Laridae, Recurvirostridae, Podicipedidae, Accipitridae and Apodidae with one species each were recorded (Graph-1). Out of 140 species 74 were Resident, 31 Migratory and 24 were Resident migratory. Species diversity and abundance of birds were observed more during December to March (Graph-2).

Painted stork a globally Near Threatened species is a resident with local movements.[25] Presence of 1,600 painted storks in this region highlights the importance of this area. Similarly, 1,400 Pelicans resident bird with local movements were also spotted during the course of study.[25] These two bird species were observed to be regular visitors of Kokkare bellur during December to March. This indicates that during the season this area is a preferred site for these birds in Mandya district (Table 3). The species diversity is the number of species and abundance of each species that live in a specific location. A diversity index is a quantitative measure of how many different species are in a community.[28,31]

The white ibis is another Near Threatened species that was frequently recorded from this area.[25] They were found scattered in Kokkare bellur and Shimsha river side during December to March, with a minimum of four and maximum of nine individuals. Great white Pelican, a migratory species which is an internationally important bird was observed in 2 or 3 flocks, with the individuals of 40-50 in each flock during the winter months of December to March. Some birds like Pond Heron, Night Heron, Little Cormorant, Grey Heron, Purple Heron, Cattle Egret, Large Egret, Open bill stork, Indian Moorhen, Common Coot, Ricer tern, Brahmini Kite, White breasted King fisher and White throated munia were found very few (4-5) each species in number during the study period. In Graph-3, the composition of birds in major feeding guilds in the study area showed that the insectivore guild was the most common with 35.09% species, followed by carnivore (23.82%), omnivore (14.30%), herbivore (11.53%) and piscivore (9.5%). Therefore, the diversity index is considered as a measure of diversity, which is a useful tool for understanding the biodiversity profile in the study area.[32-34]

Besides, these birds being generally at or near the top of most wetland food chains are highly susceptible to habitat disturbance and are therefore good indicators of general conditions of wetland habitat. Hence, the rural wetlands (Shimsha river region) should be prioritized and its conservation values should be highlighted.[35-39] Hydrologic conditions can directly modify or change chemical and physical properties such as nutrient availability, degree of substrate anoxia, soil salinity, sediment properties and pH. These modifications of the physio-chemical environment, in turn, have a direct impact on the biotic response in the region.[40-46]

Managerial strategies and recommendations:-

The interaction of man with bird sanctuary during the last few decades has been of concern largely due to the rapid population growth-accompanied by intensified industrial, commercial and residential development further leading to pollution of birds and nature by domestic, industrial sewage, and agricultural run-offs as fertilizers, insecticides and feedlot wastes. The fact that wetland values are overlooked has resulted in threat to the source of these benefits. Since sanctuaries are a common property resource, it is an uphill task to protect or conserve the ecosystems unless; the principal stakeholders are involved in the process.

In India, sanctuaries are distributed in all the specific bio-geographic regions and exhibit significant ecological diversity, primarily because of the variability of climate conditions and the changing topography. The identification of these important sanctuary areas is alone not sufficient to conserve India's biodiversity. Even many protected areas face serious conservation problems, despite their status. Also, very few of India's protected areas were chosen to specifically conserve birds.

Conservation strategies are proposed for Pelicans, Stork and other bird species at PRKB area.

Since, more than 500 years the village of Kokkare bellur has been shared by birds and human beings living in Symbiosis. The tall trees in village (*Ficus bengalensis, Ficus religiosa, Tamarindus indica, Thespecia populenea, Acacia nilotica*) have provided a safe place for spot-billed pelicans to build their nests. In turn, the fish diet of breeding birds has repaid the villagers with a potassium and phosphate rich source of manure for their crops, but now this centuries-old pattern of harmony between avian visitors and their human the hosts are badly shattered and the pelicans' survival is in danger.

The spotted billed pelican (*Pelicans philippensis*) is a globally threatened species with the population suffered a rapid decline during the last seventy years. Annual mid-winter waterfowl census which was conducted by the Asian Wetlands Bureau did not report more than 5000 birds across South Asia, in its 1993 report. Of the ten known nesting sites in India, one pelicanry in Kolamuru village in AP and one in Kaziranga in Assam is now almost abandoned. No current information is available from Northern Sri Lanka where the mangroves used to have nesting sites.

Need for Conservation

Main factors contributing to decline in pelican population at Kokkare bellur village.

1. Destruction of habitat:

A) Lack of nesting space

- The increasing use of land for arable crops has also caused the loss of trees that provided important breeding sites.
- Increase in human population and resultant pressure on remaining trees for fuel and feed: the trees in which the pelicans nest are all owned by different individuals in the village and not by government departments. So there can be no legislative protection provided. The fragmentation of land and property is at its peak, making the last two trees the ultimate source of cash for the village poor. The main business in the village is Sericulture as well as farming, both crop and livestock.The animal population, mainly goats, consumes about two tons of green leaves every day and trees are cut down indiscriminately throughout the year.
- Baked bricks are manufactured to meet the growing needs of modern brick houses. Here for local use. Cooking bricks consumes a lot of firewood, which is invariably reduces existing trees.

B) Disturbance to habitat:

- Growing numbers of tourists and photographers: Pelicans are very sensitive to humans proximity. When tourists and photographers get too close to nesting trees, parents Pelicans fly away. Predators like crows use this opportunity to attack them Chicks and eggs.
- Heavy vehicles moving on the main road passing through the village hit lower branches of trees with nests. Chicks often fall from the nest and onto the ground.

2. Threats at foraging sites:

A) Reduction of food

- Pollution of marshlands: A transition from traditional organic agriculture Chemical based methods of green revolution. This adversely affected the fishing grounds where breeding pelicans go to feed. The excess chemicals that wash off Nearby water bodies cause explosive growth of aquatic vegetation.
- Many irrigation tanks adjacent to agricultural land become choked thus making it difficult to get into the water to catch pelicans. Also pesticides often cause high fish mortality and high pesticide loading in insectivorous fish. Loading Pesticides becomes severe and can thin the egg-shells. 4 major industries in areas continuously release toxic wastes into rivers and water bodies, affecting fish due to turbidity and lack of organic oxygen.
- Siltation of tanks.

B) Hunting

Hunting of pelicans for food has been reported at foraging grounds nearby areas (i.e., Chennapattanam etc.).

Conservation action plan

The conservation plan will have both long-term and short-term perspective. The priority will be urgent issues should be given. The important factor is going to be the human component and reconciling the needs of the villagers and the needs of the birds. Currently local Forest officials offer token compensation to the villagers whose trees are used by birds Nesting amount given does not cover even half the value of crop loss (Example: in case of tamarind).

Even to get such a small amount, the villagers have to pay bribe to the local forest watchman. To make matters worse, the authorities have tried to intimidate the villagers with threats. Instead of using persuasion, legal action if they cut or cut down trees will be admitted.

Moreover, every attempt of tree plantation by the forest department has been a complete failure. Due to the lack of local consultation and participation a completely different approach called which will involve the community in taking responsibility for the care of the pelicans. In the coming years, a management strategy should be developed in partnership with the villagers to ensure PRKB remains a safe haven for pelicans.

Immediate measures

The main objective behind this has been to involve the younger generation in carrying of conservation activities:

- Pruning: to rescue fallen pelican chicks from nests
- To protect the young orphan chicks from stray dogs, a barn was built with iron poles and nets.

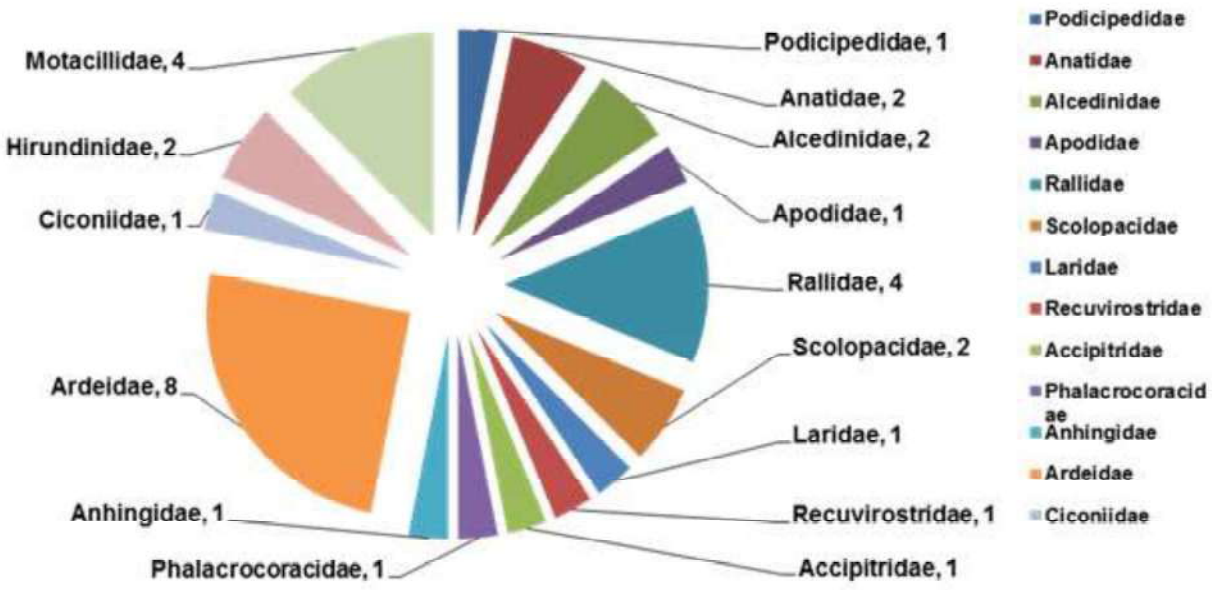
- Several slips and a small pond were prepared inside the enclosure.
- Pelicans are fed fish 3 times a day. The amount of fish consumed per day is recorded.
- Pelicans' growth is recorded by regularly measuring their weight, length of beak, length of wings and legs.
- Hand feeding is gradually reduced and birds are made to take fish from the pond
- Juvenile birds are induced to fly by hand.
- Everyone involved (including children) is educated about Spot Bill Pelicans
- All the birds are surrounded by colored bands before they are brought back into the forest.

Long term Measures

- Doing community work like planting trees and watering.
- Doing community work like planting trees and watering. Creating and promoting nurseries of plant species favored by both birds and farmers Plantation of above mentioned plants gradually to meet their fuel and fodder needs and also for providing good nesting trees to pelicans over the years.
- To initiate efforts to revive local water harvesting structures as a source to feed the birds, for immediate pasture and for cultivating fish in these small ponds stylus.
- Initiating environmental activities in local schools.
- Publishing a wall journal to generate community interest in nature health sanitation and Suggest an eco-friendly life-style.
- It will be a valid report on the current situation and immediate action that is needed to save Pelicans of Kokkare bellur.

In addition, the challenges that will have to be confronted in the future include:

- Changes taking place in the villagers' lifestyles and attitudes, due especially to commercialization and modernization.
- Integrating conservation in this micro-site with the larger landscape on which the birds depend, and where ecologically destructive activities are taking place.
- Rising unemployment in the village, economic aspiration of the younger generation which differs from their elders and the lack of innovation income generation schemes which can absorb these youth.



Graph 1- Distribution of Birds family wise documented at Kokkare bellur

Table 3.Check List of Birds documented at KokkareBellur

SL. No.	Type of Bird Species	Vernacular Name	Scientific Name	Remarks
1.	Little Grebe or Dabchick	Gulamulaka	*Podiceps ruficollis*	VC/r/B
2.	Spot billed or Grey Pelican	Hejjarle	*Pelecanus philippensis*	VC/V/B
3.	Little cormorant	NeeruKage	*Phalacrocorax niger*	C/r/B
4.	Grey Heron	Budu Baka or Kari Krouncha	*Ardea cinerea*	C/r
5.	Purple Heron	Nerle Baka or Nerle Krouncha	*Ardea purpurea*	C/r/B
6.	Indian Pond Heron or Paddy Bird	Gaddegumma	*Ardea lagrayii*	VC/r/B
7.	Cattle Egret	Bellakki	*Bubulcus ibis*	VC/r
8.	Large Egret	DoddaBellaki	*Ardea alba*	C/r
9.	Small or Median Egret	Uncommon	*Egretta intermedia*	Uc
10.	Little Egret	Chikka Bellaki or Narayani Hakki	*Egretta garzetta*	C/r/B
11.	Night Heron	Ratri Baka	*Nycticorax nycticorax*	C/r
12.	Painted Stork	BanadaKokkare	*Mycterialeuco cephala*	VC/V/B
13.	Open bill Stork	Kavadu Kokkina Kokkare	*Anastomus oscitans*	C/V
14.	White necked Stork	Kari Kokkare	*Ciconia episcopus*	C/V
15.	White Ibis	Busa Hakki	*Threskiornis aethiopica*	VC/V
16.	Black Ibis	Kammara Kage	*Pseudibis papillosa*	VC/r/B
17.	Glossy Ibis	--	*Plegadis falcinellus*	R/V
18.	Spot-bill Duck	--	*Anaspoecilor hyncha*	VC/r/B
19.	Gargany or Blue winged Teal	--	*Anasquer quedula*	C/W
20.	Cotton Teal	Sarale Hakki	*Nettapus coromandelianus*	C/V
21.	Blackwinged Kite	--	*Elanus caeruleus*	C/r/B
22.	Pariah Kite	Haddu	*Milvus migrans*	VC/r/B
23.	Brahminy Kite	Garudana Hakki	*Haliastar indus*	VC/r/B
24.	Shikara	--	*Accipiter nisus*	C/r/B
25.	Sparrow hawk	Bijju	*Accipiter nisus*	C/r/B
26.	Indian White backed Vulture	Rana Haddu	*Gyps benghalensis*	Uc/V
27.	Egyptian Vulture	Jalagara Haddu	*Neophron percnopterus*	Uc/V
28.	Marsh Harrier	--	*Circus aeruginosus*	C/W
29.	Grey Partridge	Goojala Hakki	*Francolinus pondicerianus*	C/r/B
30.	Common or Grey Quail	--	*Colurnix colurnix*	C/r/B
31.	Yellowlegged Button Quail	Mani Goujala	*Turnix tanki*	C/r/B
32.	WhitebreastedWaterhen	BeliYeda NeeruKoli	*Amaurornis phoenicurus*	C/r/B
33.	Indian Moorhen	Kari Neeru Koli	*Gallimala chloropus*	C/r/B
34.	Purple Moorhen	Kennerle NeeruKoli	*Porphyrio porphyrio*	C/V
35.	Coot	Namada Koli	*Fulica atra*	C/V
36	Red wattled Lapwing	Tittiba	*Vanellus indicus*	C/r/B
37.	Yellow wattled Lapwing	Haladi Tittiba	*Vanellus malabaricus*	C/r/B
38.	Marsh Sandpiper	Joogo Maralupepe	*Tringa stagnatilis*	UC/W
39.	Greenshank	--	*Tringa nebularia*	C/W
40.	Green Sandpiper	Hasiru Maralupepe	*Tringa ochropus*	C/W
41.	Wood or Spotted Sandpiper	Chikki Maralupepe	*Tringa glareola*	C/W
42.	Common Sandpiper	Maralupepe	*Tringa hypoleucos*	C/W
43.	Pintail Snipe	Esnapu	*Gallinago gallinago*	C/W
44.	Painted Snipe	Esnapu	*Roustratula benghalensis*	C/W
45.	Blackwinged Stilt	Stiltu	*Himantopus himantopus*	C/W
46.	Whiskered Tern	--	*Childonias hybrid*	C/W
47.	River Tern	--	*Sterna aurantia*	C/W
48.	Blackbellied Tern	--	*Sterna acuticauda*	UC/W
49.	Black Rock Pigeon	Paravala	*Columba livia*	C/V
50.	Indian Ring Dove/Collared Turtle Dove	Chikka Paravala	*Streptopelia decaocto*	C/r
51.	Spotted Dove	Kapotha or Manisure Hakki	*Streplopelia chinensis*	C/r/B
52.	Roseringed Parakeet	Gili	*Psittacula krameri*	C/r/B
53.	Pied Crested Cuckoo	Juttina Kogile	*Clamalor jacobinus*	UC/V
54.	Indian Cuckoo	--	*Cuculus micropterus*	UC/V
55.	Indian Koel	Kogile	*Eudynamis scolopacea*	VC/r/B
56.	Crow Pheasant or Coucal	Kembutha or Sambar Kage	*Centropus sinensis*	C/r/B
57.	Barn Owl	Beli Gube	*Tyto alba*	C/r/B
58.	Collared Scops Owl	Gube	*Otus bakkamoena*	C/r/B
59.	Southern Spotted Owlet	Halakki	*Athena brama*	C/r/B
60.	Great Indian Horned Owl	Dodda Gube	*Bubo bubo*	C/r/B
61.	Indian Little Nightjar	--	*Caprimulgus asiaticus*	R/r
62.	House Swift	Banadi Hakki	*Apus affinus*	C/V
63.	Palm Swift	--	*Cypsiurus parvus*	UC/V
64.	Pied Kingfisher	Beli Mincholli	*Ceryle rudis*	C/r/B
65.	Small Blue Kingfisher	Mincholli	*Alcedo atthis*	C/r/B
66.	White-breasted Kingfisher	Belli Yede Mincholli	*Halcyon smyrnensis*	C/r/B
67.	Blue-tailed Bee-Eater	NeleBalada Nonahiduka	*Merops philippinus*	R/W
68.	Small Green Bee-Eater	Nonahiduka	*Merops orientalis*	C/r
69.	Indian Roller	Navarangi Hakki	*Coracias benghalensis*	C/r/B

70.	Hoopoe	Chandramukata	*Upupa epops*	VC/r/B
71.	Grey Hornbill	Setagina Hakki	*Tockus birostris*	C/r/B
72.	Large Green Barbet	--	*Megalaima zeylanica*	R/V
73.	Small Green Barbet	Chambu Kutiga	*Megalaima viridis*	VC/r/B
74.	Crimsonbreasted Barbet or Coppersmith		*Megalaima haemacephala*	VC/r/B
75.	Lesser Goldenbacked Woodpecker	Mara Kutka	*Dinopium benghalense*	C/r/B
76.	Blackbacked Woodpecker	Mara Kutka	*Chrysocolaptes festivus*	C/r/B
77.	Singing Bush Lark	Nela Gubbi	*Mirafra javanica*	C/V
78.	Redwinged Bush Lark	--	*Mirafra erythroptera*	C/V
79.	Ashcrowned Finch Lark	--	*Eremopterix grisea*	C/B
80.	Rufoustailed Finch Lark	--	*Ammomanes phoenicurus*	C/V
81.	Crested Lark	--	*Galerida cristata*	UC/V
82.	Common Swallow	--	*Hirundo rustica*	C/W
83.	Wiretailed Swallow	--	*Hirundo smithii*	C/W
84.	Redrumped Swallow	--	*Hirundo daurica*	R/W
85.	Grey Shrike	Budu Kalinga	*Lanius excubitor*	R/V
86.	Rafousbacked Shrike	Kalinga	*Lanius schach*	C/V/B
87.	Brown Shrike	--	*Lanius cristatus*	C/V
88.	Golden Oriole	--	*Oriolus oriolus*	C/V
89.	Black Drongo	Kajana	*Dicrurus adsimilis*	C/r/B
90.	Grey or Ashy Drongo	Budu Kajana	*Dicrurus leucophaeus*	C/r
91.	Whitebellied Drongo	--	*Dicrurus caerulescens*	R/V
92.	Brahminy Myna	Karithale Myna	*Sturnus pagodarum*	C/W
93.	Rosy Pastor	--	*Sturnus roseus*	C/W
94.	Jungle Myna	Mise Myna	*Acridotheres fuscus*	C/r/B
95.	House Crow	Kage	*Corvus splendens*	VC/r/B
96.	Jungle Crow	Jangli Kage or Kadu Kage	*Corvus macrorhynehos*	VC/r/B
97.	Wood Shrike	--	*Tephrodornis pondicerianus*	R/V
98.	Blackheaded Cuckoo Shrike	--	*Coracina melanoptera*	R/V
99.	Small Minivet	--	*Pericrocotus cinnamomeus*	C/V
100.	Common Lora	UliHakki	*Aegithina tiphia*	C/r/B
101.	Goldmantled Chloropsis	--	*Chloropsis cochinchinensis*	C/V
102.	Redwhiskered Bulbul	Pikalara	*Pycnonotus jocosus*	C/r/B
103.	Redvented Bulbul	Kotaga	*Pycnonotus cafer*	C/r/B
104.	Whitebeaded Babbler	Taragde Hakki	*Turdoides affinis*	C/r/B
105.	Tickell's Redbreasted Blue Flycatcher	--	*Muscicapa tickelliae*	UC/r/B
106.	Whitespotted Fantail Flycatcher	--	*Rhipidura albicollis*	UC/r/B
107.	Paradise Flycatcher	--	*Terpsiphone paradisi*	UC/r/B
108.	Streaked Fantail Warbler	Besangebalada Hakki	*Cisticola juncidis*	C/r/B
109.	Ashy Wren Warbler	--	*Prinia socialis*	C/r/B
110.	Tailor Bird	Darje Hakki	*Orthotomus sutorius*	C/r/B
111.	Indian Great Reed Warbler	--	*Acrocephalus dumetorum*	C/r/B
112.	Chiffchaff	--	*Phylloscopus collybita*	C/W
113.	Green Leaf Warbler	--	*Phylloscopus trochiloides*	UC/W
114.	Magpie Robin	--	*Copsychuss aularis*	C/r/B
115.	Pied Bushchat	Belechitiga	*Saxicola caprata*	C/r/B
116.	Indian Robin	--	*Saxicoloides fulicata*	C/r/B
117.	Indian Grey Tit	Muddagubbi	*Parus major*	C/V
118.	Indian Tree Pipit	--	*Anthus hodgsoni*	UC/V
119.	Indian Paddyfield Pipit	--	*Anthus novaeseelandiae*	C/V
120.	Tawny Pipit	--	*Anthus campestris*	C/W
121.	Forest Wagtail	--	*Motacilla indica*	R/W
122.	Greyheaded Yellow Wagtail	Haldi Kundikasa	*Motacilla flava*	C/W
123.	Blueheaded Yellow Wagtail	--	*Motacilla flava*	R/W
124.	Blackheaded Yellow Wagtail	--	*Motacilla flava*	UC/W
125.	Grey Wagtail	Buda Kundikusa	*Motacilla cinerea*	C/W
126.	White Wagtail	Bele Kundikasa	*Motacilla alba*	UC/W
127.	Large Pied Wagtail	------	*Motacilla maderaspatensis*	C/r/W
128.	Thickbilled Flowerpecker	Huvu Kudaka	*Dicaeum agile*	C/V
129.	Tickell's Flowerpecker	Huvu Kudaka	*Dicaeum erythrorhynchos*	C/r/B
130.	Purplerumped Sunbird	Surahakki	*Nectarinia zeylonica*	C/r/B
131.	Purple Sunbird	Aparanji Huvinahakki	*Nectarinia asiatica*	C/r/B
132.	White-eye	------	*Zosterops palpebrosa*	R/V
133.	House Sparrow	Gubbi	*Passer domesticus*	C/r/B
134.	Baya or Weaver Bird	Gijaga	*Ploceus philippinus*	C/r/B
135.	Streaked Weaver Bird	BattadaGijaga	*Ploceus manyar*	C/r/B
136.	Red Munia or Avadavat	Kempu Gubbi	*Estrilda amandava*	R/V
137.	Whitethroated Munia	Tene Gubbi	*Lonchura malabarica*	C/r/B
138.	Whitebacked Munia	-------	*Lonchura striata*	C/r/B
139.	Spotted Munia	Tene Gubbi	*Lonchura punctulata*	C/V/B
140.	Blackheaded Munia	Kari Tale Gubbi	*Lonchura malacca*	C/r/B

VC=Very common; **C**= Common; **R**=Rare; **Uc**=Uncommon; **r** =Resident; **B**=Breeding; **V**=Vagrant; **W**=Wintering

Plate 1: Some important Birds documented at Kokkarebellur

Pelecanus philippensis
Spot-billed Pelican

Ardea purpurea
Purple Heron

Ardea intermedia
Median Egret

Bubulcus ibis
Cattle Egret

Nycticorax nycticorax
Night Heron

Ardeola grayii
Indian Pond Heron

Haliastur Indus
Brahminy Kite

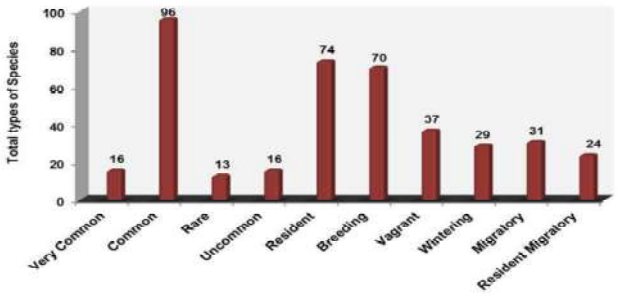
Anastomus oscitans
Asian Open-billed Stork

Egretta garzetta
Little Egret

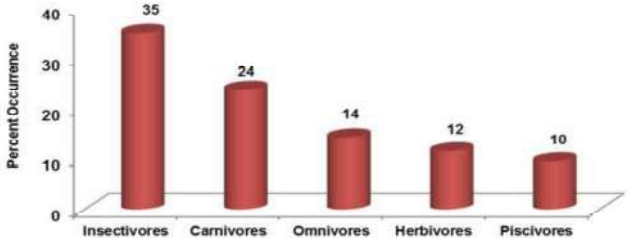
Halcyon smyrnensis
White breasted Kingfisher

Ardea alba
Large Egret

Fulica atra
Common Coot



Graph-2: Status/Remarks of Birds documented from Kokkarebellur



Graph-3: Distribution of Feeding Guilds (%) of Birds category documented at Kokkarebellur

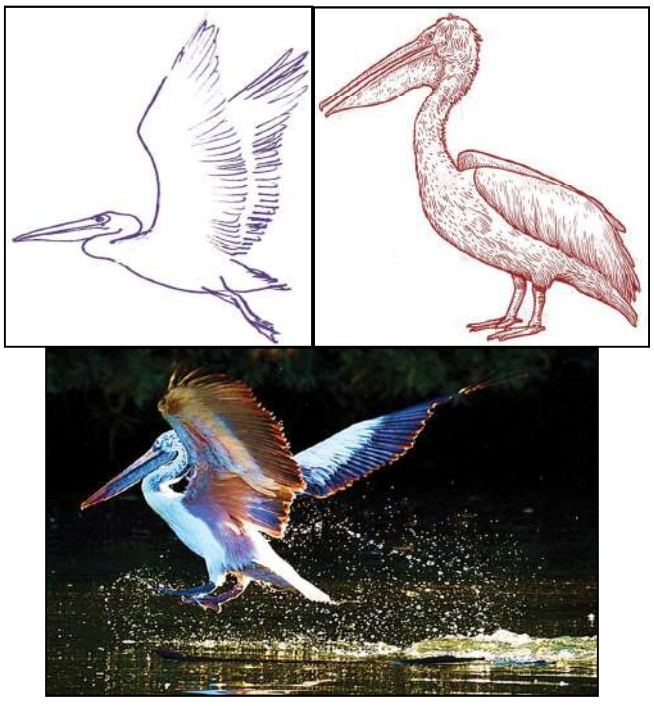


Fig. 4- Pelican at different strokes

Appendix1- Format of Socio-economic survey data sheet for Assessment of Anthropogenic pressure & Creation of Conservation awareness on birds at Kokkare bellur, Karnataka

Name of the Village	Date:						
1. Particulars of the Family							
Address & Mob. No.	Head of the family (Native / Migrating)	Family Members Name	Sex & Age	Relation with HOF	Occupation	Educational Qualifications	Others
2. Distance from the Sanctuary / Wetland							
3. Do you have any Problems with Drinking water supply?	a. Yes - Not Clean / Difficult to access/ Others b. No -						
4. Do any of household members have a Health Problem?	a. Yes - b. No -						
5. Details of Agriculture (Own land / Coolie)							
i. Types of Crops Produced							
ii. Types of Cattles & Poultry (in Nos.)							
iii. Types of Cultivation Methods & Water Resources	Traditional / Modern / Others; Bore well / River / Lake / Others						
iv. Types of Fertilizers and Pesticides using in Cultivation							
v. What happened to the agricultural production in the last 3 Years (Please Tick)	a. Increased - Details: b. Decreased - Details: c. Did not Change						
vi. Knowledge about Organic / Bio fertilizer?							
vii. Knowledge about Sanctuary / Wetland / Birds and its importance?							
6. Opinion about the Wetland / Sanctuary	Advantages					Disadvantages	
7. Wetland Resources Utilization	Fishing / Firewood collection / Cattle grazing / Others (Given Details)						
8. Do you have Problems in Your Village?	a. Environmental Problems – b. Social Problems – c. Economic Problems – d. Agricultural Problems –						
Signature							

CONCLUSION

In the study, different elevations like. Tree heights, small hillocks followed by Shimsha river basin, agriculture land area and pelican mass coverage in the whole village were the major factor determining species richness and abundance. The position of study localities is a main factor determining bird community composition. The diversity of bird species were mainly found in habitats that were far human settlements, having high annual mean temperature and more roughness. The species diversity was high during July-August compared to September-October and in north-facing slopes, and also in shrub and tree covered areas than adjacent grasslands followed by agriculture lands.

The bird's species (resident and migratory) numbers and abundance were higher in PRKB according to the habitat suitability, which support free water and abundant food supply (insects, grasses, and aquatic fauna) as well as nesting and resting sites. Similarly, most migratory birds

feed on insects. In addition, the PRKB is an agriculture oriented area with several seasonal and daily human activities, during the day hours and part of the night, which disturbs birds. Additionally, the structure of PRKB, which include many trees and shrubs, make it a protective cover for different bird species from predators as black-winged kite, which was recorded with a higher numbers at PRKB.

Pelicans were hosted almost in the tree components even it is connected to residential area (people living area). The entire structure of Pelican mass on the tree was look like two tier village that means in the lower tier village (Kokkare bellur) were living and in the upper tier corpus of Pelicans were observed. In result, position of sampled localities, elevation, aspect, land use types and different climatic factors were important determinants of bird diversity along altitudinal gradients in PRKB area. Hence, to protect bird diversity mainly in low altitudes in Kokkare bellur region, it is much needed to improvise the structure of habitats for most of the bird species. However, high altitude habitats with gradients are also found to be important for some uncommon bird species. Thus, a large area with heterogenous habitats is important for bird species management and conservation. However, the community participation in conservation bird's species has been accomplished.

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