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M Padma Sorna Subramanian
Medicinal Plants Garden,
CCRS, Mettur, Salem,
Tamil Nadu, India

A Saravana Ganthi
Department of Botany,
Rani Anna Govt. College for
Women, Tirunelveli,
Tamil Nadu, India

K Subramonian
Department of Botany,
The MDT Hindu College,
Tirunelveli, Tamil Nadu, India

Diversity and distribution of hydrophytes in point Calimere Wildlife and birds sanctuary, Tamil Nadu, India

M Padma Sorna Subramanian, A Saravana Ganthi and K Subramonian

Abstract

Point Calimere is an area of high biodiversity, with many unique species of animals and birds. The Flagship species of the Point Calimere Wildlife and Bird Sanctuary (PCWBS) is near threatened Blackbuck antelope, the sole member of the Antelope family in India and the most numerous large animals in the sanctuary. It has the largest population of Blackbuck in South India. Back water channels, Munniyapan Lake and Nalla thaneerkulam are the vital aquatic ecosystems, which provide food, oxygen and shelter to the aquatic organisms and birds. The water bodies present in sanctuary and its adjoining area rich in hydrophytes which has not been investigated. So the present study focused on broad investigation of distribution and diversity of hydrophytes of this area. Due to the presence of halophytic and fresh water aquatic habitats, variability of hydrophytes are high in the study area. Totally 59 species are recorded from 25 families. Family Cyperaceae is dominant, which is followed by Amaranthaceae and Plantaginaceae. Totally 51 herbs are recorded from the study area. Different morpho-ecologic groups recorded, 15 species of emergent anchored, 34 species of marshy plants, five species of anchored with floating leaves, one free floating, two submerged anchored and two suspended hydrophytes were recorded. Totally 29 medicinal plants are recorded in the study area. The present work exhibited the database of hydrophytes in Point Calimere Wildlife and Birds Sanctuary, which will help in future work for its conservation and to maintain the local biodiversity.

Keywords: Flowering phenology, hydrophytes, medicinal plants, point Calimere Wildlife and birds sanctuary

Introduction

The diversity of plants include 2,68,600 flowering plants, 1,201 species of Gymnosperms, 12,000 species of Ferns and fern allies, 16,236 species of Bryophytes, 98998 species of Fungi and 17000 species of Lichen. It is estimated that 10% flowering plants are yet to be identified (Groombridge and Jenkins, 2002; Jefferies, 2005; Zeigler, 2007) [8, 12, 29]. The number of described species of flowering plants in the world vary from 2,23,300 (Scotland and Wortley, 2003) [21], 2,58,650 (Thorne, 2002; IUCN, 2004) [23, 11], about 2,70,000 (Groombridge and Jenkins, 2002; Chapman, 2009) [8, 4], 3,15,903 (Kier *et al.*, 2009) [13] and 3,69,400 (RBG Kew, 2016) [20]. Nevertheless, thousands of species might have disappeared or in the process of extinction, before understanding their existence in the earth (Krishna *et al.*, 2018) [14]. It is believed that nearly 2 million species have already become extinct (Zeigler, 2007) [29], and probably over 5 million species, that ever existed on the Earth became extinct due to rapid environmental changes (Kunin and Lawton, 1996) [15]. It is prime need to explore and document the biological resource of the country. Point Calimere consists of a wide range of floristic diversity occurring at various ecological zones. Hence the present study made to document the aquatic and semi aquatic plants in the Point Calimere Wildlife and Birds Sanctuary, Tamil Nadu, India.

Area of study

The area of study Point Calimere falls under the Nagapattinam district and it was under the erstwhile district of Tanjore of Tamil Nadu before bifurcation. The Point Calimere Reserve forest extends to an area of 5663 hectares of flat land, having slight slopes, with consolidated and shifting sand dunes along with salt marshes which are inundated by the tides and monsoonal showers causes variation in the salinity of the margins of the elevated inlets. The sanctuary, located adjacent to and east of Kodikkarai and Kodikkadu villages, is basically an

Corresponding Author:
M Padma Sorna Subramanian
Medicinal Plants Garden,
CCRS, Mettur, Salem,
Tamil Nadu, India

island surrounded by the Bay of Bengal to the east, the Palk Strait to the south and swampy backwaters and salt pans to the west and north (Map 1). Kodikkadu in the north and Kodikkarai near angular extreme of Point Calimere are connected by road. There had been a rail link from Kodikkarai to Vedaranyam which is not in use now. These two villages are parted by a long creek which connects the salt swamp in the west with the sea on the east. The people who dwell in Point Calimere jungles are presently called “Seenthil Valayars”.

Methodology

The source of materials for this floristic research was the extensive field collections of specimens made from the area of study. Gamble and Fischer's Flora of the Presidency of Madras [7], Matthew's Flora of the Tamil Nadu Carnatic [17], Henry *et al.*, Flora of Tamil Nadu [9] and Daniel and Umamaheswari's Flora of Gulf of Mannar [5] were the basic reference materials for identification. For recent binomial the online databases TROPICOS (2017) [24], The Plant List (2013) [22] and IPNI (2020) [10] are referred, whenever necessary. The eflora of Karaikal also referred for common names. The use and parts used are explored based in the published literature (Useful plants of India, 1986 and Yoganarasiman, 2000) [25, 28].

Results and Discussion

Topographically the Point Calimere Wildlife and Birds Sanctuary, Tamil Nadu, is divided into three forest reaches Coastal vegetation, Saline marshy vegetation and Tropical dry evergreen forest. The vegetation varies with different habitats such as foreshore sandy, inland sandy, salt marsh, mangrove, sand dune and woody scrub jungles. The reserve has two main water storage units such as Munniyapan Lake and Nalla thaneerkulam. Fresh water of potable quality has been available at quite a few spots in natural ponds and manmade water holes, as claimed by the natives. According to natives the areas have progressively become saline in most spots. The wells near the temple and the mosque near Kodikkadu are the only sources of potable water presently available. The pH of the water in the area of study ranges from 7.3 to 8.0.

Aquatic and semi-aquatic plants are represented mostly by herbs. In the fresh water pools of the rainy season, aquatic ephemerals such as *Ludwigia Lindernia*, *Bacopa*, *Limnophila*, *Marsilea* etc., come up. The quality of the water exhibits different characteristics in Nalla thaneerkulam when compare to other places, so the fresh water vegetation such as *Aeschynomene indica*, *Lindernia antipoda*, *Nothosaerva brachiata*, *Scoparia dulcis*, *Stemodia viscosa*, *Portulaca oleracea*, *Marsilea*, are found common around this area. The plants distributed near old light house are mostly halophytic in nature and this may be due to the presence of high content of chloride, sulphate, calcium, magnesium, sodium and potassium in water. The dominant halophytic succulents in this area are *Salicornia*, *Suaeda* and *Arthrocnemon*. Mangrove vegetation inhabits the Muniappan Lake area. The plants like *Salicornia*, and *Avicennia* are dominant in this area.

Different morpho-ecologic groups recorded, 15 species of emergent anchored, 34 species of marshy plants, five species of anchored with floating leaves, one free floating, two submerged anchored and two suspended hydrophytes were recorded (Table 1). Anchored hydrophytes with floating leaves are habitat in shallow stagnant waters and survive during unfavourable periods by perennial organs like rhizome, tubers, stolens etc. eg. *Nymphaea pubescens*, *Nelumbo*

nucifera, *Aponogeton natans*. Suspended hydrophytes are the plants anchored and submerged in young stage, but later get detached from their roots and lie below the surface of the water. They cannot survive in fast flowing water restricted to stagnant ponds eg: *Eriocaulon quinquangulare*, *Utricularia bifida*, *Drosera burmannii*. Anchored hydrophytes with floating shoots plants are attached to substratum, branches trail or creep along water surface, often rooting at nodes eg: *Ipomoea aquatica*, *Ludwigia perennis*. *Acanthus ilicifolius* *Aeschynomene indica* *Ammannia baccifera* *Ammannia octandra*, *Avicennia officinalis*, *Hygrophila auriculata*, *Monochoria vaginalis*, *Nesaea lanceolata*, *Nothosaerva brachiata* are found both in stagnant and running water.

Totally 59 species are recorded from 25 families (Table 1). Only one Pteridophyte species *Marsilea minuta* was reported. The family Cyperaceae represented by 6 species, families such as Amaranthaceae and Plantaginaceae are represented by 5 species each, followed by family Linderniaceae represented by 4 species. Totally 19 families represented by one species. Large numbers of marshy plants are represented by herbs. Totally 51 herbs are recorded from the study area (Fig: 1). *Sarcostemma secamone* and *Ipomoea aquatica* are twiners. *Avicennia officinalis* is a small tree. Insectivores plants like *Drosera burmanii*, *Drosera indica* and *Utricularia bifida* have been recorded in the area of study. *Lindernia minima* is the common peninsular endemics recorded in the present study.

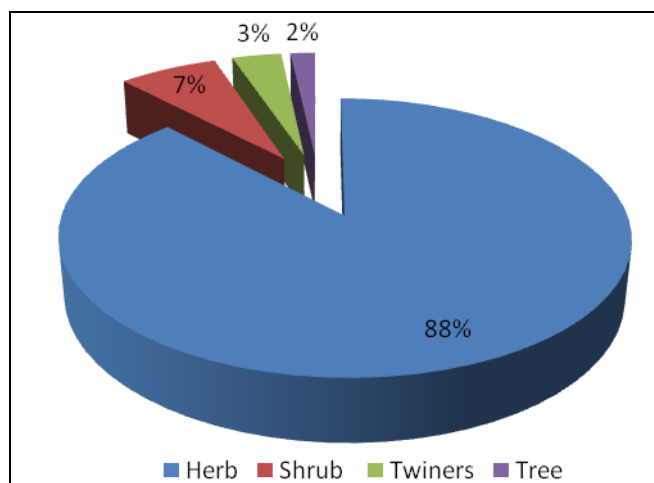


Fig 1: Habitwise distribution

Flowering Phenology

Flowering depends on temperature and humidity. Climatically there are two seasons in a year; the warm and the rainy. The warm season prolonged with high temperature and humidity, the warmest months being April, May and June. During this period occasional rains known as inter-monsoon showers come. However, South West Monsoon which begins by the end of June and early July, accompanied by the easterly winds from the sea, reduces the atmospheric temperature. The average annual rainfall is around 1100 mm, 70% of which occurs during October – December. The fundamental characteristic of this climate is due to the large variability of rains from year to year. The high amount of rain is almost always cyclonic in origin.

The humidity during the dry season is fluctuate by rising in the evening and falling in the forenoon. The relative humidity does not remain same throughout the year. The coolest month January has high humidity. From October to February, its values vary between 70 - 90 percent. On the rainy days the

values remain practically constant between 90 - 95 percent; on the days without rains, a classical rhythm of maximum at day break (6 to 8 a.m.) and minimum between 1 to 3 p.m. Low humidity is reported in the warmest months April, May and June, when the wind blow over the dry land. The variations are between 50 to 70 percent.

Totally 27 (47.3%) species starts flowering during the rainy months either October or November. High humidity promote flowering in eight species (13.5%) during December (Table 1). In twelve species (20.3%) the luxurious vegetative growth occur during rainy season, and flower starts at the end of rainy season from January or February. A heavy rain after a long dry summer is initiate flowering in four species (6.7%). *Avicennia officinalis* is initiate flowering during hot summer. Seven species (11.9%) exhibits full blossom throughout the year.

Economic Importance

Leaves of *Alternanthera sessilis* *Centella asiatica*, *Marsilea minuta*, *Portulaca oleracea* *Sesuvium portulacastrum* used as vegetable. Totally 29 medicinal plants are recorded in the study area (Table 2). Seeds of *Aeschynomene indica* yield fatty oils. *Typha angustata* is used for thatching. Flowers of *Nelumbo nucifera* is used to worship God. Rhizome is edible in *Nelumbo nucifera*. *Cyperus iria* culms are woven into mats.

Cyperus rotundus dried roots are aromatic, used in perfumes and incense sticks. Leaf of *Eclipta prostrata* is used in preparation of hair oil. Stilt root of *Pandanus odorifer* used in preparation of country brush.

Discussion

Similar to present report, floristic study of composition of hydrophytes in different water reservoirs in different parts of world were carried out by many researchers eg. Puri District, Odisha (Bandita *et al.*, 2019) [1], Chiyada Village, Bavla, Gujarat (Bharat, 2015) [2], West Bengal (Das *et al.*, 2009) [6], Swabi district, Pakistan (Muhammad Fawad, 2013) [18] and Tirunelveli district, Tamil Nadu (Lakshmanan and Saravana Ganthi, 2018) [16]. Aquatic plants perform a extensive range of ecological roles, and make a considerable contribution to the structure, function and service provision of aquatic ecosystems (Wood Kevin, 2018) [27], Threats to fresh waters such as pollution of different kinds, unfavorable climatic changes, eutrophication, acidification, and alien species invasion lead to reduction in native aquatic plants diversity which also threatens the faunal diversity of aquatic ecosystem (Chambers *et al.*, 2008) [3]. Varshney (1981) [26] and Oommachan *et al.* (1980) [19] reported some aquatic plants are used as pollution indicator.



Source: District Forest Office, Nagapattinam

Map 1: Land cover map showing various sites in Point Calimere



Salt marsh



Mangrove



Nalla thaneerkulam



Theerthapallam



Near old light house



Munniappan Lake

Table 1: List of hydrophytes in the study area

Botanical Name	Family	Habit	Flowering	Habitat	Tamil Name
<i>Acanthus ilicifolius</i> L.	Acanthaceae	Shrub	Nov. - Feb.	Emergent - Anchored	Kazhuthai mulli, Aartumulli
<i>Aeschynomene indica</i> L.	Fabaceae	Herb	Nov.- Feb.	Emergent - Anchored	
<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	Amaranthaceae	Herb	Nov.- May	Marshy	Ponnankanni
<i>Ammannia baccifera</i> L.	Lythraceae	Herb	Nov.- Jan.	Emergent - Anchored	Neermel-neruppu
<i>Ammannia octandra</i> L.	Lythraceae	Herb	Jan. - Mar.	Emergent - Anchored	
<i>Aponogeton natans</i> (L.) Engl.& Krause	Aponogetaceae	Herb	Nov.- Mar.	Anchored with floating leaves	Kotti vitlaan kizhangu
<i>Arthrocnemum indicum</i> (Willd.) Moq-Chenop.	Amaranthaceae	Herb	Dec. - Feb.	Salt Marsh	Pavalapoondu
<i>Avicennia officinalis</i> L.	Acanthaceae	Small Tree	May - Jul.	Emergent - Anchored	Uppattam
<i>Bacopa monnieri</i> (L.) Pennell	Plantaginaceae	Herb	Feb. - Sep.	Emergent - Anchored	Neerbrahmi
<i>Basilicum polystachyon</i> (L.) Moench.,	Lamiaceae	Herb	Jan. - Mar.	Marshy	Sannaki poondu
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Herb	Throughout the year	Marshy	Vallarai
<i>Cyanotis cristata</i> (L.) D.Don,	Commelinaceae	Herb	Sep.- Jan.	Marshy	
<i>Cyperus difformis</i> L.	Cyperaceae	Herb	Jan.- Apr.	Marshy	Vattakorai
<i>Cyperus exaltatus</i> Retz.	Cyperaceae	Herb	Nov. - Jan.	Marshy	
<i>Cyperus pygmaeus</i> Rottb	Cyperaceae	Herb	Sep.- Jan.	Marshy	
<i>Cyperus iria</i> L.	Cyperaceae	Herb	Sep.- Jan.	Marshy	Yanaikkitti, oosikorai
<i>Cyperus rotundus</i> L.	Cyperaceae	Herb	Throughout the year	Marshy	Koraikizhangu
<i>Cyperus squarrosus</i> L.	Cyperaceae	Herb	Sep.- Jan.	Marshy	
<i>Dentella repens</i> (L.) Forst.	Rubiaceae	Herb	Nov.- Jun.	Marshy	
<i>Drosera burmannii</i> Vahl	Droseraceae	Herb	Jan.- Feb.	Marshy	Kosuotti poondu
<i>Drosera indica</i> L.	Droseraceae	Herb	Jan.- Feb.	Marshy	Azhukanni
<i>Eclipta prostrata</i> (L.) Mant.	Asteraceae	Herb	Oct.-Apr.	Marshy	Vellai karisalakanni
<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	Herb	Jan. - May	Free floating	Venkayattamarai
<i>Epaltes divaricata</i> (L.) Cass	Asteraceae	Herb	Nov. - Mar.	Marshy	Narakaranthai
<i>Eragrostis japonica</i> (Thunb.) Trin.	Poaceae	Herb	Jan. - Mar.	Marshy	Kanjirapul
<i>Eriocaulon quinquangulare</i> L.	Eriocaulaceae	Herb	Nov.- Feb.	Suspended hydrophytes	
<i>Hygrophila auriculata</i> (Schumach.) Heine.	Acanthaceae	Shrub	Nov.- Mar.	Emergent - Anchored	Neermulli
<i>Ipomoea aquatica</i> Forssk.F	Convolvulaceae	Twiner	Nov.-Feb.	Anchored with floating shoots	Vallai-k-kirai,.
<i>Limnophila heterophylla</i> (Roxb.) Benth.	Plantaginaceae	Herb	Nov.-Feb.	Emergent - Anchored	
<i>Limnophila indica</i> (L.) Druce,	Plantaginaceae	Herb	Nov. - Feb.	Emergent - Anchored	Thanneer poondu
<i>Lindernia antipoda</i> (L.) Alston	Linderniaceae	Herb	Oct.- Feb.	Marshy	
<i>Lindernia crustacea</i> (L.) F. Muell.	Linderniaceae	Herb	Oct.- Jan.	Marshy	
<i>Lindernia hyssopioides</i> (L.) Haines	Linderniaceae	Herb	Oct. - Jan.	Marshy	
<i>Lindernia minima</i> (Benth.) Mukh	Linderniaceae	Herb	Dec.- Jan.	Marshy	
<i>Ludwigia perennis</i> L.	Onagraceae	Shrub	Mar.- Jun.	Anchored with floating shoots	Musalkathilai
<i>Marsilea minuta</i> L.	Marsiliaceae	Herb	Jan.-Mar.	Marshy	Aalai keerai
<i>Monochoria vaginalis</i> (Burm.f.) Presl,	Pontederiaceae	Herb	Jan.-Mar.	Emergent - Anchored	Karu-n-kualai
<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	Herb	Aug.-Jun.	Anchored with floating leaves	Thamarai
<i>Nesaea lanceolata</i> (Heyne ex C.B. Clarke) Koehne	Lythraceae	Herb	Dec. - Jun.	Emergent - Anchored	
<i>Nothosaerva brachiata</i> (L.) Wight,	Amaranthaceae	Herb	Nov.- Feb.	Emergent - Anchored	
<i>Nymphaea pubescens</i> Willd.	Nymphaeaceae	Herb	Aug. - Jun.	Anchored with floating leaves	Alli, Vellambal
<i>Ottelia alismoides</i> (L.) Pers.	Hydrocharitaceae	Herb	Feb.-May	Submerged - anchored	Nirkkuliri
<i>Pandanus fascicularis</i> Lam.	Pandanaceae	Shrub	Dec.- Apr.	Emergent - Anchored	Thazhambu
<i>Peplidium maritimum</i> (L.f.) F.	Phrymaceae	Herb	Nov.- Feb.	Emergent -	

				Anchored	
<i>Phyla nodiflora</i> (L.) Greene	Verbanaceae	Herb	Throughout the year	Marshy	Poduthala
<i>Portulaca oleracea</i> L.	Portulacaceae	Herb	Throughout the year	Marshy	Paruppukkeerai
<i>Portulaca pilosa</i> L.	Portulacaceae	Herb	Dec.- Feb.	Marshy	Kozhikizhangu
<i>Portulaca quadrifida</i> L.	Portulacaceae	Herb	Throughout the year	Marshy	Pasalai
<i>Salicornia brachiata</i> Roxb.	Amaranthaceae	Herb	Dec. - Jul.	Salt Marsh	Pavala poodu, Seethapavalam
<i>Sarcostemma secamone</i> (L.) Bennet	Apocynaceae	Twiner	throughout the year	Marshy	Kodikalli
<i>Scoparia dulcis</i> L.,	Plantaginaceae	Herb	Throughout the year	Marshy	Sarakkotthin
<i>Sesuvium portulacastrum</i> (L.) L.	Aizoceae	Herb	Sep. - May	Marshy	Vallaikkirai
<i>Sphaeranthus indicus</i> L.	Asteraceae	Herb	Jan.- May	Marshy	Kottai Karanthai
<i>Stemodia viscosa</i> Roxb.	Plantaginaceae	Herb	Nov -Feb.	Marshy	
<i>Suaeda nudiflora</i> (Willd.) Moq.	Amaranthaceae	Shrub	Dec.- May	Salt Marsh	Karuumari
<i>Tonningia axillaris</i> (L.) Kuntze,	Commelinaceae	Herb	Aug.- Jun.	Marshy	
<i>Typha angustata</i> Bory & Chaub.	Typhaceae	Herb	Aug.- May	Emergent - Anchored	Sambu
<i>Utricularia bifida</i> L.	Lentibulariaceae	Herb	Dec.- Jan.	Suspended hydrophytes	
<i>Vallisneria natans</i> (Lour.) Hara.	Hydrocharitaceae	Herb	Oct. - Mar.	Submerged - anchored	

Table 2: List of medicinal plants and their uses

Botanical Name	Uses
<i>Acanthus ilicifolius</i>	Roots used in curing asthma, paralysis and leucorrhoea
<i>Alternanthera sessilis</i>	Whole plant used in night blindness
<i>Ammannia baccifera</i>	Whole plant used in glandular swellings, leucorrhoea
<i>Ammannia octandra</i>	Whole plant poultice applied to open carbuncles
<i>Bacopa monnieri</i>	Plant used in epilepsy, insanity and other nervous diseases
<i>Basilicum polystachyon</i>	Decoction given in epilepsy
<i>Centella asiatica</i>	Leaves used as brain tonic
<i>Cyanotis cristata</i>	Plant a good forage
<i>Cyperus rotundus</i>	Tubers used as aromatic and antipyretic
<i>Dentella repens</i>	Plant used for poulticing sores
<i>Drosera burmannii</i>	Plant rubefacient
<i>Drosera indica</i>	Maceration of plant used as an external application on corns
<i>Eclipta prostrata</i>	Whole plant used in hepatic, spleen enlargements and in skin troubles
<i>Epaltes divaricata</i>	Roots astringent and tonic
<i>Hygrophila auriculata</i>	Plant useful as good diuretic
<i>Lindernia crustacea</i>	used in bilious affections and dysentery
<i>Ludwigia perennis</i>	Leaves used in dropsy, pain, swelling and as deobstruent
<i>Monochoria vaginalis</i>	Root chewed for toothache
<i>Nelumbo nucifera</i>	Rhizomes demulcent used in dysentery and dyspepsia
<i>Nymphaea pubescens</i>	Rhizomes demulcent used in dysentery and dyspepsia
<i>Ottelia alismoides</i>	Fruit used as cooling agent
<i>Pandanus fascicularis</i>	Flowers fragrant and used for decoration
<i>Phyla nodiflora</i>	Whole plant useful in dysentery and leucorrhoea
<i>Portulaca pilosa</i>	Plant has febrifuge and diuretic properties
<i>Sarcostemma secamone</i>	Dried stem emetic
<i>Scoparia dulcis</i>	Infusion of leaves used in fever, cough, bronchitis and as a gargle for toothache
<i>Sphaeranthus indicus</i>	Whole plant used in eczema, skin diseases, and in diseases of vatam
<i>Stemodia viscosa</i>	Dried plant used as a demulcent
<i>Typha angustata.</i>	Rhizomes astringent and diuretic

Conclusion

This site was recorded the 2nd largest congregation of migratory waterbirds in India, with a peak population in excess of 100,000, representing 103 species. In October, these waterbirds arrive from Rann of Kutch, Eastern Siberia, Northern Russia, Central Asia and parts of Europe for their feeding season and start returning to those breeding places in Jan.. These waterbirds include threatened species as Spot-billed Pelican, Spotted Greenshank, Spoonbill, Sandpiper and Black-necked Stork. Near threatened species include White

Ibis, Asian Dowitcher, Lesser Flamingo, Spoonbill, Darter and Painted Stork. The most common of the 35 resident species are White-browed bulbul, Brahminy kite, Small Green-billed Malkoha, Crow pheasant, Rose-ringed parakeet, Grey partridge, Blue-tailed Bee-eater and Common iora. The Munninyapan Lake, Theerthapallam and Nalla thaneerkulam are the lifeline for the wildlife and birds of the entire Point Calimere Wildlife Sanctuary. It also attracts a lot of migratory birds especially in the winter. Therefore, necessary steps should be taken to protect and restore water bodies. This will

be conserving the entire spectrum of biodiversity including ecosystem diversity, species diversity and genetic diversity of birds, animals, insects and plants.

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