Study on Avifaunal Diversity of four different Mangrove regions of Kundapura

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Abstract

Mangroves are salt tolerant forest ecosystems which support a rich species diversity of flora and fauna. Mangroves harbor a greater variety of bird life. Our list of birds was compiled from field work carried out from April-2010 to March-2013. A total of 79 species of birds representing 14 orders and 36 families were recorded from the mangroves of Kundapura. Species diversity of avifauna was encountered through Species Richness and Diversity Indices. Diversity indices such as Shannon-Weiner Index, Simpson Index and Evenness Index were calculated. Species diversity and abundance of birds peaked during October-May with the arrival of migratory birds. Minimum diversity was recorded during June-September owing to the departure of migratory birds.

Keywords: Mangroves; Species diversity; Flora; Fauna; Migratory.

Introduction:

Mangrove is an evergreen, salt tolerant plant community, which grows in inter-tidal coastal zones of tropical and subtropical regions of the world. They act as important habitats for many species of fauna (Duraimurugan *et al*. 2017). The mangrove ecosystem is inhabited by a variety of smaller birds, resident birds, migratory birds and wading birds. One of the most productive ecosystems of world is mangrove forests, providing shelter and feeding sites for many avifaunas (Kumar & Kumara. 2011). Mangrove habitats are host to many waterbirds around the globe (Saber Ghasemi. 2012). Mangroves show diversified avifaunal members. Many of the bird species are associated with the mangroves, for many reasons. Birds use the mangroves for nesting, breeding and as a source of secondary food (Kulkarni Narendra A. 2018). Mangroves are plants which lived at maximum subsiding tide point to maximum rising tide point area, with mud as its substrate. For other organisms, mangroves used as shelter and foraging place. One of those organisms is birds, birds can be used as bioindicators of environmental quality because it has a sensitivity to environmental changes (Aditya Rachmaputra1 *et al*. 2018).

Materials and Methods:

Study area: The domain of study is located at Kundapura, 440 km from Bangalore and 37 km from Udupi, at 13°37'24" N latitude and 74°41'30" E longitude and maximum elevation of 18 meters above sea level. Four study sites (Table: 1) have been selected beside the backwaters of the Haladi River.

Table-1 Study sites

Study sites	Latitude	Longitude	Elevation
Site-1. Herikudru	13°38'28"N	74°42'01"E	28'
Site-2. Uppinakudru	13°39'21"N	74°41'59"E	25'
Site-3. Jaladi	13°39'41"N	74°42'16"E	16'
Site-4. Hemmadi	13°40'46"N	74°41'20"E	32'

Bird watching: Our list of birds was compiled from field work conducted from April-2010 to March-2013. Weekly visits to the sites were made for three years with a maximum of 4 visits per month. Binoculars were used for bird watching; photographs were taken with a Nikon SLR Digital Camera. The birds can be recorded by line transect method (Burnham *et al*., 1980). Birds were identified by reference to field guides (Grewal, 1995; Grimmett *et al*., 2006; Ali, 2002).

Surveys were conducted every weekend in the early morning from 5.00-7.30 a.m and every evening from 5.00-7.30 p.m. The relative abundance of birds was estimated and monthly fluctuations were recorded. I quantified bird diversity and abundance in the study area. Birds were classified on the basis of "The Book of Indian birds" (Ali, 2002).

Data analysis: The data were subjected to detail analysis which included Shannon Diversity Index/Shannon-Weiner Index, Simpson Index, Species Richness Index and Species Evenness Index.

Shannon Diversity Index: Species diversity was calculated by

$$H = \sum_{i=1}^{S} -(P_i \mathrm{x} \ln P_i)$$

Where, H is the Shannon diversity index
    P_i = fraction of the entire population made up of species i
    S= numbers of species encountered
    $\sum$ = sum from species 1 to species S.

Simpson Index: Simpson (1949) derived a formula based on the expected outcome of two random samples.

$$D_s = \frac{N(N-1)}{\sum n_i(n_i-1)}$$

Where, N = the total number of individuals of all species
        n_i = the number of individuals of species i

Evenness Index: To calculate the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).

E= H'/lnS
Where, H' is Shannon-Weiner's diversity index and S is species richness.

Species Richness: Margalef's index was used as a simple measure of species richness (Margalef, 1958).
Margalef's index $= (S-1) / \ln N$

S = total number of species
N = total number of individuals in the sample
ln = natural logarithm

Results and discussion:

A total of 79 species of birds representing 14 orders and 36 families were recorded from the mangroves of Kundapura (Table-2). Species diversity of avifauna was encountered

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through Species Richness and Diversity Indices. Diversity Indices such as Shannon-Weiner Index, Simpson Index and Evenness Index were calculated. Species richness (S) is the number of species on that list, and is most often used as the first-pass-estimate of diversity for a community. Species richness was S=64 in site-1, S=63 in site-2, S=76 in site-3 and S=71 in site-4. Species richness was encountered by Margalef's index. Margalef's index value encountered avifauna was estimated to be 7.30 in site-1, 7.34 in site-2, 7.53 in site-3, and 7.17 in site-4. Shannon-Weiner index value encountered avifauna was estimated to be 4.97 in site-3 followed by site-4 (4.64), site-1 (3.22) and site-2 (2.53). Simpson Index is a calculation of variety which takes into records both richness and evenness. It has been a useful tool to understand the profile of biodiversity across study area. This Diversity Index value encountered avifauna was estimated to be 14.62 in site-1, 11.98 in site-2, 8.72 in site-3 and 9.11 in site-4. Evenness of birds compares the similarity of the population size of each of the species which was recorded as 0.77 in site-1, 0.61 in site-2, 1.15 in site-3 and 1.09 in site-4 (Table- 3).

Species diversity and abundance of birds peaked during October-May with the arrival of migratory birds. Minimum diversity was recorded during June-September owing to the departure of migratory birds. Species diversity was highest during pre-monsoon and post-monsoon and lower during monsoon (Table-4) at all the study sites. Similar observations were also made by Bhat *et al*., (2009).

Total numbers of birds inhabiting site-1, site-2, site-3 and site-4 are listed in Table-4. Site-1 was occupied by 11% of birds, site-2 was occupied by 10% of birds, site-3 was occupied by 43% of birds and site-4 was occupied by 36% of birds. Most birds occupied site-3 and site-4. Dense growths of mangroves were observed in site-3 and site-4. Hence most of the birds selected these sites as roosting place; hence more number of birds was recorded in these sites. Only patches of mangrove vegetation observed in site-1 and site-2. Hence less number of birds was recorded in these sites.

Table-2: Checklist of birds sighted in the study area (April-2010 to March-2013)
(VijayaKumar K.M & Vijayakumara. 2014)

Sl.No	Order / Family	Common name	Scientific name
1	**O:**Galliformes **F**:Phasianidae	Indian Peafowl	*Pavo cristatus*
2 3 4	**O**:Piciformes **F:**Picidae	Black-rumped Flameback Brown-headed Barbet White-cheeked Barbet	*Dinopium benghalense* *Megalaima zeylanica* *Megalaima viridis*
5	**O:**Upupiformes **F**:Upupidae	Common Hoopoe	*Upupa epops*
6	O:Coraciformes **F**:Coracidae	Indian Roller	*Coracias benghalensis*
7	**F**:Alcedinidae	Common Kingfisher	*Alcedo atthis*
8 9 10	**F:**Dacelonidae	White-throated Kingfisher Stork-billed Kingfisher Black-capped Kingfisher	*Halcyon smyrnensis* *Halcyon capensis* *Halcyon pileata*
11	**F:**Cerylidae	Pied Kingfisher	*Ceryle rudis*
12 13 14	**F:**Meropidae	Green Bee-eaters Blue-tailed Bee-eaters Chestnut-headed Bee-eater	*Merops orientalis* *Merops philippinus* *Merops leschenaulti*

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15	**O**:Cuculiformes **F**:Cuculidae	Asian Koel	*Eudynamys scolopacea*
16	**F**:Centropodidae	Greater Coucal	*Centropus sinensis.*
17	**O:**Psittaciformes **F:**Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*
18	**O:**Apodiformes **F:**Hemiprocnidae	Crested Treeswifts	*Hemiprocne coronata*
19	**O:**Strigiformes **F:**Tytonidae	Barn Owl	*Tyto alba*
20	**F:**Strigidae	Spotted Owlet	*Athene brama*
21	**O:**Columbiformes	Blue Rock Pigeon	*Columba livia*
22	**F:**Columbidae	Spotted Dove	*Streptopelia chinensis*
23	**O:**Gruiformes **F:**Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*
24	**O:**Ciconiformes	Indian Pond Heron	*Ardeola grayii*
25	**F:**Ardeidae	Little Heron	*Butorides striatus*
26		Black-crowned Night Heron	*Nycticorax nycticorax*
27		Grey Heron	*Ardea cinerea*
28		Purple Heron	*Ardea purpurea*
29		Great Egret	*Casmerodius albus*
30		Cattle Egret	*Bubulcus ibis*
31		Little Egret	*Egretta garzetta*
32		Intermediate Egrets	*Mesophoyx intermedia*
33	**F:**Threskiornithidae	Black-headed Ibis	*Threskiornis melanocephalus*
34		Black Ibis	*Pseudibis papillosa*
35	**F:**Phalacrocoracidae	Little Cormorants	*Phalacrocorax niger*
36	**F:**Anhingidae	Darters	*Anhinga melanogaster*
37	**F:**Charadridae	Red-wattled Lapwing	*Vanellus indicus*
38		Kentish Plover	*Charadrius alexandrinus*
39		Little Ringed Plover	*Charadrius dubius*
40	**F:**Scolopacidae	Common Sandpiper	*Actitis hypoleucos*
41		Marsh Sandpiper	*Tringa stagnatilis*
42		Curlew Sandpiper	*Calidris ferruginea*
43		Common Redshank	*Trigna totanus*
44		Ruddy Turnstone	*Arenaria interpres*
45		Sanderling	*Calidris alba*
46		*Long Toed Stint*	*Calidris subminuta*
47		Common Greenshank	*Trigna nebularia*
48	**F:**Accipitridae	Pariah Kite	*Milvus migrans*
49		Brahminy Kite	*Haliastur indus*
50	**F:**Ciconidae	Asian Openbill	*Anastomus oscitans*
51		Greater Adjutant	*Leptoptilos dubius.*
52		Woolly-necked Stork	*Ciconia episcopus*
53	**O:** Passeriformes	Black Drongo	*Dicrurus macrocercus*
54	**F:**Dicruridae	Greater Racket-tailed Drongo	*Dicrurus paradiseus*
55	**F:**Sturnidae	Common Myna	*Acridotheres tristis*
56		Chestnut-tailed Starling	*Sturnus malabaricus*
57	**F:**Pycnonotidae	Red-whiskered Bulbul	*Pycnonotus jocosus*
58	**F:**Silvidae	Jungle Babbler	*Turdoides striatus*

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59	**F:**Corvidae	House Crow	*Corvus splendens*
60		Asian Paradise-flycatcher	*Terpsiphone paradisi*
61		Eurasian Golden Oriole	*Oriolus oriolus*
62		Black-hooded Oriole	*Oriolus xanthornus*
63		Rufous Treepie	*Dendrocitta vagabunda*
64	**F:**Muscicapidae	Oriental Magpie Robin	*Copsychus saularis*
65		Pied Bush Chats	*Saxicola caprata*
66		Orange-headed Thrush	*Zoothera citrina cyanotus*
67	**F:**Alaudidae	Crested Lark	*Galerida cristata*
68		Oriental Skylark	*Alauda gulgula*
69		Indian Bush Lark	*Mirafra erythroptera*
70	**F:**Nectarinidae	Purple-rumped Sunbird	*Nectarinia zeylonica*
71	**F:**Passeridae	White-browed Wagtail	*Motacilla maderaspatensis*
72		Black-headed Munia	*Lonchura malacca*
73		Baya Weaver	*Ploceus philippinus*
74		Paddyfield Pipit	*Anthus rufulus*
75		House Sparrow	*Passer domesticus*
76	**F:**Cisticolidae	Common Tailorbird	*Orthotomus sutorius*
77		Zitting Cisticola	*Cisticola juncidis*
78	**O:**Anseriformes **F:**Anatidae	Lesser Whistling-ducks	*Dendrocygna javanica*
79	**O:**Bucerotiformes **F:**Bucerotidae	Great Hornbill	*Buceros bicornis*

Notes: O= Order, F= Family.

Table-3. Diversity indices of avifauna

Diversity Index	Site-1	Site-2	Site-3	Site-4
Shannon Weiner Index	3.22	2.53	4.97	4.64
Simpson Index	14.62	11.98	8.72	9.12
Species evenness	0.77	0.61	1.15	1.09
Species richness	64	63	76	71
Margalef's index	7.30	7.34	7.53	7.17

Table-4. Average and season wise bird count

| Sites	Total bird count	Monsoon	Post monsoon	Pre monsoon
1	5570	1397	2110	2063
2	4680	1152	1707	1821
3	21066	5122	7620	8324
4	17269	4094	6354	6821

Notes:
Monsoon: Rainy season (June, July, August & September)
Post monsoon: After monsoon season (October, November, December & January)
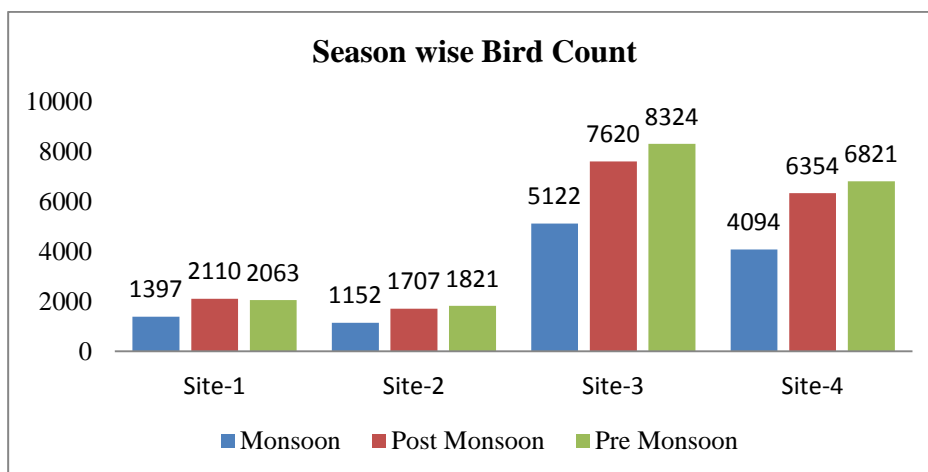**Pre monsoon**: Summer season (February, March, April & May)
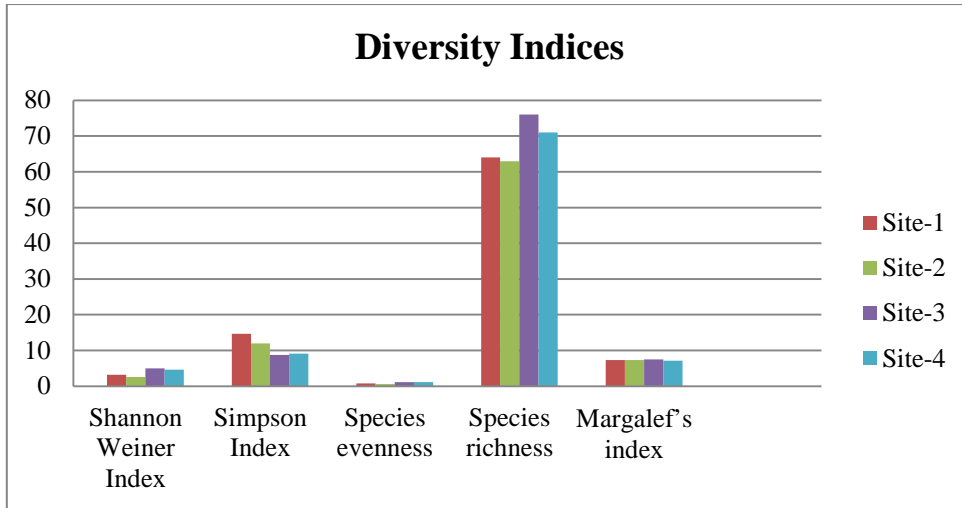
Fig-1. Showing the diversity indices of avifauna.
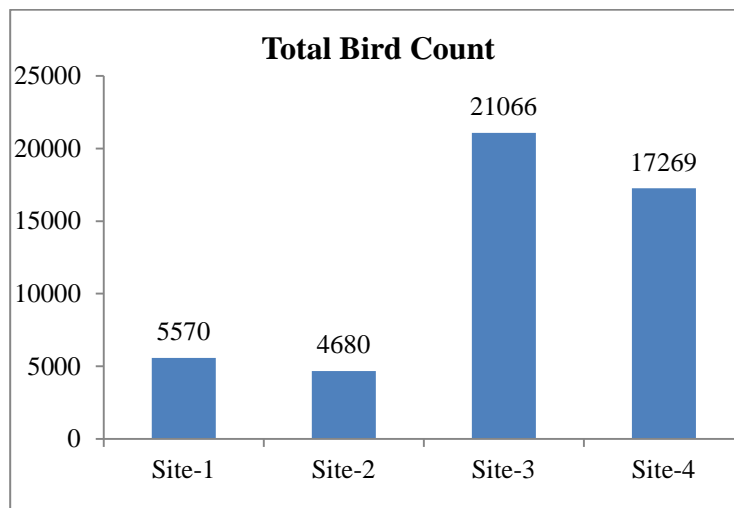
Fig-2: Showing the average total bird count from April-2010 to March-2013.

Fig-3: Showing the season wise bird count from April-2010 to March-2013.

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Summary and Conclusion:

Mangrove vegetation provide a compliant niche for the myriad resident as well as passage migrant aquatic birds, which utilize the system in varying degrees from feeding, roosting and breeding. Mangroves serve the birds in different ways. Mangrove ecosystems play a significant role in conservation of not only resident species but also migratory and endangered birds. Both aquatic as well as tree dwelling birds are commonly found in mangroves and associated areas. Ecological conditions of Kundapura mangroves support a rich diversity of birds.

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