



E-ISSN: 2320-7078  
P-ISSN: 2349-6800  
JEZS 2017; 5(1): 407-412  
© 2017 JEZS  
Received: 15-11-2016  
Accepted: 16-12-2016

**S Murali Krishnan**  
National Centre of Excellence on  
Statistical and Mathematical  
Modeling on Bioresources  
Management- MHRD, Thiagarajar  
College (Autonomous) Madurai

**N Arun Nagendran**  
National Centre of Excellence on  
Statistical and Mathematical  
Modeling on Bioresources  
Management- MHRD, Thiagarajar  
College (Autonomous) Madurai

**D Pandiaraja**  
National Centre of Excellence on  
Statistical and Mathematical  
Modeling on Bioresources  
Management- MHRD, Thiagarajar  
College (Autonomous) Madurai

**Correspondence**  
**S Murali Krishnan**  
National Centre of Excellence on  
Statistical and Mathematical  
Modeling on Bioresources  
Management- MHRD, Thiagarajar  
College (Autonomous) Madurai

## Survey of birds in Chitrangudi and Kanjirankulam village ponds in relation to vegetation: an avian paradise of south India

**S Murali Krishnan, N Arun Nagendran and D Pandiaraja**

### Abstract

Industrialization and natural habitat loss has bring identified ecosystems capable of sustain biotic communities and diversity. The present investigation recorded analysis of water quality, birds community and plant species at Chitrangudi and Kanjirankulam village ponds during the month of July 2015. These study areas are more important water resources for the surrounding areas. Point counts were used to survey birds. Bird count was from 06:30hrs to 11:00hrs in the morning and 16:00hrs to 18:00hrs in the evening. A total of 50 birds and 53 plant species belonging to 29 and 25 families were recorded during the study period. This is the first water bird exploration to address the importance of water quality, documentation of vegetation and avian diversity of the ponds. It illustrates the varied responses from different bird groups and demonstrates the importance of water quality and vegetation to enhance community abundance and diversity. Chitrangudi village pond had the highest number of bird species compare to Kanjirankulam village ponds. The bird diversity was significantly higher in Chitrangudi village pond than due to water quality and vegetation.

**Keywords:** Avifauna, water birds, Chitrangudi pond, Kanjirankulam pond, south India

### 1. Introduction

The wetlands are ecosystems or unit of the countryside that originate on the boundary between land and water. While water is a chief factor of wetland definition <sup>[1]</sup>, soil, vegetation and animal life also contribute to their exclusive characteristics <sup>[2]</sup>.

India has 243 species of water birds and 67 species of wetland dependent and associated birds, almost half of which are migratory and come to the subcontinent from their breeding sites <sup>[3]</sup>. Water birds are used as vital tool nationally and internationally for conservation and protection of wetlands as water bird habitat. The month of October to December most flourished season in southern India. During this month numerous migratory birds come from various parts of the world. Some of the migratory birds are flocking into this region <sup>[3]</sup>.

Wetland birds afford us with several of natures nearly all wonderful sights, from immense flocks wheeling transparency to newly hatched chicks, aeration in the sun. The bird's diversity is separately from their prettiness, recreational, economic significance and tremendous indicates water quality in pond. Birds are of vast economic importance to the human society. They play an imperative role in controlling inhabitants of different insects and pests. They play the role of scavenges and pollinating agents and also helps in dispersal of seeds of different vegetation. They are helpful and help to provide rich food for mankind and are known to man since ages <sup>[4]</sup>.

The avian species richness in this area is largely due to presence of water bodies like lakes, floodplains, seasonal ponds and marshes which are rich in plants and animals supports a different variety of water birds. In general wetland habitat is being lost because of the constant development of villages, industries and changed cropping pattern. The mining of banks and beds of wetlands and rivers for sand, gravel and stones causes disturbance, lowers food supply and reduces nesting habitat for birds. Vettangudi and Nanguneri bird's sanctuaries are most actively protected wetland in south India, but even here maintenance of ponds with water during drought is often a major problem <sup>[5]</sup>.

However, in the recent years, the natural wetland patches and bushy scrub areas are reported on various species of birds in different vegetation types of field <sup>[6-8]</sup>. The ephemeral vegetation of temporary ponds is conquered largely by annual and herbaceous perennials that appear during the availability of water and when pond is at varying degrees of desiccation.

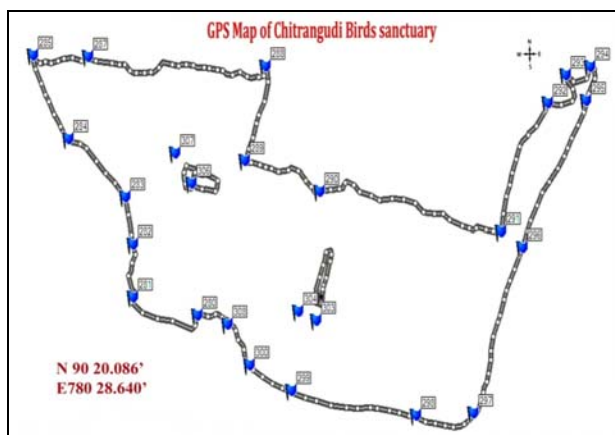
This phenomenon makes an extraordinary shift in the vegetation and their dissimilar nature of abundance. Annual hygrophytes, hemi cryptophytes and geophytes vegetation is diverse and rich [9, 10]. Aquatic angiospermic flora was reported in various studies [5, 11-14].

Monitoring of wetland birds provides valuable information on the ecological health and status of wetlands and can be a very important tool for increasing awareness regarding the conservation value of the pond ecosystem [29]. The importance of local landscapes for conservation of avifauna can only be understood by knowing the structure of the bird community of that region. The present study aims to analysis of water and survey of birds and plants to identify the consequences of direct and indirect human interferences.

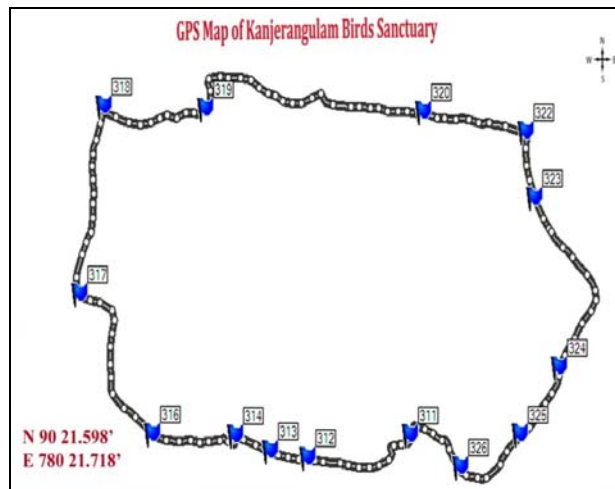
## 2. Materials and Methods

### 2.1 Study area

The Chitrangudi and Kanjirankulam Bird Sanctuary (90°21.598'N 78°021.7189'E.) commonly known as "Chitrangudi Kanmoli" is 0.4763 km<sup>2</sup> highly protected area declared in 1989 and a part of Chitrangudi village, Mudukulathur Taluk, Ramanathapuram District, Tamil Nadu, India (Figure 1 & 2). The sanctuary area is within the 15 m high embankment of the community irrigation tank. The total length of the embankment is 4. km. The crescent-shaped Kanmoi starts at a northern point where an aqueduct from the Gundar River flows into the Kanmoi. There are five sluices that drain water to the agricultural lands. The wetland is irregular in depth and retains water for 3 to 5 months if rain is normal. Excess flood water is let out towards Chitrangudi village through a sluice gate about 0.5 km from the inlet aqueduct. The sanctuary vegetation is mostly tropical dry deciduous forest. It is dominated by *Acacia nilotica* (babul) along with *Prosopis juliflora* and the grasses Bermuda grass and *Dichanthium foveolatum* (*Eremopogon foveolatus*). A babul plantation was planted in 1979 by Farm Forestry Division. The invasive *Prosopis* is slowly encroaching on much of the sanctuary area, retarding growth of babuls. The irrigation tank bund and the area outside the tank have tamarind trees, fig trees, neem trees, portia trees, silk trees (*Albizia amara*), drumstick trees (murungai) and palmyra palms. It is notable as a nesting site for several migratory heron species that roost in the prominent growth of babul trees there.



**Fig 1:** GPS Map of study pond in Chitrangudi Birds Sanctuary Mudukulathur Taluk, Ramanathapuram District, Tamil Nadu, India.



**Fig 2:** Figure:1 GPS Map of study pond in Kanjirankulam Birds Sanctuary Mudukulathur Taluk, Ramanathapuram District, Tamil Nadu, India.

### 2.2 Water analysis

Water samples were collected from the experimental ponds during the study period. Depending upon the availability, water samples were collected from the pond with clean plastic bottles at 06:00 hrs and brought to the laboratory for further analysis. Sampling and analytical procedures were done using American Public Health Association (APHA) method [15]. Water pH was determined with the help of digital pH meter (Elico, India). Water temperature was measured during sampling with help of thermometer. Total Dissolved Solid (TDS), Conductivity, Salinity and Dissolved Oxygen (DO) were analyzed by using Water Analyzer Kit (Systronics Make; Model No. 371) (Table: 1).

### 2.3 Vegetation survey

Vegetation analysis was carried out during July 2015, by employing collection, identification and verification. Aquatic vegetation of all the growth forms during surface and bund in the experimental ponds, the shift of the vegetation occurred on the surface were observed, using all out search method. Specimens were collected using standard method and were identified using regional floras [12, 16]. Further, the specimens were authenticated for their proper identification by referring thought relevant literature and expert judgment. A list plants was prepared with their scientific and vernacular names represented in Table (2).

### 2.4 Bird survey

The birds counting from 06:30hrs to 11:00hrs in the morning and 16:00hrs to 18:00hrs in the evening counted point count protocol method [32, 33] using Nikon (16\*50 4.1) Action Zooming Binocular from the month of July 2015 and photographic documentation was made. The identification made by using standard taxonomic key and literatures of birds [17, 18].

## 3. Results and Discussion

The average water temperature was 28.8 °C and air temperature goes upto 32 °C. The lowest water temperature (28 °C) observed during month of July. Balasubramanian [19] has reported that air temperature and water temperature showed large fluctuation because of different seasons in Kurangani stream of Cardamom hills Sivaramakrishnan [20]. The average pH was 7.2. The dissolved oxygen of Kurangani stream ranged 7.1 to 8.3 (Table 1). While studying in

tributaries of Kaveri river with different stream orders by Sivaramakrishnan [20, 30, 31] have recorded DO concentration range between 4-2 mg/L. Thampy [21] has recorded range of dissolved oxygen 6.5 to 8.0 mg/L was recorded by from streams of southern Western Ghats. Other parameters like TDS (ppm), Salinity (ppt), Conductivity (uS), Acidity (mg/l), Alkalinity (mg/l), Free CO<sub>2</sub> (mg/l) Chloride (mg/l), Calcium (mg/l) Total hardness (mg/l), Magnesium (mg/l) and Nitrogen (g/l) were recorded during the study period in both ponds (Table 1).

Chitrangudi and Kanjirankulam village ponds are surrounded by agriculture fields, where different crops are grown throughout the year. Plant remains and grains scattered after harvesting along with the pond water allures avifauna to the regions. The pond supports number of fishes, amphibians, mollusks and aquatic insects and their larvae which form a good food source for arriving birds and waterfowl. At Chitrangudi and Kanjirankulam village pond 50 and 45 species of birds belonging to 30 and 25 families have been reported respectively (Table 3). Out of these 50 species were water birds and 3 were terrestrial birds. Among water-birds – species of waterfowl (Table 2) were also documented. These waterfowls are winter visitors. It is evident from the list that order Passeriformes is represented by more number of families, while the highest number of species are recorded from the family Turdidae followed by Ardeidae.

The term 'waterfowl' applies to the members of the family Anatidae, popularly known as Swans, Geese and Ducks, the smallest of which are called Teals [22]. A total of 149 species are known to occur throughout the world, of which 62 from Asia [23] and 41 from India [18]. It is known that every waterfowl is a water-bird, but every water-bird is not a waterfowl. In the recent past, the term waterfowl has been frequently used in a broader perspective covering water-birds as well [24]. The water bird generally include swimmers, divers and waders. The former two belong to the following four families, viz., Podicipedidae, Phalacrocoracidae, Anatidae, Laridae. While the waders (marsh birds) belong to the following families, viz., Ardeidae, Charadriidae, Recurvirostridae, Gruidae, Rallidae, Ciconiidae, Jacanidae, Threskiornithidae and Burhinidae. Among water birds waders perhaps represent the greatest species diversity [3]. Waders (Marsh birds) like Pond herons, Purple herons, Avocets, Greenshank, Red wattle lapwing, Black-winged stilt, little ring plover, Shanks, Curlews, Sand pipers, Cattle egrets and Bitterns were seen wading through the shallow waters and occasionally probing along dry margins of the wetland. These small birds prefer shallow muddy banks of the pond and close by small water spots.

The tree species of *Acacia nilotica*, *Azadirachta indica*, *Borassus flabellifer*, *Phoenix pusilla*, *Pongamia pinnata*, *Prosopis juliflora*, *Tamarindus indica*, *Tecoma stans*, *Terminalia arjuna* and *Thespesia populnea* were present at the banks of the pond give shelter to common terrestrial residential birds like Mynas, Doves, Parrots, Babbler, Bulbuls, Partridges and Drongos. These birds were also found feeding on the grains scattered by local population (Table 2&3). The wetland dependent birds such as Vultures, Kites, Eagles and Kingfishers were also seen around the two ponds. They built their nests usually on lofty trees preferably near water. During winter months they prey on variety of water-birds.

Waders like Sandpipers, Stilts, Kingfishers, Cormorants, Babbler, Parrots, Bulbuls and Curlews are considered as secluded species. Many Bird species inhabit wetland as their

winter home. Neither all the species nor all the individuals of these winter visitors arrive here at a time. The basic requirement of the migratory water birds at their wintering sites are adequate food supply and safety [25], which are fulfilled by this pond and surrounding area. They arrive in succession at Chitrangudi and Kanjirankulam village ponds at winter.

In Chitrangudi village pond was observed more number of Plover and Heron and Demoiselle Cranes. Demoiselle cranes are the smallest and second most abundant crane species. Demoiselle Cranes are basically birds of dry grasslands. India is the wintering ground for the Demoiselle cranes. During migration it travels more than 2000 km. in 5 to 7 days and reaches at the wet lands, agriculture fields, stubble fields in India. Demoiselle Cranes are omnivorous. Principal foods of the Demoiselle Crane include plant material, insects, beans and other cereal grains.

Study reveals that family Charadriidae, Phalacrocoracidae and Ardeidae form the bulk of the birds sighted at the Chitrangudi and Kanjirankulam village ponds. Some birds like Black winged, stilt, Plover, Heron, Egret, Cormorants, Red-wattled and Lapwing were found more numbers. Highest bird density was observed during survey, when the anthropogenic activities are less. Anthropogenic activities affect the habitat of water birds [25]. This pond is being used for water collection for house hold work and livestock bathing. These activities disturb the water birds in the both ponds.

The both Chitrangudi and Kanjirankulam village ponds considered to be the best economic use for livestock grazing. Though the cattle bathing and grazing often disturb avifauna, it significantly affects all birds associated with grassland and shrub. Birds are especially more responsive to livestock grazing, compared to other animal populations [26].

The present study documented 53 different plant species (Table 2). The number and diversity of bird's species are strongly positively correlated with aspects of vegetation structure [27, 28] that is, the more complex the structure or composition of the vegetation, the more likely that habitat will contain more bird species. In this study, tree density, percentage canopy cover and sapling density were important vegetation characteristics responsible for the high bird species richness recorded in Chitrangudi and Kanjirankulam village ponds, this implies that any activity that leads to the reduction or clearing of vegetation will ultimately impact on avian species evenness and diversity.

**Table 1:** Water analysis for the samples collected from Chitrangudi and Kanjirankulam village ponds during the month of July 2015.

S. No.	Variables	Pond 1	Pond 2
1	Water Temperature (° C)	32.82 ± 0.36	32.3 ± 0.04
2	pH	7.24 ± 0.11	7.25 ± 0.08
3	DO (ppm)	4.6 ± 0.18	3.39 ± 0.12
4	TDS (ppm)	90.65 ± 6.82	52.52 ± 1.53
5	Salinity (ppt)	0.1 ± 0.01	0.06 ± 0
6	Conductivity (uS)	178.22 ± 13.79	102.34 ± 3.3
7	Acidity (mg/l)	21.34 ± 0.82	9.67 ± 1.41
8	Alkalinity (mg/l)	79.78 ± 8.85	38.67 ± 8.49
9	Free CO <sub>2</sub> (mg/l)	18.78 ± 0.72	8.51 ± 1.24
10	Chloride (mg/l)	42.99 ± 1.74	38.46 ± 2.51
11	Calcium (mg/l)	8.73 ± 1.69	5.48 ± 0.57
12	Total hardness (mg/l)	46.67 ± 10.2	40.67 ± 5.66
13	Magnesium (mg/l)	44.54 ± 9.92	39.44 ± 5.53
14	Nitrogen (g/l)	0.70 ± 0.001	0.72 ± 0.013

Values are means ±SE (n=3). Pond 1 -Chitrangudi; Pond 2- Kanjirankulam

**Table 2:** Diversity of vegetation's occurred in Chitrangudi and Kanjirankulam pond surfaces during the month of July 2015

Sl. No	Scientific Name of the Plant	Family	Habit	Pond 1	Pond 2
1	<i>Abrus precatorius</i> L.	Fabaceae	Climber	*	*
2	<i>Abutilon hirtum</i> (Lam.) Sweet.	Malvaceae	Shrub	✓	✓
3	<i>Abutilon indicum</i> G. Don.	Malvaceae	Herb	✓	✓
4	<i>Acacia catechu</i> (L.f.) Willd.	Mimosaceae	Liana	*	*
5	<i>Acacia nilotica</i> (L.) Willd. ex Delile	Mimosaceae	Tree	✓	✓
6	<i>Acalypha indica</i> L.	Euphorbiaceae	Herb	*	✓
7	<i>Achyranthes aspera</i> L.	Amaranthaceae	Herb	✓	✓
8	<i>Aerva lanata</i> (L.) Juss. ex Schultes	Amaranthaceae	Herb	✓	✓
9	<i>Agave angustifolia</i> Haw.	Agavaceae	Shrub	*	✓
10	<i>Aloe vera</i> (L.) Burm.f.	Liliaceae	Herb	*	✓
11	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae	Herb	✓	✓
12	<i>Alysicarpus monilifer</i> (L.) DC.	Fabaceae	Herb	*	*
13	<i>Aristida hystrix</i> L.	Poaceae	Herb	*	*
14	<i>Aristida setacea</i> Retz.	Poaceae	Herb	*	✓
15	<i>Aristolochia bracteolata</i> Lam.	Aristolochiaceae	Climber	✓	*
16	<i>Aristolochia indica</i> L.	Aristolochiaceae	Climber	*	*
17	<i>Aristolochia tagala</i> Cham.	Aristolochiaceae	Climber	*	*
18	<i>Asystasia gangetica</i> (L.) T. And.	Acanthaceae	Herb	✓	✓
19	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Tree	✓	✓
20	<i>Azima tetracantha</i> Lam.	Salvadoraceae	Shrub	✓	✓
21	<i>Blepharis maderaspatensis</i> (L.) Heyne ex Roth	Acanthaceae	Herb	*	*
22	<i>Boerhavia diffusa</i> L.	Nyctaginaceae	Herb	✓	✓
23	<i>Borassus flabellifer</i> L.	Arecaceae	Tree	✓	✓
24	<i>Calotropis gigantea</i> (L.) R.Br.	Asclepiadaceae	Shrub	✓	✓
25	<i>Canthium angustifolium</i> Roxb.	Rubiaceae	Shrub	*	*
26	<i>Capparis divaricata</i> Lam.	Capparidaceae	Shrub	*	*
27	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Climber	✓	✓
28	<i>Jatropha gossypifolia</i>	Euphorbiaceae	Shrub	✓	✓
29	<i>Pedaliium murex</i> L.	Pedaliaceae	Herb	*	*
30	<i>Pentatropis capensis</i> (L.f.) Bullock	Asclepiadaceae	Climber	✓	✓
31	<i>Pergularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae	Climber	✓	✓
32	<i>Phoenix pusilla</i> Gaertn	Arecaceae	Tree	*	*
33	<i>Phyllanthus amarus</i> Schum. & Thonn.	Euphorbiaceae	Herb	*	✓
34	<i>Phyllanthus maderaspatensis</i> L.	Euphorbiaceae	Herb	✓	✓
35	<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	Tree	✓	*
36	<i>Prosopis juliflora</i> (Sw.) Dc.	Mimosaceae	Tree	✓	✓
37	<i>Rhynchosia minima</i> (L.) DC.	Fabaceae	Climber	✓	*
38	<i>Ricinus communis</i> L.	Euphorbiaceae	Shrub	✓	*
39	<i>Ruellia patula</i> Jacq.	Acanthaceae	Herb	✓	*
40	<i>Ruellia prostrata</i> Poir.	Acanthaceae	Herb	✓	✓
41	<i>Sansevieria roxburghiana</i> Schultes & Schultes	Liliaceae	Herb	*	*
42	<i>Scoparia dulcis</i> L.	Scrophulariaceae	Herb	✓	*
43	<i>Sida acuta</i> Burm.f.	Malvaceae	Herb	✓	*
44	<i>Sida cordata</i> (Burm. f.) Borssum	Malvaceae	Herb	✓	✓
45	<i>Solanum trilobatum</i> L.	Solanaceae	Shrub	✓	*
46	<i>Sphaeranthus indicus</i> L.	Asteraceae	Herb	✓	*
47	<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tree	✓	✓
48	<i>Tecoma stans</i> (L.) Kunth	Bignoniaceae	Tree	✓	*
49	<i>Tephrosia purpurea</i> (L.) Pers.	Fabaceae	Herb	*	✓
50	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	Combretaceae	Tree	✓	✓
51	<i>Themeda triandra</i> Forssk.	Poaceae	Herb	✓	*
52	<i>Thespesia populnea</i> (L.) Soland ex Correa	Malvaceae	Tree	✓	*
53	<i>Marshelia minuta</i>	Marsiliaceae	Herb	✓	✓

(✓ -present and \* – absent) Pond 1 -Chitrangudi; Pond 2- Kanjirankulam

**Table 3:** Avian diversity in Chitrangudi and Kanjirankulam pond ecosystem during the month of July 2015

S. No	Scientific Name of the Bird	Common Name	Family	Pond 1	Pond 2
1	<i>Accipiter badius</i> Gmelin, 1788	Shikra	Accipitridae	✓	✓
2	<i>Milvus migrans</i> Boddaert, 1783	Black Kite	Accipitridae	✓	✓
3	<i>Mirafra cantillans</i> Blyth, 1844	Singing Bush Lark	Alaudidae	✓	✓
4	<i>Halcyon smyrnensis</i> Linnaeus, 1758	White-breasted Kingfisher	Alcedinidae	✓	✓
5	<i>Alcedo atthis</i> Linnaeus, 1758	Common Kingfisher	Alcedinidae	✓	✓
6	<i>Anas poecilorhyncha</i>	Spot-bill Duck	Anatidae	✓	x
7	<i>Tachymarptis melba</i> Gray, 1829	Asian palm-Swift	Apodidae	✓	x
8	<i>Egretta garzetta</i> Linnaeus, 1766	Little Egret	Ardeidae	✓	✓
9	<i>Bubulcus ibis</i> Linnaeus, 1758	Cattle egret	Ardeidae	✓	✓
10	<i>Ardeola grayii</i> Sykes, 1832	Indian Pond-heron	Ardeidae	✓	✓

11	<i>Casmerodius albus</i> Linnaeus, 1758	Great Egret	Ardeidae	✓	x
12	<i>Egretta intermedia</i> Linnaeus, 1758	Median Egret	Ardeidae	✓	x
13	<i>Artamus fuscus</i> Vieillot, 1817	Ashy Woodswallow	Artamidae	✓	✓
14	<i>Charadrius dubius</i>	Little ringed plover	Charadriidae	✓	x
15	<i>Vanellus indicus</i> Boddaert, 1783	Red-wattled Lapwing	Charadriidae	✓	✓
16	<i>Vanellus malabaricus</i> , Boddaert, 1783	Yellow-wattled lapwing	Charadriidae	✓	✓
17	<i>Anastomus oscitans</i> Boddaert, 1783	Asian Openbill	Ciconiidae	✓	x
18	<i>Columba livia</i> Gmelin, 1789	Rock Pigeon	Columbidae	✓	x
19	<i>Streptopelia chinensis</i> Scopoli, 1786	Spotted Dove	Columbidae	✓	x
20	<i>Streptopelia decaocto</i> Frivaldszky, 1838	Eurasian collared dove	Columbidae	✓	✓
21	<i>Streptopelia senegalensis</i> Linnaeus, 1766	Laughing Dove	Columbidae	✓	✓
22	<i>Coracias benghalensis</i>	Indian roller	Coraciidae	✓	✓
23	<i>Dentrocitta vagabunda</i> Latham, 1790	Rufous Treepie	Corvidae	✓	✓
24	<i>Corves splendens</i> Vieillot, 1817	House Crow	Corvidae	✓	✓
25	<i>Corves macrorhynchos</i> Wagler, 1827	Jungle Crow	Corvidae	✓	✓
26	<i>Centropes sinensis</i> Stephens, 1815	Greater Coucal	Cuculidae	✓	x
27	<i>Cuculus poliocephalus</i> Latham, 1790	Lesser Cuckoo	Cuculidae	✓	x
28	<i>Eudynamis scolopacea</i> Linnaeus, 1758	Asian koel	Cuculidae	✓	x
29	<i>Clamator jacobinus</i> Boddaert, 1783	Pied Cuckoo	Cuculidae	✓	✓
30	<i>Dicrurus macrocercus</i> Vieillot, 1817	Black Drongo	Dicruridae	✓	✓
31	<i>Dicrurus leucophaeus</i> Vieillot, 1817	Ashy Drongo	Dicruridae	✓	✓
32	<i>Stactolaema olivacea</i>	Green barbet	Lybiidae	✓	x
33	<i>Merops philippinus</i>	Blue-tailed Bee-eater	Meropidae	✓	✓
34	<i>Terpsiphone paradise</i> Linnaeus, 1758	Asian Paradise Flycatcher	Monarchidae	✓	✓
35	<i>Motacilla maderaspatensis</i> Gmelin, 1789	White-Browed Wagtail	Motacillidae	✓	x
36	<i>Anthus rufulus</i> Vieillot, 1818	Paddyfield Pipit	Motacillidae	✓	x
37	<i>Saxicoloides fulicata</i> Linnaeus, 1766	Indian Robin	Muscicapidae	✓	x
38	<i>Luscinia brunnea</i> Hodgson, 1837	Indian Blue Robin	Muscicapidae	✓	x
39	<i>Nectarinia asiatica</i> Latham, 1790	Purple Sunbird	Nectariniidae	✓	✓
40	<i>Nectarinia zeylonica</i> Linnaeus, 1766	Purple-rumped Sunbird	Nectariniidae	✓	✓
41	<i>Oriolus oriolus</i> Linnaeus, 1758	Eurasian Golden Oriole	Oriolidae	✓	✓
42	<i>Passer domesticus</i> Linnaeus, 1758	House Sparrow	Passeridae	✓	✓
43	<i>Phalacrocorax niger</i> Vieillot, 1817	Little Cormorant	Phalacrocoracidae	✓	✓
44	<i>Pavo cristatus</i> Linnaeus, 1758	Indian Peafowl	Phasianidae	✓	✓
45	<i>Dinopium benghalense</i> Linnaeus, 1758	Black-Rumped Flameback	Picidae	✓	x
46	<i>Psittacula krameri</i> Scopoli, 1769	Rose-Ringed Parakeet	Psittacidae	✓	✓
47	<i>Pycnonotus cafer</i> Linnaeus, 1766	Red-Vented Bulbul	Pycnonotidae	✓	✓
48	<i>Amaurornis phoenicurus</i> Pennant, 1769	White-breasted Waterhen	Rallidae	✓	✓
49	<i>Acridotheres tristis</i> Linnaeus, 1766	Common Myna	Sturnidae	✓	✓
50	<i>Threskiornis melanocephalus</i> Latham, 1790	Oriental White Ibis	Threskiornithidae	✓	x

Pond 1 -Chitragudi; Pond 2- Kanjirankulam

#### 4. Acknowledgments

The authors gratefully acknowledge MHRD, Government of India, New Delhi for providing financial support and establishment of National Centre of Excellence in Statistical and Mathematical Modeling on Bioresources Management in Thiagarajar College, Madurai. S. Muralikrishnan extended thanks to Dr. D. Kannan, Department of Botany, Thiagarajar College helped for water analysis.

#### 5. References

- Ramsar Convention Bureau. The Ramsar Convention Manual: A Guide to the Convention on Wetlands (Ramsar, Iran, 1971), 2nd ed. Ramsar Convention. RCB, the Gland, 1997, 170.
- Koetze D. How wet is a Wetland? An introduction to understanding wetland hydrology, soils and landforms. Wetland Use Booklet 2. Share-Net. Wildlife and Environment Society of South Africa, 1996. 24.
- Mohan D, Gaur A. Avian diversity around Jajiwal Pond – A natural wetland. Proceedings of Taal2007: The 12<sup>th</sup> World Lake conference, 2008, 542-546.
- Vijayan VS, Prasad SN, Vijayan L, Muralidharan S. In land wetlands of India: Conservation priorities. Salim Ali Centre for Ornithology and Natural History, Coimbatore. 2004, 33.
- Kannan D, Miller Paul Z. Grass species population studies in freshwater pools of Sivaganga District, South India with different land-use, In: Proc. 22<sup>nd</sup> International Rangeland Congress: Revitalizing Grasslands to Sustain Our Communities, 15-19 September Australia, (Editors David L Michalk, Geoffrey D Millar Warwick B Badgery and Kim M Broadfoot), 2013; 2:1054-1055 ISBN: 978-1-74256-543-9 (3 volumes; 2024pp.), New South Wales Department of Primary Industry, Kite St., Orange New South Wales, Australia, 2013.
- Basvarajappa S. Status of the Asian Giant Honey bee *Apis dorsata* and its Conservation in southern part of the Deccan peninsula, Karnataka, India. In: Gupta, V.K. (Ed.) Prospective in Animal Ecology and Reproduction Daya Publishing House, New Delhi, 2004, II.
- Daniels RTR, Hegde M, Gadgill M. Birds of the manmade ecosystems: the plantations. Ani. Sci. 1990; 99(1):79-89.
- Joyson EA, Mathew DN. Structure and Composition of two birds community in the Southern western Ghats. J Bomb. Nat. Hist. Soc. 2002; 99(1):8-25.
- Brullo S, Minissale P. Considerazione sintassonomiche sula classe Isoeto-Nanojuncetea. Itinera Geobotanica. 1998; 11:263-290.
- Deil JJ. Local and landscape-level influences on wetland bird communities of the prairie pothole region of Iowa, USA. Wetlands. 2005; 21:41-47.
- Subramanyam K. Aquatic Angiosperms. CSIR, New Delhi, 1962.

12. Cook CDK. Aquatic and Wetland Plants of India. Oxford University Press, 1996, 385.
13. Saini DC, Singh SK, Rai K. Biodiversity of Aquatic and Semi-Aquatic Plants of Uttar Pradesh (with special reference to eastern Uttar Pradesh). Uttar Pradesh State Biodiversity Board, Lucknow (India), 2010.
14. Sukumaran S, Jeeva S. Angiosperm flora from wetlands of Kanyakumari district, Tamilnadu, India. Check List. 2011; 7(4):486-495.
15. American Public Health Association. Standard methods for the examination of water and wastewater. American Public Health Association, Water Environment Federation, 2005.
16. Gamble JS. Fischer CEC. Flora of the Presidency of Madras London. Adlord and Sons Ltd. 1915-1935; (1-3):1389.
17. Naganathan R. Avifaunal diversity of Gulf of Mannar. Government of Tamil Nadu Forest Department, 2004.
18. Ali S, Ripley DS. A Pictorial Guide to the Birds of the Indian Subcontinent (Oxford Univ. Press, Oxford, 1983.
19. Balasubramanian C, Venkataraman K, Sivaramakrishnan KG. Bioecological studies on the burrowing mayfly *Ephemera (Aethephemera) nadinae* (Ephemeroptera: Ephemeridae) in Kurangani stream of Western Ghats, J. Bombay Nat. Hist. Soc. 1992; 89(1):72-77.
20. Sivaramakrishnan KG, Venkataraman K, Sridhar K, Marimuthu S. Spatial patterns of benthic macroinvertebrate distributions along Kaveri river and its tributaries in south India, Int. J Eco. Environ. Sci. 1995; 21:141-161.
21. Thampy PSJ, Raja M, Sivaruban T, Arunachalam M. Application of Rapid Bioassessment in selected streams of the Western Ghats using Benthic Macroinvertebrates, Int. J Environ. Biol. 2013; 3(4):173-179.
22. Delacour J. The waterfowl of the world. Acro Publishing company, INC, New York. 1974, 1-4.
23. Sonobe K, Usui S. A field guide to the Waterbirds of Asia. Wild bird Society of Japan. Tokyo. 1993, 224.
24. Tak PC, Sati JP, Kumar A. Species richness and seasonal population changes in waterfowls. Zoological Survey of India, Fauna of Asian Wetland, Wetland Ecosystem Series. 2003; 5:213-235.
25. Bharatha Lakshmi B. Avifauna of Gosthani estuary near Visakapatnam, Andhra Pradesh. J. Natcon. 2006; 18(2):291-304.
26. Sivaperuman C, Dookia S, Kankane PL, Baqri QH. Diversity, abundance and dominance of avian species in the Thar desert of Rajasthan. In: Changing faunal ecology in Thar desert. (Eds; BK Tyagi and Q.H. Baqri. 2005, 187-229.
27. MacArthur RH. MacArthur JW. On bird's species diversity. *Ecology*. 1961; 42:594-598.
28. Karr JR, Roth RR. Vegetation structure and avian diversity in several new world areas. Am. Nat, 1971; 105:423-435.
29. Harisha M. Assessment of status diversity and threats of wetland birds of Bathi Lake, Doddabathi Village, Davanagere District, Karnataka, India. J Entomol. Zool. Stud. 2016; 4(4):586-590.
30. Kubendran T, Ramesh M. Monitoring of adult aquatic insect activities and ecological role in the riparian zone of streams in the Western Ghats, India. IRA-Int. J App. Sci. 2016; 4(3):460-470.
31. Kubendran T, Ramesh M. Composition and distribution of aquatic insect communities in relation to water quality in two freshwater streams of southern Western Ghats, India. J. Entomol. Zool. Stud., 2016; 4(5):689-695.
32. Honore S, Derouin F, Sibley D. Determination of genotypes of *Toxoplasma gondii* strains isolated from patients with toxoplasmosis. Journal of Clinical Microbiology. 1997; 35:1411-1414.
33. Pomeroy DE, Dranzoa C. Methods of studying distribution, diversity and abundance of birds in East Africa-some quantitative approaches. African Journal of Ecology. 1997; 35:110-123.