

COMMUNITY STRUCTURE OF WATERBIRDS IN THADDUVANKODDY, KAPPUTHU AND NAGARKOVIL IN THE NORTHERN REGION OF SRI LANKA

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Abstract

Waterbirds use many kind of coastal wetlands including swamps, lagoons, estuaries, bays, mudflats and open beaches. The present study was conducted to assess the community structure of waterbird families in Thadduvankoddy, Kapputhu and Nagarkovil in Jaffna Peninsula. Three counting blocks in length of 500 m with open width was selected in each site and counting of birds was done once a month from December, 2016 to November, 2017. A total of 67 waterbird species representing 19 families were recorded in three sites (55 species in Thadduvankoddy, 59 in Kapputhu and 51 in Nagarkovil). The highest measures of species richness (59), mean density of waterbirds \pm SE(24.72 \pm 3.33birds km⁻²), Shannon-Wiener diversity (2.91), Pielou's evenness (0.72), Margalef richness (6.15) and Berger Parker dominance (0.27) indices were recorded in Kapputhu. Flamingos were the most dominant group of birds in all three sites (32.65%, 27.30 % and 29.05 % in Thadduvankoddy, Kapputhu and Nagarkovil respectively, followed by migrant ducks in Thadduvankoddy (30.54 %) and in Kapputhu (17.07). Cormorants and darters were the dominant group of birds followed by flamingos in Nagarkovil. The two-way ANOVA revealed that the abundance of waterbirds significantly varied temporally among different months ($p=0.05$) in the three sites. That might be due to the migration of waterbirds and availability of water. The difference in waterbird species composition and the diversity indices could be due to the variation in habitat heterogeneity, availability of food and water resources. Thadduvankoddy provided habitat for wide array of waterbirds from October to March, 2017. Flamingos and ducks were the most dominant groups of birds in Thadduvankoddy. However, the site in Thadduvankoddy got completely dry from April to August, 2017 and it was a seasonal wetland during the rainy season. The availability of sufficient water level throughout the year makes Kapputhu, an excellent habitat for wide variety of waterbirds especially flamingos and ducks. However, Thadduvankoddy got completely dry during dry season. Comparatively deeper water (>1 m) and dense mangroves in Nagarkovil provided suitable habitats for cormorants and darters for feeding and roosting. However, the drop in water level during dry season made the habitat suitable for wide array of waterbirds including flamingos. Thus, the findings revealed that community structure of waterbirds depend on temporal variation of water level and availability of sufficient water.

Keywords: Community structure, waterbirds, Northern wetlands

Introduction

Coastal wetlands are prominent habitats for many waterbirds. Waterbirds use many kind of coastal wetlands including swamps, lagoons, estuaries, bays, mudflats and open beaches. Knowledge on population and community structure of waterbirds and their habitats are necessary for conservation strategies ^[1]. Studies on waterbird communities are limited in Thadduvankoddy, Kapputhu and Nagarkovil, as these areas were inaccessible nearly for three decades due to the armed conflict ^[2,3,4,5]. Therefore, the present study will fill the gaps on ornithological studies in these coastal wetlands. The present study compared diversity and abundance of waterbird species among three different habitats, Thadduvankoddy, Kapputhu and Nagarkovil in the northern region of Sri Lanka, to determine species composition and community structure of waterbird families in the region.

Materials and Methods

The present study was carried out in three locations namely, Thadduvankoddy in the Kandavalai DSD (9^o 30' 0" N, 80^o 25' 0" E), Kapputhu in the Vadamaradchi South West DSD (9^o 44' 09" N, 80^o 10' 48" E), and Nagarkovil in the Vadamaradchi East DSD (9^o 36' 00" N, 80^o 17' 00" E).



Figure 01. The three study sites, Thadduvankoddy, Kapputhu and Nagarkovi

The site in Thadduvankoddy is a marsh filled with water during rainy season, used by various resident and migrant waterbirds for feeding. This land got completely dry during dry season and the land was used by public for walking as a short route to reach their village. Kapputhu can be described as salt marsh with mangroves. *Excoecaria agallocha* is the dominant mangrove species and *Lumnitzera racemosa* is common in Kapputhu^[6]. Nagarkovil consists of dense mangroves. Recently, Nagarkovil has declared as a Nature Reserve by Department of Wildlife Conservation.

Bird counting was done once a month from December, 2016 to November, 2017. Three counting blocks in length of 500 m with open width along a transect line were selected for bird counting. Each block was separated at least by 500 m to avoid double counting as most were open areas. All the waterbirds were counted during dawn, noon and dusk on alternate months from 0600 h –1800 h to capture temporal variations by walking along the transect line^[7]. Waterbird species were identified ^[8] and counted using binoculars (10 x 50) and spotting scope (60 x)a standard field guide.

Data Analysis

Diversity indices such as Shannon Diversity Index (H), Pielou Index (J), Margalef’s Richness Index and Berger-Parker Dominance Index were used to compare the diversity and abundance of waterbirds in three study sites^[9]. The relative abundance was compared for families of waterbirds recorded. Two-way ANOVA was also performed by using SPSS (21) to find out the variations in the diversity and abundance of birds in relation to time and space.

Results and Discussion

A total of 67 waterbird species, representing 19 families were recorded in three wetlands in Thadduvankoddy, Kapputhu and Nagarkovil in the northern region of Sri Lanka. Occurrence of 39 waterbird species in all three habitats indicated that these sites are suitable habitats of wide array of waterbird species. The recording of 55 species in Thadduvankoddy, 59 in Kapputhu and 51 in Nagarkovil showed that Kapputhu had attracted more waterbird species compared to Thadduvankoddy and Nagarkovil (Table 01). The difference in species composition and the diversity indices could be due to variation in habitat heterogeneity, availability of food and water resources. Habitat heterogeneity including, mangroves, marshlands and mudflats in Kapputhu make it a suitable habitat for waterbirds throughout the year.

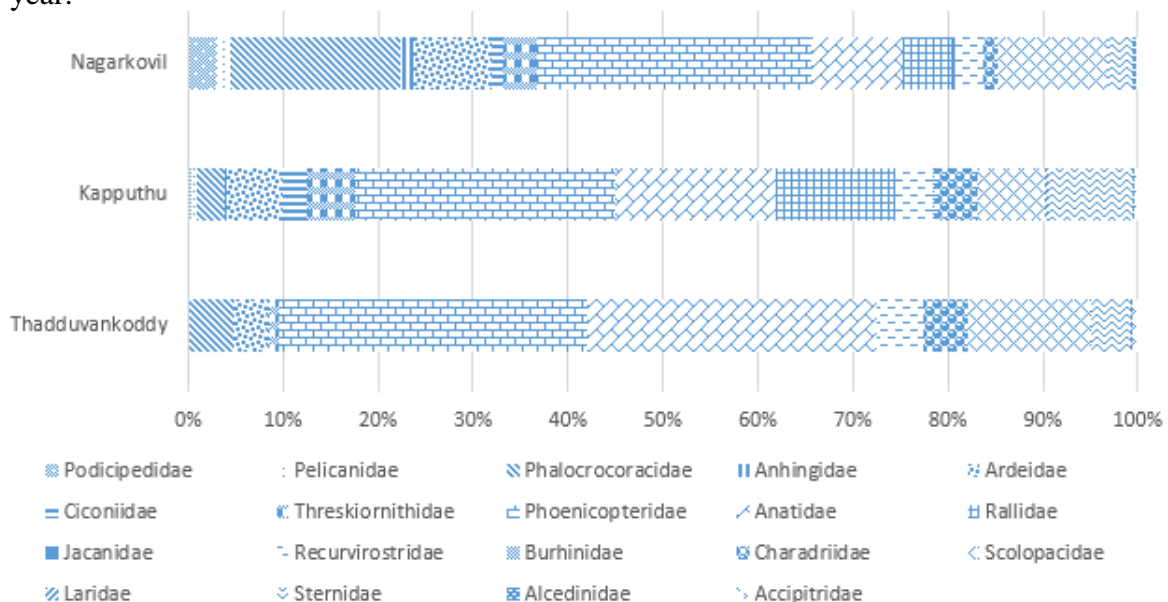


Figure 02: Composition of waterbird families (%) in three locations; Thadduvankoddy, Kapputhu and Nagarkovil.

Family Phoenicopteridae (represented by flamingos) was the most dominant family in all three sites (32.65%, 27.30 % and 29.05 % in Thadduvankoddy, Kapputhu and Nagarkovil respectively), followed by family Anatidae (represented by ducks) in Thadduvankoddy (30.54 %) and in Kapputhu (17.07%) (Figure 02). This could be due to the availability of sufficient water level in Thadduvankoddy and Kapputhu. Family Phalacrocoracidae (represented by cormorants and darters) was the dominant family next to Phoenicopteridae in Nagarkovil.

Table 01. Comparison of species richness, Mean density (birds /km²) (square-root transformed) (±SE), and diversity, evenness, richness and dominance indices among three selected locations.

	Thadduvankoddy	Kapputhu	Nagarkovil
Species Richness	55	59	51
Mean density (birds/km²) transformed (±SE)	20.27 (±3.98)	24.72 (±3.33)	22.48 (±2.66)
Shannon-Wiener diversity Index	2.46	2.91	2.68
Pioulou's Evenness Index	0.61	0.72	0.69
Margalef richness Index	5.95	6.15	5.44
Berger Parker dominance Index	0.33	0.27	0.29

The two way ANOVA (Table 02) revealed that the abundance of waterbirds significantly varied temporally in different months ($p=0.05$) in the three sites due to the migration of waterbirds, availability of water and food. Water level in Thadduvankoddy eventually decreased and the study site in Thadduvankoddy turned completely dry during dry season and the land was used for public transportation. This was a seasonal wetland in Thadduvankoddy during the rainy season. However, sufficient water level was available for waterbirds throughout the year in Kapputhu. Presence of deep water (> 1 m) and dense mangroves makes the habitat suitable for diving waterbirds including cormorants and darters in Nagarkovil. These bird species use mangroves for roosting. When water level decrease to less than 1 m during dry season, this site in Nagarkovil was used by wide array of waterbirds. Flamingos were the most dominant during that period. Drying of the major wetlands in the region and the sufficient level of water in Nagarkovil (< 1 m) during June, July and August, 2017 might be reasons for the occurrence of flamingos and other waterbirds in Nagarkovil during such period.

Table 02. Summary of two-way ANOVA for total abundance of waterbirds among months and sites, and their interactions

Source	Degrees of freedom	F	Significance (<0.05)
Month	11	2.330	0.016
Site	2	0.417	0.661
Month * Site	22	1.524	0.093

Conclusion

The findings of this study revealed that Thadduvankoddy, Kapputhu and Nagarkovil are suitable habitats for many waterbirds. This might be due to the habitat heterogeneity and availability of food and water resources. Thadduvankoddy is a seasonal wetland during rainy season and provided suitable habitat for wide array of waterbirds. Flamingos and ducks were the most dominant in Thadduvankoddy. The site got completely dry during the dry season. The availability of sufficient water level throughout the year makes Kapputhu, an excellent habitat for wide variety of waterbirds throughout the year. Comparatively deeper water in Nagarkovil (>1 m) and dense mangroves in Nagarkovil provided suitable habitat for cormorants and darters for feeding and roosting. However, the drop in water level during June, July and August make the habitat suitable for wide array of waterbirds including flamingos. Thus, community structure of waterbirds depends on temporal variation of water level and availability of sufficient water.

Table 03: Status of waterbird species in the three study sites

	Family name	Common Name	Scientific Name	Resident / Migrant	NCS	GCS
1	Podicipedidae	Little Grebe	<i>Tachybaptus ruficollis</i>	R	LC	LC
2	Pelecanidae	Spot-billed Pelican	<i>Pelecanus philippensis</i>	R	LC	NT
3	Phalacrocoracidae	Indian Cormorant	<i>Phalacrocorax fuscicollis</i>	R	LC	LC
4	Phalacrocoracidae	Little Cormorant	<i>Phalacrocorax niger</i>	R	LC	LC
5	Anhingidae	Oriental Darter	<i>Anhinga melanogaster</i>	Uncommon R	LC	NT
6	Ardeidae	Grey Heron	<i>Ardea cinerea</i>	R	LC	LC
7	Ardeidae	Purple Heron	<i>Ardea purpurea</i>	R	LC	LC
8	Ardeidae	Great Egret	<i>Egretta alba</i>	R	LC	LC
9	Ardeidae	Intermediate Egret	<i>Ardea intermedia</i>	R	LC	LC
10	Ardeidae	Little Egret	<i>Egretta garzetta</i>	R	LC	LC
11	Ardeidae	Cattle Egret	<i>Ardea ibis</i>	R,M?	LC	LC
12	Ardeidae	Indian Pond Heron	<i>Ardeola grayii</i>	R	LC	LC
13	Ardeidae	Striated Heron	<i>Butorides striatus</i>	R	LC	LC
14	Ardeidae	Yellow Bittern	<i>Ixobrychus sinensis</i>	R,M	NT	LC
15	Ciconiidae	Painted Stork	<i>Mycteria leucocephala</i>	R	LC	NT
16	Ciconiidae	Asian Openbill	<i>Anastomus oscitans</i>	R	LC	LC
17	Threskiornithidae	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	R	LC	NT
18	Threskiornithidae	Glossy Ibis	<i>Plegadis falcinellus</i>	M		LC
19	Threskiornithidae	Eurasian Spoonbill	<i>Platalea leucorodia</i>	R	LC	LC
20	Phoenicopteridae	Greater Flamingo	<i>Phoenicopterus roseus</i>	M		LC
21	Anatidae	Lesser Whistling Teal	<i>Dendrocygna javanica</i>	R	LC	LC
22	Anatidae	Eurasian Wigeon	<i>Anas penelope</i>	M		LC
23	Anatidae	Northern Shoveller	<i>Anas clypeata</i>	M		LC
24	Anatidae	Northern Pintail	<i>Anas acuta</i>	M		LC
25	Anatidae	Garganey	<i>Anas querquedula</i>	M		LC
26	Anatidae	Spot-billed Duck	<i>Anas poecilorhyncha</i>	R,M?	CR	LC
27	Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	R	LC	LC
28	Rallidae	Purple Swamphen	<i>Porphyrio porphyrio</i>	R	LC	LC

29	Rallidae	Common coot	<i>Fulica atra</i>	R	LC	LC
30	Rallidae	Common Moorhen	<i>Gallinula chloropus</i>	R	LC	LC
31	Jacaniidae	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	R	LC	LC
32	Recurvirostridae	Black-winged Stilt	<i>Himantopus himantopus</i>	R,M	LC	LC
33	Burhinidae	Great Thick-knee	<i>Esacus recurvirostris</i>	R	LC	LC
34	Charadriidae	Yellow-wattled Lapwing	<i>Vanellus malabaricus</i>	Uncommon R	LC	LC
35	Charadriidae	Red-wattled Lapwing	<i>Vanellus indicus</i>	R	LC	LC
36	Charadriidae	Asiatic Golden Plover	<i>Pluvialis fulva</i>	M		LC
37	Charadriidae	Common Ringed Plover	<i>Charadrius hiaticula</i>	M		LC
38	Charadriidae	Little Ringed Plover	<i>Charadrius dubius</i>	R,M	VU	LC
39	Charadriidae	Kentish Plover	<i>Charadrius alexandrinus</i>	R,M	VU	LC
40	Charadriidae	Monglian Plover	<i>Charadrius mongolus</i>	M		LC
41	Scolopacidae	Black-tailed Godwit	<i>Limosa limosa</i>	M		NT
42	Scolopacidae	Whimbrel	<i>Numenius phaeopus</i>	M		LC
43	Scolopacidae	Eurasian Curlew	<i>Numenius arquata</i>	M		NT
44	Scolopacidae	Common Redshank	<i>Tringa totanus</i>	M		LC
45	Scolopacidae	Common Greenshank	<i>Tringa nebularia</i>	M		LC
46	Scolopacidae	Green Sandpiper	<i>Tringa ochropus</i>	M		LC
47	Scolopacidae	Marsh Sandpiper	<i>Tringa stagnatilis</i>	M		LC
48	Scolopacidae	Wood Sandpiper	<i>Tringa glareola</i>	M		LC
49	Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>	M		LC
50	Scolopacidae	Pintail Snipe	<i>Gallinago stenura</i>	M		LC
51	Scolopacidae	Little Stint	<i>Calidris minuta</i>	M		LC
52	Scolopacidae	Curlew Sandpiper	<i>Calidris ferruginea</i>	M		NT
53	Laridae	Great Black- headed Gull	<i>Larus ichthyaetus</i>	M		LC
54	Laridae	Brown-headed Gull	<i>Larus brunnicephalus</i>	M		LC
55	Sternidae	Whiskered Tern	<i>Chlidonias hybridus</i>	M		LC
56	Sternidae	White-winged Tern	<i>Chlidonias leucopterus</i>	M		LC
57	Sternidae	Gull-billed Tern	<i>Sterna nilotica</i>	M,R	CR	LC
58	Sternidae	Caspian Tern	<i>Sterna caspia</i>	R,M	CR	LC
59	Sternidae	Little Tern	<i>Sterna albifrons</i>	R	VU	LC
60	Sternidae	Lesser-Crested Tern	<i>Sterna bengalensis</i>	M		LC
61	Sternidae	Great-crested Tern	<i>Sterna bergii</i>	R	NT	LC
62	Alcedinidae	Pied Kingfisher	<i>Ceryle rudis</i>	R	LC	LC
63	Alcedinidae	Common Kingfisher	<i>Alcedo atthis</i>	R	LC	LC
64	Alcedinidae	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	R	LC	LC
65	Accipitridae	Brahminy Kite	<i>Haliastur indus</i>	R	LC	LC
66	Accipitridae	Black Kite	<i>Milvus migrans</i>	R	LC	LC
67	Accipitridae	White-bellied Fish Eagle	<i>Haliaeetus leucogaster</i>	R	LC	LC

Reference

1. Hanski, I.A. & Gilpin, M.E. Metapopulation biology: ecology, genetics, and evolution. *San Diego, CA: Academic Press*. 1997.
2. Kandasamy G., Weerakoon, D. K., Sivaruban, A., & Jayasiri, H. B. Spatial variation of waterbirds in eight selected sites in the Northern Province of Sri Lanka, *Australasian Ornithology Conference 2017a*: 47.
3. Kandasamy G., Weerakoon, D. K., & Sivaruban, A. Spatial variation of waterbirds in Pallai and Thadduvankoddy in the Northern Province of Sri Lanka, *Third International Conference on Science, Engineering and Environment, SEE-USQ, 2017, Brisbane, Australia*. 2017b: 124-129.
4. Kandasamy, G., Weerakoon, D. K., & Sivaruban, A. Spatial variation of waterbirds in Kapputhu and Nagarkovil in the Jaffna Peninsula. Forty Years of Bird Research – Field Ornithology Group of Sri Lanka, *FOGSL symposium, Faculty of Science, University of Colombo*. 2017c.
5. Kandasamy, G., Weerakoon, D. K., Sivaruban, A., & Jayasiri, H. B. Diversity and Abundance of Waterbird communities in the Jaffna and Kilinochchi Districts: Where do we have to go from here? *Vingnanam Journal of Science*. 2019, 14 (1): 15-21.
6. Rajkumar, P., Wijesundara, C. S., & Ranawana, K. B. Distribution of mangrove species in Anthanathidal and Kapputhu areas in the Jaffna Peninsula, Sri Lanka. Page 8-8 in *Proceeding of the International Symposium on Mangrove Ecosystems*. 2018 of Seacology-Sudeesa Sri Lanka Mangrove Conservation Program. 2018.
7. Bibi, F., Ali, Z. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *Journal of Animal and Plant Sciences*. 2013. 23(2): 469-474.
8. Harrison, J, A. *A Field Guide to the Birds of Sri Lanka*. Oxford University Press, Oxford. 2011. 208 pp.
9. Magurran, A.E. *Measuring Biological Diversity*. Blackwell Publishing, Oxford, 2004: 256 pp.