

**ASSESSMENT OF BIRD AND MACROFAUNA DIVERSITY IN MANGROVE ECOSYSTEM OF JAKHAU CREEK, GULF OF KACHCHH, INDIA**

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ABSTRACT: Mangrove ecosystem serves as feeding and breeding ground for variety of living organisms including crustaceans, mollusks, fish and many resident and migratory birds. Macro invertebrate fauna are first consumer of mangrove detritus, decomposition matter and hence play a vital role in regulating food web in mangrove ecosystem. Macrofauna are also the most preferred food of migratory as well as resident birds occurring in mangrove ecosystem. The present study provides the baseline information on bird and macrofauna diversity in Jakhau creek system. The bird and macrofauna sampling were carried out at regular interval through point count method. Total 65 bird species belonging to 17 families have been recorded. Out of all recorded bird species, 49% were migratory. 27 species of macro invertebrate were recorded in to five major groups Viz. polychaetes (30%), crustaceans (30%), gastropods (26%), bivalves (7%) and fish (7%). The study reveals that the mangrove ecosystem of Jakhau creek can be a good feeding ground for migratory birds although it requires several conservation strategies and regulation of coastal transportation and other human activities.

Keywords: Mangrove, Birds, Macro invertebrates, diversity, Jakhau creek.

INTRODUCTION

Mangrove ecosystem is predominant habitats that occur in the intertidal zone, act as a buffer zone between marine and terrestrial ecosystem and play a significant role to represent tropical biodiversity. Mangroves are one of the biologically rich, diverse and productive ecosystems. It supports very large biomass of flora and fauna [11]. Mangrove ecosystem plays a vital role for the coastal organisms such as benthos, fishes, birds and mammals. Birds are fascinating creature of the world they are ecological litmus paper. The mangrove detritus matter is a key factor to drive mangrove food web. The ecological importance of mangrove area can hardly be overestimated as they form nursery for many species of birds and invertebrates. Birds are closely related to mangrove ecosystem which includes being pollinators, seed dispersers, pollution regulators, providing food for other animal predators and also contributes in nutrient recycling processes [8]. Wintering palaeartic waders use them as roosting sites after feeding in tidal mud flats [14]. These winter visitor birds are migrating for feeding and breeding. The present investigation was carried out at Jakhau port of the northern flank of Gulf of Kachchh an important fishing port for the fishing community. Very few studies carried out on Jakhau creek system related to birds and macro invertebrates [2,10,13]. The main objective of the present study was to inventories birds and macro invertebrate composition and primary investigation of availability of prey species for the migratory birds in mangrove habitat.

MATERIALS AND METHODS**Study area**

The present study has been carried out at Jakhau coast, also known as Jakhau creek system of Gulf of Kachchh is located between 23⁰13'N and 68⁰43'E of the extreme western border of Kachchh district on the coastline of the Arabian sea. The area is famous and one of the oldest ports on Kachchh coast. Creeks of Jakhau are also well known for very productive saltpans, dense patches of natural mangroves and also identified as one of the important sites for mangrove plantation by various agencies. Apart from port and salt pan activities, the area is known for seasonal fishing activity, especially for prawns.

The area has coastal international border of India and Pakistan so the shore is highly protected by various authorities such as BSF (Border Security Force), coast guard, coast police and forest department. These protections also helps in regulating human and industrial activities in the area. The district of Kachchh harbours total mangrove cover of 23.76 sq. km out of these Jakhau creeks share approximately 10 sq. km area.

The entire study was carried out during the migratory seasons of the year 2011 to 2013 by field surveys at regular intervals to inventorise bird and macrofauna.

Bird identification

Sampling was carried out during migratory season (October to March). The area surveyed by lying at least four transects of 300m in the mangrove area. On each transect line, birds were observed at three points at the interval of 100m [7] (Figure 2). The birds were observed by a pair of 10X50 binoculars and 20X to 25X spotting scope, identified with the help of standard book [4].

Sampling and identification of macro invertebrates

Macro invertebrates were collected from the sediment samples collected by grab sampler on the transect line. Total three cores were collected using grab sampler of 10 cu cm at the interval of 1m on the transect line. The sediment collected in the core was passed through a sieve of 1mm² mesh size. The macro invertebrates were identified on the site using the standard field keys. However few unidentified animals were poured in wide mouth plastic container and preserved in 10% formalin with Rose Bengal (dye) and carried to the laboratory for identification [1, 15, 5].

Data analysis

The data were analysed to calculate the diversity of birds and macrofauna to know the relationship between the macrofauna and bird species in the mangrove ecosystem. The diversity indices were computed by software PAST[®] [3]. The correlation analysis was made using software SPSS.

RESULTS

Bird Diversity

The bird assemblage was recorded in the entire Jakhau creek system during the migratory period reveals total 65 bird species belonging to 17 families (Figure 1) and 38 genera out of which, 49% were migratory, 34% were residential and 17% were resident migratory. Among all the birds, 25 species of wading birds were recorded during the study period. Moreover, eight IUCN red listed species were also recorded, among them Spoonbilled sandpiper (*Calidris pygmaea*) was critically endangered, six species were near threatened and one was recorded as vulnerable (Table 1).

The Shannon wiener diversity of bird species were calculated as 3.05±0.27 (Mean ± SD), the Menhinic index of species richness calculated as 2.10±0.46 and the species evenness calculated as 0.54±0.03. Figure 2 depicts the foraging classification of bird species [12], shows that the congregations of herbivore birds were comparatively lower and they were mainly ducks including Common teal (*Anas crecca*), Eurasian wigeon (*Anas penelope*), Northern showeler (*Anas clypeata*).

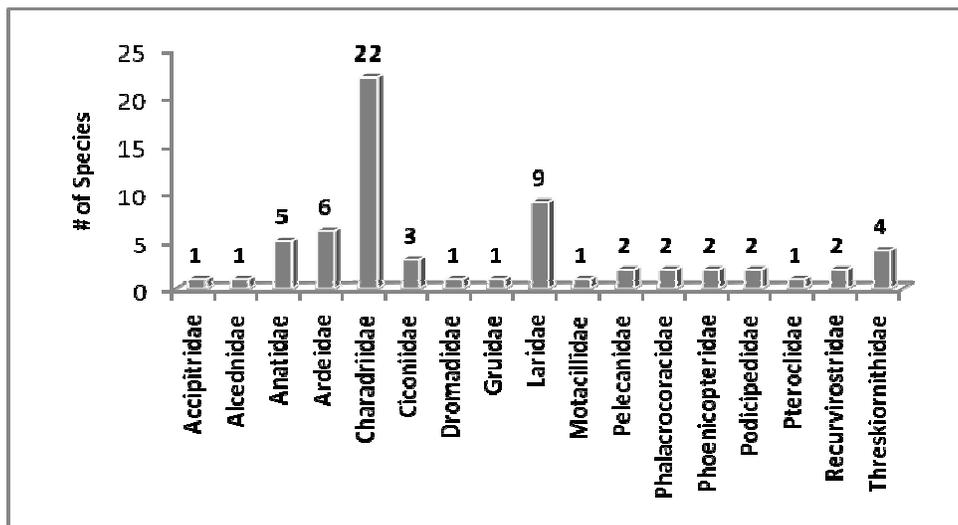


Figure 1: Family wise classification of the bird species recorded in the study area

Ducks are mainly fresh water dwellers and hardly use the saline mangroves wetlands due to less availability of food resources, however their presence indicates that fewer fresh water resources during the study period. The other two groups were visual surface foragers and tactile surface foragers representing mainly waders. Its suggest that the large mudflats of the study area supports good feeding ground for the waders as well as other migratory birds [10].

Macro invertebrate Diversity

Total 3.744 m³ surveyed for sampling of the macro invertebrate during the study period. Total 27 species of macro invertebrate (Table 2) belongs to five major groups’ viz. Polychaetes (30%), Crustaceans (30%), Gastropods (26%), Bivalves (7%) and Fishes (7%). The Shannon wiener diversity of macro invertebrate species were calculated as 1.90±0.14, the Menhinc index of species richness calculated as 0.96±0.08 and the species evenness calculated as 0.37±0.09. With compare to other taxonomic group crustaceans found more abundant taxa (48%) where as *Macrophthalmus depressus* was found dominant species of macrofauna during the study period. Polychaetes was found the second dominant taxa (34%) with more abundant *Tubelaria sp.* and *Nereis* species. Gastropods formed third dominant group (18%) of total abundance which was represented dominant species of *Assimineia brevicula* and *Carithidae cingulata*. The other two groups like bivalvia and fishes are less captured during the study period.

With respect to density of birds and macro invertebrate, the density of bird ranges between 780 to 5995 per km² and the density of macro invertebrate are ranges between 292 to 545 per m³. Figure 3 shows the strong positive correlation between the bird and macro invertebrate densities (R²=0.912).

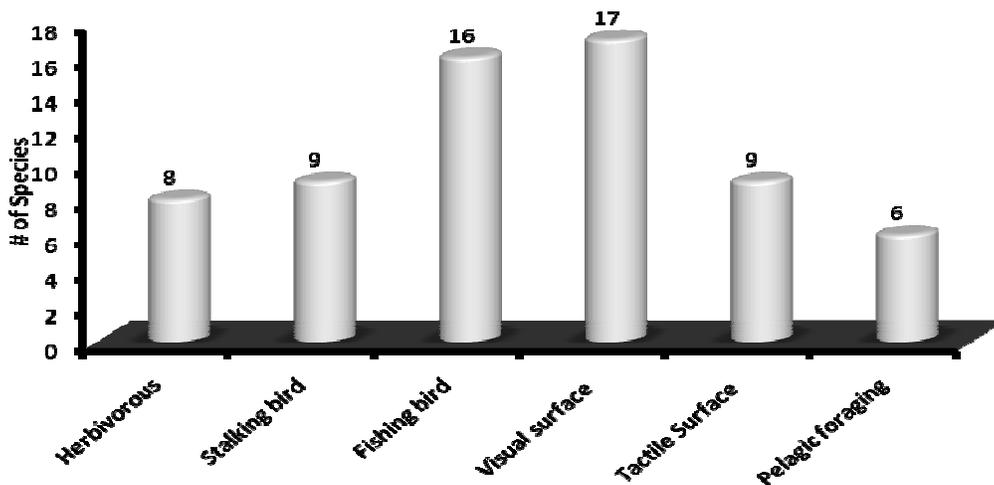


Figure 2: Classification of bird species according to their foraging guilds

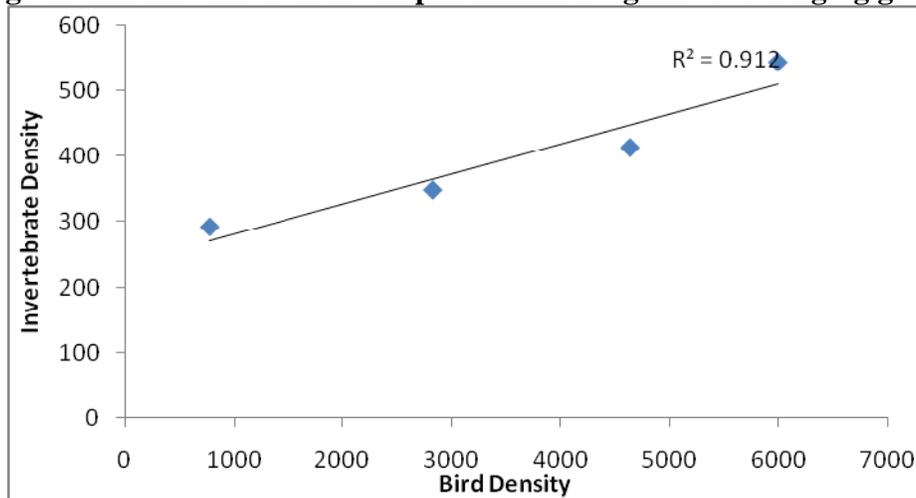


Figure 3: Correlation between birds and macro invertebrate density

Table 1: Checklist of bird species at Jakhau Mangrove sites

Family	Common Name	Scientific Name	IUCN Status 2012	Residential Status
Accipitridae				
1	Brahminy Kite	<i>Haliastur indus</i>	LC	R
Alcednidae				
2	White-Throated Kingfisher	<i>Halcyon smirnmensis</i>	LC	R
Anatidae				
3	Common teal	<i>Anas crecca</i>	LC	M
4	Eurasian Wigeon	<i>Anas penelope</i>	LC	M
5	Northeren Shoveler	<i>Anas clypeata</i>	LC	M
6	Northern Pintail	<i>Anas acuta</i>	LC	M
7	Spot Billed Duck	<i>Anas poecilorhyncha</i>	LC	R
8	Great Egreat	<i>Casmerodius albus</i>	LC	R
9	Grey Heron	<i>Ardea cinerea</i>	LC	R
10	Indian Pond Heron	<i>Ardeola grayii</i>	LC	R
11	Intermediate Egreat	<i>Mesophoyx intermedia</i>	LC	R
12	Little Egreat	<i>Egretta Garzetta</i>	LC	R
13	Western Reef egreat	<i>Egretta gularis</i>	LC	R
Charadriidae				
14	Bar tailed godwit	<i>Limosa lapponica</i>	LC	M
15	Black Tailed godwit	<i>Limosa limosa</i>	NT	M
16	Common green shank	<i>Tringa nebularia</i>	LC	M
17	Common redshank	<i>Tringa totanus</i>	LC	M
18	Common ringed plover	<i>Charadrius hiaticula</i>	LC	M
19	Common sandpiper	<i>Actitis hypoleucos</i>	LC	M
20	Curlew Sandpiper	<i>Calidris ferruginea</i>	LC	M
21	Dunline	<i>Calidris alpina</i>	LC	M
22	Eurasian Curlew	<i>Numenius arquata</i>	NT	M
23	Green Sandpiper	<i>Tringa ochropus</i>	LC	M
24	Grey Plover	<i>Pluvialis squatarola</i>	LC	M
25	Kentish plover	<i>Charadrius alexandrinus</i>	LC	RM
26	Little ringed plover	<i>Charadrius dubius</i>	LC	RM
27	Little Stint	<i>Calidris minuta</i>	LC	M
28	Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC	M
29	Red naked Phalarope	<i>Phalaropus lobatus</i>	LC	M
30	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC	R
31	Sanderling	<i>Calidris alba</i>	LC	M
32	Spoonbilled sandpiper	<i>Calidris pygmea</i>	CR	M
33	Whimbler	<i>Numenius phaeopus</i>	LC	M
34	Wood Sandpiper	<i>Tringa glareola</i>	LC	M
35	Yellow-wattled Lapwing	<i>Vanellus malabaricus</i>	LC	R
Ciconiidae				
36	Black-Necked Stork	<i>Ephippiorhynchus asiaticus</i>	NT	R
37	Painted stork	<i>Mycteria leucocephala</i>	NT	R
38	Woolly-Necked Stork	<i>Ciconia episcopus</i>	LC	R
Dromadidae				
39	Crabe Plover	<i>Dromas ardeola</i>	LC	M
Gruidae				
40	Common crane	<i>Grus grus</i>	LC	M

Laridae				
41	Caspian tern	<i>Sterna caspia</i>	LC	RM
42	Common tern	<i>Sterna hirundo</i>	LC	M
43	Gull-Billed turn	<i>Gelochelidon nilotica</i>	LC	M
44	Heuglin's gull	<i>Larus heuglini</i>	LC	M
45	Little Gull	<i>Larus minutus</i>	LC	RM
46	Little Tern	<i>Sterna albifrons</i>	LC	R
47	Pallas's Gull	<i>Larus ichthyetus</i>	LC	M
48	River tern	<i>Sterna aurantia</i>	NT	R
49	Yellow-Leged Gull	<i>Larus cachinnans</i>	LC	M
Motacillidae				
50	Yellow Wagtail	<i>Dendronanthus indicus</i>	LC	M
Pelecanidae				
51	Dalmatian Pelican	<i>Pelecanus crispus</i>	VU	M
52	Great white pelican	<i>Pelecanus onocrotalus</i>	LC	RM
Phalacrocoracidae				
53	Great Cormorants	<i>Phalacrocorax carbo</i>	LC	R
54	Little Cormorant	<i>Phalacrocorax niger</i>	LC	R
Phoenicopteridae				
55	Greater Flamingo	<i>Phoenicopterus ruber</i>	LC	RM
56	Lasser flamingo	<i>Phoenicopterus minor</i>	NT	RM
57	Little Grebe	<i>Tachybaptus ruficollis</i>	LC	R
58	Black-Necked Grebe	<i>Podiceps nigricollis</i>	LC	M
Pteroclididae				
59	Chestnut-Billed Sandgrouse	<i>Pterocles exustus</i>	LC	R
Recurvirostridae				
60	Black-winged Stilt	<i>Himantopus himantopus</i>	LC	R
61	Pied Avocet	<i>Recurvirostra avosetta</i>	LC	RM
Threskiornithidae				
62	Black Ibis	<i>Pseudibis papillosa</i>	LC	R
63	Eurasian Spoonbill	<i>Platalea leucorodia</i>	LC	RM
64	Glossy Ibis	<i>Plegadis falcinellus</i>	LC	RM
65	White ibis	<i>Threskiornis melanocephalus</i>	LC	RM

DISCUSSION

The result obtained in the present study revealed that the creek covered by mangroves supports diverse macro invertebrate and hence offer as a good feeding ground for aquatic birds. Total 65 birds and 27 macro invertebrate species were recorded in the mangrove creek system. Mangroves often found supporting good bird congregation during the migratory seasons, as Zockler et al (2005) [16] found 62 bird species in the Indian Sunderbans. Out of 80 bird species recorded in the Gulf of Kachchh in migratory season [2], 65 species were recorded in Jakhau creek in present study indicating the importance of mangroves for bird congregation. Similarly, 62 species of macro invertebrate was recorded by Kumar [13] in the same region; however the present study includes the macro invertebrates only during the migratory season. The less number species found in the study area could be result of restricted methodology, season and limited sampling area. The waders are found more abundant within the study area because of extensive mudflat and availability of prey species like macro invertebrate. The coastal area of Saurashtra and Kachchh are reckoned to be on a major birds flyway through the Indian subcontinent. The main route of the birds that sweep in to India from the North and Northwest in autumn and out in the reverse direction in spring [6]. The present study area also falls on this route and representing more migratory birds. Studying populations in addition to species richness, by parameter such as relative density and diversity are frequently used as indicators to predict any habitat quality and condition [9].

In present study the diversity indices of the birds and macro invertebrate depict quite high in the month of December and March indicating the migratory stay over of the birds especially for feeding. The strong positive correlation between bird and macro invertebrate densities reflects the high congregation of birds in this area due to more availability of food. Finally the result indicated spatial and temporal variation in occurrence, distribution and density, composition of macro invertebrate and bird abundance in the mangrove ecosystem. The study also suggests that the bird and macro invertebrate composition can be used for rapid assessment of mangrove ecosystems. Regular monitoring of such sites may help in conservation of migratory birds and management of important bird areas in Gulf of Kachchh.

Table 2: Checklist of Macro Invertebrate Species

No.	Species Name
Bivalves	
1	<i>Arca sp.</i>
2	<i>Dosinia sp.</i>
Crustaceans	
3	<i>Macrophthalmus depressus</i>
4	<i>Balanus amphitrite</i>
5	<i>Uca dussumieri</i>
6	<i>Scylla Serrata</i>
7	<i>Eriopisa sp.</i>
8	<i>Sesarma Brockii</i>
9	<i>Dotilla myctiroides</i>
10	<i>Uca acuta</i>
Gastropoda	
11	<i>Thalassina anomala</i>
12	<i>Nassarius stolatus</i>
13	<i>Assiminea brevicula</i>
14	<i>Carithidae cingulata</i>
15	<i>Carithidae Obtusa</i>
16	<i>Littorina scabra</i>
17	<i>Onchidium verruculatum</i>
Polychaetes	
18	<i>Thalehasapia tenuis</i>
19	<i>Marphysa Stragulam</i>
20	<i>Nereis sp.</i>
21	<i>Capitella Capitata</i>
22	<i>Tubelaria sp.</i>
23	<i>Eunice sp.</i>
24	<i>Diapatra neopolitana</i>
25	<i>Perinereis sp.</i>
Fishes	
26	<i>Boleophthalmus sp.</i>
27	<i>Periophthalmus sp.</i>

CONCLUSION

The study concludes that the Jakhau creek can be one of the important bird areas with respect to migratory birds and waders and require attention for conservation. Saltpans in the area also plays key role in maintaining the water level which supports considerable population of waders in the area. Protection of natural mangrove sites and planting mangroves around the saltpans may help in the conservation of migratory birds. The finding of the present study may provide useful information to prepare population dynamics model of the mangrove ecosystem and the rapid assessment of the aquatic ecosystems using birds and macro fauna as a key indicator.

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