Asian Journal of Conservation Biology, December 2021. Vol. 10 No. 2, pp. 308–316 AJCB: FP0175/69837
ISSN 2278-7666 ©TCRP Foundation 2021 https://doi.org/10.53562/ajcb.69837

Research Article

Diversity of Avifauna observed and recorded in Thinnanur Lake in Tiruchirappalli District, Tamil Nadu, India

T. Siva* and P. Neelanarayanan

Research Department of Zoology, Nehru Memorial College (Autonomous & Affiliated to Bharathidasan University), Puthanampatti – 621 007, Tiruchirappalli District, India.

(Received: June 30, 2021; Revised: August 31, 2021; Accepted: September 09, 2021)

ABSTRACT

The avifaunal diversity in the ecosystem act as a pollinators, seeds dispersal agents, scavenger and predators of rodents and insect pest and also an important indicator to evaluate different habitats both qualitatively and quantitatively. Wetlands are one of the important key habitat type for birds for their food, roosting, nesting and rearing young activities. The present study was conducted in Thinnanur lake of Thinnanur village from Tiruchirappalli District, Tamil Nadu. Duration of the study period were conducted during November 2015 to March 2016. A total of 102 birds were observed and recorded and belong 18 orders of 45 families. All the birds recorded in the study area were categorized into 7 ecological groups based on their feeding habits Insectivorous (35.29 %), Omnivorous (24.51 %), Carnivorous (22.55 %), Granivorous (10.78 %), Piscivorous (2.94 %), Nectivorous (2.94 %) and Frugivorous (0.98 %). Among the 102 birds species 84 for resident and 18 for winter migrant. There were 100 species are least concern and remaining 2 is near threatened species observed during the study period.

Key words: Diversity, Avifauna, Wetland, Omnivorous, Survey, least concern, Granivorous

INTRODUCTION

Water birds are an essential component of the wetland ecosystem as they occupy several trophic levels in the food web of wetland nutrient cycles (Dhakate *et al.*, 2008). Birds inhabiting wetlands for feeding, breeding, nesting or roosting are broadly defined as water birds (Kumar *et al.*, 2005). Due to high nutritional value and productivity, it attracts the huge number of migratory and resident bird species (Manikannan *et al.*, 2012). Birds are also regarded as good subjects for exploring a number of questions of ecological and conservation significance (Urfi, 2003). Recent research is focused on the impact of climate change on birds and how the birds are responding for the ongoing climate change pandemonium (Yom-Tov *et al*., 2006; Van Buskirk *et al*., 2010; Gardner *et al*., 2011). India is a home of many species of birds including local as well as migrant birds. Water birds are ecologically dependent on wetlands. They play an important role in human life on culturally, socially, scientifically and as a food resource. The Indian subcontinent supports diverse avifauna (1370 species *i.e*. 13% of the world's birds) and which includes 141 endemic species (Grimmett *et al.,* 2011). Tamil Nadu is known for its rich diversity of avifauna with more than 450 species including several endemic and conservation prioritized species (Islam and Rahmani, 2004). Wetlands and water birds are inseparable elements, wetlands are serve as a reservoir for sustaining native flora and fauna (Surana *et al*, 2007). The aquatic birds are important bio-indicators of lake ecosystems which should be protected to conserve the biodiversity and environment (Siva and Neelanarayanan, 2017a).

According to Gibbs, (1993) wetlands are the productive and biologically diverse and fragile ecosystem. Wetlands are being used for agriculture, aquaculture, reclamation for harboring and industrial purpose, disposing the waste materials, discharging the industrial seasoning, dumping dredged soil, coir retting and for fishing (Nameer, 1998 and Balachandran *et al*., 2002). Among the various habitats, wetlands are considered as one of the most threatened one in the world (Prasad *et al.,* 2015). During the last century, the world has lost over 50% of wetlands due to various human influences, and the remaining of them have declined because of various human activities (Zhijun *et al.,* 2010). Wetlands in India face tremendous anthropogenic pressure mainly due to the release of domestic sewage, industrial effluents, dumping of solid waste, over-exploitation of the natural resources and conversion of wetlands into barren lands. This resulted in biodiversity loss and disturbance of the wetland services (Ramachandra, 2006). This loss of wetlands has dangerously reduced the availability stopover sites for migrating birds and has increased the importance of remaining wetlands to migrants as well as nesting species. The wetlands were prioritized based on birds and size and socioeconomic use of the particular wetlands (Prasad *et al.*, 2004). On that way the current study is the first attempt to explore the avifauna diversity in the Thinnanur Lake.

MATERIALS AND METHODS

Study area

The study area of Thinnanur Lake is situated in the Thinnanur village of Musiri taluk of Tiruchirappalli

**Corresponding Author's E-mail: sivanaturewild@gmail.com*

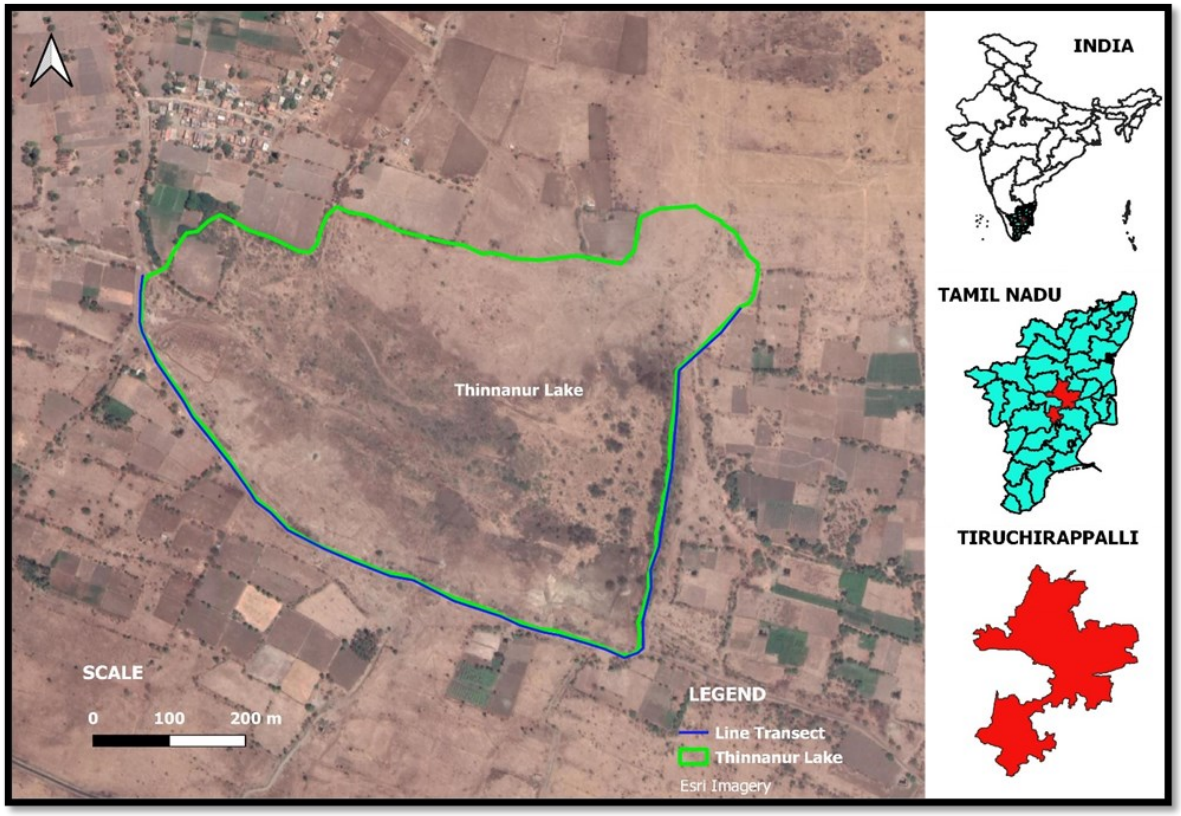


Figure 1. Location of Thinnanur Lake

District. The area of the lake is 31.6 hectares. The location of the study area is Latitude 11°058178 N and Longitude 78°624904 E (Figure 2). The freshwater lake is fed by natural rain waters. The natural vegetation present inside and on the edges of the lake consists of *Prosopis juliflora*, *Azadirachta indica* and *Tamarindus indicus*. The lake was received rain water during the study period. And more than one decade there is no water from the lake. Once the lake is filled with rain water during this season many water birds and migratory birds are visit on this lake. We have done first time in this study in this area for diversity of avifauna.

Methods

The Avifauna were observed in *Thinnanur Lake* during winter on November 2015 and March 2016 of five months. It is preliminary observation study for this place. Line transect method was followed during every week of the early morning 07:00 to 10.00 am and evening 04:00 to 06:00 pm when the bird activity was high (Bibby *et al*., 1998). Birds were sighted by using binoculars Olympus 8-16 x 40 and 10 x 50 zoom and identification was done by field guide Grimmett *et al.* (2011). The birds were photographed by using Nikon 3300 with zoom lens 55 to 200 mm lens.

Figure 2. A view of Thinnanur Lake during December 2015

RESULTS AND DISCUSSION

The Thinnanur Lake is known to attract many birds includes migrants, waterfowls, swimmers, divers, waders and near threatened species. During the present study 102 species of birds were observed and recorded and which belong to 18 orders and 45 families (Table 1). Maximum bird species were recorded from the order belonging to Passeriformes, Accipitriformes, Charadriiformes, Peliconiformes and Anseriformes. The terrestrial birds are in high numbers during study area. The Passeriformes order was represented by 43 bird species that dominated and contributed to the diversity of the terrestrial bird species, this is attributed to the presence of Paddy fields surrounding the lake. The study areas supports 43 passerine and 59 non-passerine bird species. Among the passerines, the best represented family is the Acrocephalidae (4 species), Corvidae, Cisticolidae, Sturnidae, Nectariniidae, Estrildidae and Motacilidae (3 species), and other families represents remaining species. Of the non-passerines, the Accipitridae (10 species) has the most species, followed by Charadriiformes (9 species) and Peliconiformes (6 species). Among the 102 species, 84 (82 %) are resident species and remaining 18 (18 %) winter migrants (species migrates from outside India during winter). The present study indicate out of 102 species of birds 100 birds are Least concern and remaining two species

Table 1. List of birds observed in the Thinnanur Lake

S. No	Order	Family	Common Name	Scientific Name	Status	Food Habit	IUCN Status	WLPA Schedule
1	Anseriformes	Anatidae	Cotton Pygmy-goose	*Nettapus coromandelianus*	RE	O	LC	IV
2			Indian Spot-billed Duck	*Anas poecilorhyncha*	RE	O	LC	IV
3			Northern Shoveler	*Anas clypeata*	WM	O	LC	IV
4			Northern Pintail	*Anas acuta*	WM	O	LC	IV
5			Garganey	*Anas querquedula*	WM	O	LC	IV
6	Galliformes	Phasianidae	Grey Francolin	*Francolinus pondicerianus*	RE	O	LC	IV
7			Indian Peafowl	*Pavo cristatus*	RE	O	LC	I
8	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	RE	C	LC	IV
9	Suliformes	Phalacrocoracidae	Little Cormorant	*Microcarbo niger*	RE	P	LC	IV
10			Indian Cormorant	*Phalacrocorax fusicollis*	RE	P	LC	IV
11	Pelecaniformes	Ardeidae	Intermediate Egret	*Ardea intermedia*	RE	C	LC	IV
12			Little Egret	*Egretta garzetta*	RE	C	LC	IV
13			Cattle Egret	*Bubulcus ibis*	RE	I	LC	IV
14			Indian Pond-Heron	*Ardeola grayii*	RE	C	LC	IV
15			Black-crowned Night-Heron	*Nycticorax nycticorax*	RE	C	LC	IV
16		Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*	RE	C	LC	IV
17	Accipitriformes	Accipitridae	Black-winged Kite	*Elanus caeruleus*	RE	C	LC	I
18			Red-necked Falcon	*Falco chicquera*	RE	C	NT	I
19			Oriental Honey-buzzard	*Pernis ptilorhynchus*	RE	C	LC	I
20			Short-toed Snake Eagle	*Circaetus gallicus*	RE	C	LC	I
21			Booted Eagle	*Hieraaetus pennatus*	WM	C	LC	I
22			White-eyed Buzzard	*Butastur teesa*	RE	C	LC	I
23			Pallid Harrier	*Circus macrourus*	WM	C	NT	I
24			Shikra	*Accipiter badius*	RE	C	LC	I
25			Black Kite	*Milvus migrans*	RE	C	LC	I
26			Brahminy Kite	*Haliastus indus*	RE	C	LC	I

Table 1 continued in next page

27	Gruiformes	Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	RE	O	LC	IV
28			Eurasian Moorhen	*Gallinula chloropus*	RE	O	LC	IV
29			Eurasian Coot	*Fulica atra*	RE	O	LC	IV
30	Charadriiformes	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	RE	I	LC	IV
31		Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	RE	I	LC	IV
32			Little Ringed Plover	*Charadrisu dubius*	RE	I	LC	IV
33		Rostratulidae	Greater Painted-snipe	*Rostratula benghalensis*	RE	O	LC	IV
34		Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	WM	C	LC	IV
35			Wood Sandpiper	*Tringa glareola*	WM	C	LC	IV
36			Green Sandpiper	*Tringa ochropus*	WM	I	LC	IV
37			Marsh Sandpiper	*Tringa stagnatilis*	WM	C	LC	IV
38			Common Greenshank	*Tringa nebularia*	WM	C	LC	IV
39	Pterocliformes	Pteroclidae	Chestnut-bellied Sandgrouse	*Pterocles exustus*	RE	O	LC	IV
40	Columbiformes	Columbidae	Rock Pigeon (Feral Pigeon)	*Columba livia*	RE	G	LC	IV
41			Eurasian Collared-Dove	*Streptopelia decaocto*	RE	G	LC	IV
42			Spotted Dove	*Streptopelia chinensis*	RE	G	LC	IV
43			Laughing Dove	*Spilopelia senegalensis*	RE	G	LC	IV
44	Cuculiformes	Cuculidae	Pied Cuckoo	*Clamator jacobinus*	RE	O	LC	IV
45			Asian Koel	*Eudynamys scolopaceus*	RE	O	LC	IV
46			Southern Coucal	*Centropus sinensis parroti*	RE	O	LC	IV
47			Blue-faced Malkoha	*Phaenicophaeus viridirostris*	RE	I	LC	IV
48			Common Hawk Cuckoo	*Hierococcyx varius*	RE	I	LC	IV

Table 1 continued in next page

49	Bucerotiformes	Upupidae	Eurasian Hoopoe	*Upupa epops*	RE	C	LC	IV
50	Strigiformes	Strigidae	Spotted Owlet	*Athene brama*	RE	C	LC	IV
51	Apodiformes	Apodidae	Alpine Swift	*Tachybaptus melba*	RE	I	LC	IV
52			Asian Palm-Swift	*Cypsiurus balasiensis*	RE	I	LC	IV
53	Coraciiformes	Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*	RE	C	LC	IV
54			Pied Kingfisher	*Ceryle rudis*	RE	P	LC	IV
55		Meropidae	Green Bee-eater	*Merops orientalis*	RE	I	LC	IV
56			Blue-tailed Bee-eater	*Merops philippinus*	WM	I	LC	IV
57		Coraciidae	Indian Roller	*Coracias benghalensis*	RE	I	LC	IV
58	Psittaciformes	Psttiaculidae	Rose-ringed Parakeet	*Psittacula krameri*	RE	G	LC	IV
59	Piciformes	Picidae	Black-rumped Flameback	*Dinopium benghalense*	RE	I	LC	IV
60	Passeriformes	Vangidae	Common Woodshrike	*Tephrodornis pondicerianus*	RE	I	LC	IV
61		Aegithinidae	Common Iora	*Aegithina tiphia*	RE	I	LC	IV
62		Campephagidae	Black-headed Cuckooshrike	*Lalage melanoptera*	RE	I	LC	IV
63		Laniidae	Bay-backed Shrike	*Lanius vittatus*	RE	I	LC	IV
64		Dicruridae	Black Drongo	*Dicrurus macrocercus*	RE	I	LC	IV
65		Monarchidae	Indian Paradise-Flycatcher	*Terpsiphone paradisi*	RE	I	LC	IV
66		Corvidae	Rufous Treepie	*Dendrocitta vagabunda*	Re	O	LC	IV
67			House Crow	*Corvus splendens*	RE	O	LC	V
68			Large-billed Crow	*Corvus macrorhynchos culminatus*	RE	O	LC	IV
69		Alaudidae	Rufous-tailed Lark	*Ammomanes phoenicura*	RE	O	LC	IV
70			Ashy-crowned Sparrow-Lark	*Eremopterix griseus*	RE	O	LC	IV
71			Jerdon's Bushlark	*Mirafra affinis*	RE	I	LC	IV
72		Hirundinidae	Barn Swallow	*Hirundo rustica*	WM	I	LC	IV
73		Acrocephalidae	Booted Warbler	*Iduna caligata*	WM	I	LC	IV
74			Sykes's Warbler	*Iduna rama*	WM	I	LC	IV
75			Blyth's Reed Warbler	*Acrocephalus dumetorum*	WM	I	LC	IV
76			Clamorous Reed Warbler	*Acrocephalus stentoreus*	WM	I	LC	IV

Table 1 continued in next page

77	Passeriformes	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	RE	O	LC	IV
78			White-browed Bulbul	*Pycnonotus luteolus*	RE	O	LC	IV
79		Leiothrichidae	Yellow-billed Babbler	*Turdoides affinis*	RE	I	LC	IV
80			Large Grey Babbler	*Argya malcolmi*	RE	I	LC	IV
81		Cisticolidae	Zitting Cisticola	*Cisticola juncidis*	RE	I	LC	IV
82			Common Tailorbird	*Orthotomus sutorius*	RE	I	LC	IV
83			Plain Prinia	*Prinia inornata*	RE	I	LC	IV
84		Sylviidae	Hume's Whitethroat	*Sylvia althaea*	RE	I	LC	IV
85		Muscicapidae	Indian Robin	*Copsychus fulicatus*	RE	I	LC	IV
86			Pied Bushchat	*Saxicola caprata*	RE	I	LC	IV
87		Sturnidae	Rosy Starling	*Pastor roseus*	WM	O	LC	IV
88			Brahminy Starling	*Sturnia pagodarum*	RE	O	LC	IV
89			Common Myna	*Acridotheres tristis*	RE	O	LC	IV
90		Dicaeidae	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	RE	F	LC	IV
91		Nectariniidae	Purple-rumped Sunbird	*Leptocoma zeylonica*	RE	N	LC	IV
92			Purple Sunbird	*Cinnyris asiaticus*	RE	N	LC	IV
93			Loten's Sunbird	*Cinnyris lotenius*	RE	N	LC	IV
94		Motacillidae	White Wagtail	*Motacilla alba*	WM	I	LC	IV
95			White-browed Wagtail	*Motacilla maderaspatensis*	RE	I	LC	IV
96			Paddyfield Pipit	*Anthus rufulus*	RE	I	LC	IV
97		Passeridae	House Sparrow	*Passer domesticus*	RE	G	LC	IV
98			Chestnut-shouldered Petronia	*Gymnoris xanthocollis*	RE	G	LC	IV
99		Ploceidae	Baya Weaver	*Ploceus philippinus*	RE	G	LC	IV
100		Estrildidae	Indian Silverbill	*Euodice malabarica*	RE	G	LC	IV
101			White-rumped Munia	*Lonchura striata*	RE	G	LC	IV
102			Scaly-breasted Munia	*Lonchura punctulata*	RE	G	LC	IV

RE – Resident, WM – Winter Migrant, O – Omnivorous, C – Carnivorous, P – Piscivorous, I – Insectivorous, G – Granivorous, F – Frugivorous, N – Nectivorous, LC – Lease Concern, NT – Near Threatened

for Red necked Falcon and Pallied Harrier are Near Threatened species.

In the present study bird species are separated based on the food habits. There were 7 types of food habitat species observed in the study period (Figure 2). Insectivorous birds are highest for 36 species (35.29 %) followed by Omnivorous for 25 (24.51 %), Carnivorous for 23 (22.55 %), Granivorous for 11 (10.78 %), Piscivorous for 3 (2.94 %), Nectivorous for 3 (2.94 %) and Frugivorous for 1 (0.98 %) (Table 2; Figure 3). During the study period the birds were listed as Wildlife Protection Act 1972 under schedule list. From the list 11 species were categorized Schedule I, 90 species are Schedule IV and 1 species for Schedule V. The bird watching is a good hobby of humans to concentrate on nature and birds for worldwide. The migratory birds across the globe has been long recognized as a natural wonder. Each year, water birds fly thousands of kilometers across a vast range of climates and habitats, in response to the urge to nest or to avoid adverse weather conditions. (Arun Kumar, 2003).

Table 2. Month wise number of species during the study period

Sl. No	Month & Year	Number of Species	Total Number of birds observed
1	November 2015	51	707
2	December 2015	75	2187
3	January 2016	80	2150
4	February 2016	83	2419
5	March 2016	63	850

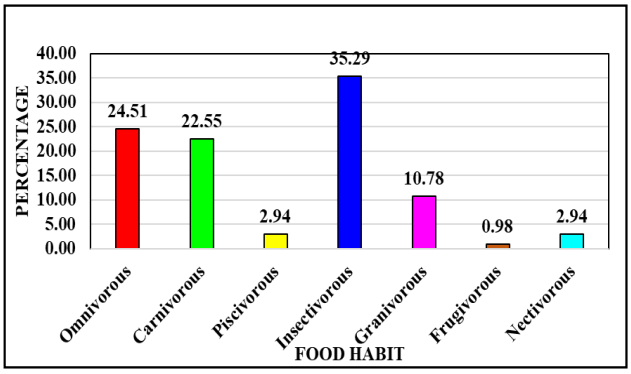


Figure 3. Percentage of food habits from Thinnanur Lake

During the present study the number of species increased every month and decreased at the end of March. And numbers also increased during the February 2016. The maximum species observed for 83 in the month of February 2016 (Fig.4.). However, it was observed that the water cover in the wetland reduces drastically in the month of February itself and some amount of water was used for agriculture purpose.

This study provides a baseline data of the avian diversity of Thinnanur Lake. There was a fluctuation in birds number of different months during the study time. This may be due to the influence of the season as well as the agriculture practice of this area. Apart from that several reports confirmed that seasonal variation, local migration pattern, reproductive behaviour, latitude and

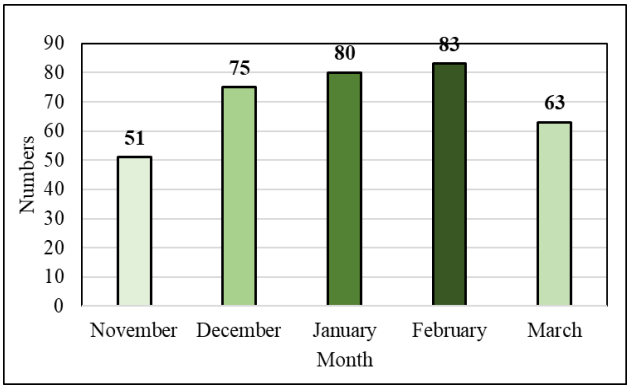


Figure 4. Month wise number of species observed from Thinnanur Lake

the regional and global microclimatic events and erratic climate might also influence the birds number in any habitat (Pittock, 2003, Romano *et al*., 2005). The species composition of a specific area or a community is interlinked to the available resources of the area, which includes physical structure of the habitat, food availability and biotic interactions (Terdalkar *et al*., 2005). The results indicate that the current study area fulfills all the requirements for the recorded avifauna.

Siva and Neelanarayanan (2017) have reported 94 species of birds from Koothappar big tank in Tiruchirappalli Distirct. Siva and Neelanarayanan (2019) have prepared a checklist of birds of Puthanampatti Lake, where they have listed 75 species of birds. Lakshmanan *et al.,* (2020) have made a checklist of birds covering Thuraiyur lake, which consisted of 64 bird species. According to Muthusamy *et al*., (2021) reported 68 species of birds in three different wetlands of Perambalur Distirct. The present findings verify the views of (Siva and Neelanarayanan, 2017; Siva and Neelanarayanan, 2019; Lakshmanan *et al*., 2020 and Muthusamy *et al*., 2021) had reported the presence of bird species of aquatic avifauna from different families almost same species from the present study. Apart from the above report from food habits birds are almost similar in the present study. From the above information a detailed study is required to know the role of birds in the future bird related studies.

CONCLUSION

Present study illustrates the importance of the area as a good habitat for avifauna. There were 102 species of birds, belonging to eighteen orders and forty five families, were recorded during the study. The results of the present study indicate that if water is available from the lake there would be more number of both wetland and terrestrial birds. After that there is no water from 2016 May to till date. And number of bird species also decreased, only terrestrial birds were observed after that period. Once the lake receive the water from rainfall it could be change of wetland birds sighting in future.

ACKNOWLEDGEMENT

We are highly grateful to the Principal and the Management of Nehru Memorial College (Autonomous) for their help and encouragement. We thank Mr. T. Mohan Raj and Mr. N. Subash Nachimuthu, of Nehru Memorial College, for their help during many of our field visits during this bird survey.

Annexure I: Photo plate of selected bird species

Cotton Pygmy-goose

Indian Spot-billed Duck

Garganey

Indian Peafowl

Indian Pond-Heron

Glossy Ibis

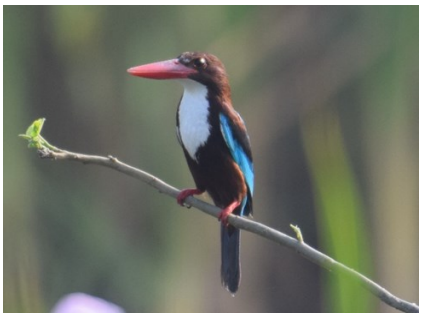
Black-winged Kite

Red-necked Falcon

White-eyed Buzzard

Eurasian Coot

Black-winged Stilt



White-throated Kingfisher

Chestnut-bellied Sandgrouse

Blue-faced Malkoha

Indian Roller

REFERENCES

Balachandran, P.V., G. Mathew and Peter, K.V. 2002. Wetland agriculture problems and prospects. pp: 50-68. In: Wetland Conservation and Management in Kerala (Ed.) Jayakumar. State committee on Science Technology and Environment, Thiruvananthapuram.

Bibby, C., Jones, M. and Marsden, S. 1998. *Expedition Field Techniques: Bird Surveys*. Royal Geographical Society, London.

Dhakate, P.M., Tejaswini, A., Patil. and Rajiv Bhartari. 2008. Wetland Birds of Corbett Tiger Reserve Landscape, Sengupta, M. and Dalwani, R. (Editors). *Proceedings of Taal*: The 12th World Lake Conference, 1974-1982.

Gardner, J.L., Peters, A., Kearney, M.R., Joseph, L. and Heinsohn, R. 2011. Declining body size: third universal response to warming? *Trends in Ecology and Evolution.* 26, 285– 291.

Gibbs, J. P. 1993. The importance of small wetlands for the persistence of local populations of wetland-associated animals. *Wetlands.* 13: 25-31. http://dx.doi.org/10.1007/BF03160862.

Grimmett, R., Inskipp, C. and Inskipp, T. 2011. Birds of the Indian subcontinent. Oxford University Press, New Delhi. pp. 528.

Islam, M.Z. and Rahmani, A.R. 2004. *Important Bird Areas in India: Priority Sites for Conservation*. Indian Bird Conservation Network: Bombay Natural History Society and Birdlife International (UK), xviii+1133pp.

Kumar, A., Sati, J.P., Tak, P.C. and Alfred, J.R.B. 2005. Handbook on Indian Wetland Birds and their Conservations, *Zoological Survey of India*, 472.

Lakshmanan, G., Siva, T., Muthusamy, A. and Neelanarayanan, P. 2020. Avifaunal diversity observed in the contaminated wetland ofThuraiyur Lake (Chinna Eri) in Tiruchirappalli District, Tamil Nadu. Sarovar Saurabh ENVIS Newsletter. Vol 16 (3). Pp. 1-3.

Manikannan, R., Asokan, S. and Mohamed Samsoor Ali, A. 2012. Abundance and Factors Affecting Population Characteristics of Waders (Charadriiformes) in Great Vedaranyam Swamp of Point Calimere Wildlife Sanctuary, South-east Coast of India, *International Journal of Ecosystem*. 2(1), 6-14. DOI: 10.5923/j.ije.20120201.02.

Muthusamy, A., Siva, T., Lakshmanan, G. and Neelanarayanan, P. 2021. Checklist of birds from select wetlands from Perambalur District, Tamil Nadu. Sarovar Saurabh ENVIS Newsletter. Vol 17 (1). Pp. 6-9.

Nameer. 1998. An overview of wetlands of Kerala Waterbirds, 32(2): 225-233.

Pittock, B. 2003. Climate change: An Australian guide to the science and potential impacts, Australian Green house office, Canberra. Viewed 12 Oct 2004 http://www.greenhouse.gov.au/science/guide/pubs/science-guide.pdf.

Prasad, S.N., Jaggi, A.K., Kaushik, P., Vijayan, L., Muralidharan, S. and Vijayan, V.S. 2004. Inland wetlands of India, Conservation Atlas. Salim Ali Centre for Ornithology and Natural History. Coimbatore, India, 222.

Prasad, S.N., Sengupta, T., Alok Kumar., Vijayan, V.S., Lalita Vijayan., Ramachandra, T., Ahalya, N. and Tiwari A.K. 2015. Wetland of India, http://wgbis.ces.iisc.ernet.in/ energy/water/paper/ wetlands/impacts.html.

Ramachandra, T.V. 2006. Soil and Groundwater Pollution from Agricultural Activities, Commonwealth of learning, Canada and Indian Institute of Science, Bangalore, Printed by Capital Publishing Company, New Delhi (Reprinted in 2009 by TERI Press, New Delhi).

Romano, M., Barberis, I., Pagano, F. and Maidagan, J. 2005. Seasonal and inter annual variation in water bird abundance and species composition in the Melincue Saline lake, Argentina. Eur J Wild Res., 51: 1-13. DOI: 10.1007/s10344-005-0078-z.

Siva, T. and Neelanarayanan, P. 2017a. Avifauna checklist of Karaivetti Bird Sanctuary in Ariyalur District, Tamil Nadu. Sarovar Saurabh ENVIS Newsletter. Vol.13 (2) pp 1-5.

Siva, T. and Neelanarayanan, P. 2017b. Checklist of birds of Koothappar Big Tank in Tiruchirappalli District, Tamil Nadu. Sarovar Saurabh ENVIS Newsletter. Vol 13 (3) pp 1-6.

Siva, T. and Neelanarayanan, P. 2019. Checklist of birds around Puthanampatti lake in Tiruchirappalli District, Tamil Nadu. Sarovar Saurabh ENVIS Newsletter. Vol 15 (2) pp 1-3.

Surana, R., Subba, B.R. and Limbu, K.P. 2007. Avian diversity during rehabilitation stage of Chimdi Lake, Sunsari, Nepal. *Our Nature*, 5: 75-80. DOI: https://doi.org/10.3126/on.v5i1.802.

Terdalkar, S., Kulkarani, A.S. and Berde, V.B. 2005. Avian diversity in and around Mangroves of Bhatye estuary, Ratangiri, Maharashtra. J. Aqua. Biol., 20(2): 70-83.

Urfi, A.J., Monnalisa, S., Kalam, A. and Megathan, T. 2003. Breeding ecology of Birds: Why do some species nest singly while others are colonial? *Resonance.* 8: 22-32.

Van Buskirk, J., Mulvihill, R.S. and Leberman R.C. 2010. Declining body sizes in North American birds associated with climate change. *Oikos.* 119, 1047–1055. DOI: 10.1111/j.1600-0706.2009.18349.x.

Yom-Tov, Y., Yom-Tov, S., Wright J., Thorne, C.J.R., and Du Feu, R. 2006. Recent changes in body weight and wing length among some British passerine birds. *Oikos.* 112, 91–101. https://doi.org/10.1111/j.0030-1299.2006.14183.x.

Zhijun, M., Yinting, C., Bo, L. and Jiakuan, C. 2010. Managing wetland habitats for waterbirds: An international perspective, *Wetlands,* 30, 15-27. DOI: 10.1007/s13157-009-0001-6.