

Status and distribution of population and potential breeding and foraging sites of Spot-billed Pelican *Pelecanus philippensis* in Tamil Nadu, India.

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Abstract

A survey was conducted to identify the population and potential breeding and foraging sites of Spot-billed Pelican *Pelecanus philippensis* from September 2007 to September 2010 in the state of Tamil Nadu, India. Based on published and unpublished records, various potential wetlands were identified and surveyed during the peak breeding season of pelican (November-April). All the pelicans sighted at various wetlands were counted and their breeding details if any were noted besides recording other details on the wetland types. In total, pelicans were found breeding at five places and exploiting as many as 54 wetlands of various types exclusively for foraging purpose during the study period in Tamil Nadu. Spot-billed Pelican prefers largely inland wetlands than other types such as marine/coastal wetlands and Human-made wetlands. Among the five breeding places, large numbers of pelicans were found breeding at Vedanthangal and Koonthangulam. Breeding populations of 501 pairs in 2007, 695 pairs in 2008, and 712 pairs in 2009 were estimated for Tamil Nadu which is higher than previous estimates. Lack of awareness, poaching, and fishing activities are the major threats to these birds wherever they occur. A synchronized census is recommended at every wetland during the early and late breeding seasons of the Spot-billed Pelican.

Keywords: breeding sites, foraging sites, *Pelecanus philippensis*, population, spot-billed pelican

INTRODUCTION

Spot-billed Pelican *Pelecanus philippensis*, a near threatened of the eight species of pelicans in the world, listed under Schedule IV of the Indian Wildlife (Protection) Act, 1972, can be found only in South and Southeast Asia over a range of territory between 129,000 and 181,000 km² with a stronghold in India, Sri Lanka, southern Cambodia, and coastal areas of Sumatra. In India, it is presently distributed in southern and north-eastern India with a stronghold in the states of Andhra Pradesh, Tamil Nadu, Karnataka and Assam (BirdLife International 2001, 2010). No specific attempt has however, been made to assess the population of pelican in India and thus, Asian Waterbird Census (AWC) has been the major source for assessing the population of Spot-billed Pelican (SBP). The total population is estimated to be 2,500–5,000 individuals in South Asia, 3,000–5,000 individuals in South-East Asia and <25 individuals in Sumatra (BirdLife International 2001, Wetlands International 2002). Manakadan and Kannan (2005) estimated a population of 2850 – 3700 individuals for the states of Andhra Pradesh, Kerala, Karnataka and Tamil Nadu and reported their estimation as crude as it was based on very few visits

to sites, conducted at different times, and also relied on secondary information. Li *et.al.*, (2009) recently reported a maximum population size of 5293, 4158, 3701, and 7865 individuals of Spot-billed Pelican for the periods 1987-92, 1993-97, 1998-2002 and 2003-2007, respectively, for entire Asia. For the present investigation, an attempt was made to assess the population and document the potential breeding and foraging sites of the Spot-billed Pelican in Tamil Nadu, India from September 2007 to September 2010.

STUDY AREA

Tamil Nadu (8°04' – 13° 34' N and 76° 14' – 80° 21' E) is situated on the southeastern side of the Indian Peninsula. It has a geographical area of 1, 30,058 km² (4% of the land area of the country) and a long coastline of about 1076 km. It has 22,877 km² of forested area (17.59% of state's geographical area) in the form of tropical rain forest, dry deciduous forest, dry thorn forests, montane shola grasslands and mangroves at various levels. The State has protected areas in the form of National Parks (5), Wildlife Sanctuaries (9), Tiger Reserves (3), Bird Sanctuaries (13), Conservation Reserve (1) and Biosphere Reserves (3). The maximum temperature in the plains is about 45°C in the summer and the minimum goes down to about 10°C during the winter. The normal rainfall in the state is about 950mm with an average number of 50 rainy days. However, it is a water deficient state. The total precipitation is around 32909 Million Cubic Meters (MCM). The surface water

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availability is about 17,563 MCM and ground water availability is around 15,346 MCM. The surface water resources have been fully harnessed by impounding the available water in 61 major reservoirs and also in 39,202 water bodies: panchayat union tanks 20,413, public workers department 8,903 and ex-zamin tanks 9,886 (Anonymous report). An annotated checklist of the birds of Tamil Nadu is not available; but more than 450 species are likely to occur (Islam and Rahmani 2004). Islam and Rahmani (2004) have identified 34 Important Bird Areas for Tamil Nadu and of which 15 were reported harbouring Spot-billed Pelican (SPB). However, no comprehensive attempt has been made earlier to document the population, and breeding and foraging sites of SPB in Tamil Nadu.

METHODS

Based on the available published literature (Pittie 2005, BirdLife International 2001, Kannan and Manakadan 2005, and Subramanya 2005), e-discussion with members through *tamilbirds@yahoogroups.co.in*, interaction with forest officials, amateur and professional ornithologists, and local people, a list of wetlands was initially prepared for the survey of Spot-billed Pelican in Tamil Nadu. All the listed wetlands were surveyed during pelican's peak breeding season (November-April) from September 2007 to September 2010. Each wetland was visited six times (once in a month during the peak breeding season) to confirm the presence of pelican utilizing the wetlands. Surveys were carried out during early morning (0500-0900hrs), midday (1200-1400hrs) and evening (1630-1800hrs) hours. Once a pelican was sighted in a place, information *viz.*, name and coordinates of the place where the pelican was sighted, number of pelicans sighted, usage of the wetland based on the activity performed during the time of sighting (breeding/foraging/or both) and type of the wetland (marine/coastal wetlands, inland wetlands and human-made wetlands). Ramsar Convention Secretariat (2006) was used for the classification of wetlands. In addition, threats to pelican at each wetland were also identified. Pelican counts were made using Vanguard (DCF 10X42) binocular and Audubon Spotting Scope (15-60X zoom) at elevated sites/watch towers near the wetlands. In some places counts were carried out on foot to cover large area. As duplication is very likely in the count of foraging pelicans, breeding pairs alone are discussed in the present paper for estimating the breeding population. Hence, maximum care was taken to include all the nests found in the breeding sites but due to dense vegetation and lack of accessibility, missing of very few nests was inevitable. Global positioning system (Magellan) was used to get the coordinates of the wetlands. ERDAS IMAGINE and Arcview software were used to prepare potential site-maps of pelican.

RESULTS AND DISCUSSION

Kannan and Manakadan (2005) recorded SBP in 18 sites for the entire Tamilnadu. Subramanya (2005) reported as many as 15 active sites (breeding). In the present study, in total, SBP was found utilizing as many as 54 sites in Tamil Nadu (Table 1, Figure 1). Among the 54 wetlands, 10 wetlands have been protected under Wildlife Sanctuary category, one under the Marine National Park category, and one under the Reserved Forest category by the Forest Department of Tamil Nadu and thus fauna and flora of those sites receive some level of protection. The other 45 wetlands, being free from any sorts of legal protection, are very vulnerable to all human related activities despite 21 of which are identified as Important Bird Areas by Islam and Rahmani (2004). In general, lack of awareness, poaching of eggs, chicks and adults, pollution, and fishing activities are the major threats to SBP regardless of sites. On 20th April 2010, three dead pelicans were recovered by the forest department in Keelkattalai Lake near Thoraipakkam-Pallavaram radial road, Chennai and were found killed (strangulation) by the poachers. As most of the individuals of SBP stay up to June in Tamil Nadu, dipping of water level in majority of the wetlands has become a major threat to SBP during that period. It often drives the SBP venture into new wetlands where such poaching incidents are more likely than in the old wetlands.

Although I could not sight any SPB in places *viz.*, Vellode of Erode District, Vagaikulam of Tirunelveli District, Muthannankulam, Selvampathy, Krishnampathy, Narasampathy, Pudukulam, Kolarampathy, Ganganarayanasamudram, Sottaiandikuttai, Puttuvikikulam, Kuniyamuthurkulam, Kurucikulam, Periyakulam, Selvachinthamanikulam, Valankulam, Singanallur kulam, and Chinnakulam of Coimbatore Taluk, and near SPIC guest house at Tuticorin, local people and ornithologists confirmed these wetlands are also used by SBP for the past three years.

Mapping the distribution of SBP shows that not all the districts of Tamil Nadu are represented (Figure 1 and 2). SBP was sighted from 18 districts and was not sighted from Tiruppur, Vellore, Krishnagiri, Tiruvanmalai, Dharmapuri, Slaem, The Nilgiris, Namakal, Perambalur, Karur, Tiruchirappalli, Dindigul, Pudukkottai and Theni districts during the study period. The maximum number of wetlands with SBP was from the districts of Kanchipuram (9), Ramanathapuram (8) and Coimbatore (8). Other districts *viz.* Virudunagar (4), Tiruvarur (3), Kanyakumari (3), Villupuram (2), Tirunelveli (2), Tanjore (2), Nagappattinam (2), Madurai (2), Cuddalore (2), Ariyalur (2), Tuticorin (1), Tiruvallur (1), Sivaganga (1), Erode (1), and Chennai (1) hold less than five wetlands with SBP each. The above mentioned information is by

Table 1. Details of foraging and breeding wetlands of Spot-billed Pelican in Tamil Nadu during September 2007 to September 2010.

S.N	Locations (District)	Latitude and Longitude	Wetland type and Protection status	Threats identified
1	Vedanthangal (Kanchipuram)	12° 32' 02" N, 79° 52' 29" E	Seasonal/intermittent freshwater lakes (WLS/ TN-29)	Occasional Poaching
2	Pallikaranai (Kanchipuram)	12° 56' 47.36" N, 80° 13' 25.86" E	Seasonal/intermittent/brackish/alkaline marshes/pools (RF)	Regular Poaching, pollution, encroachment, fire
3	Kalavai lake-Near sengalpat lake (Kanchipuram)	12° 41' 50.84" N, 79° 58' 49.70" E	Seasonal/intermittent freshwater lakes	Fishing
4	Annamalancherry (Kanchipuram)	13° 24' 58" N, 80° 19' 24" E	Seasonal/intermittent freshwater lakes	Fishing
5	Edayur (Kanchipuram)	12° 37' 00" N, 80° 13' 00" E	Coastal brackish/saline lagoon	Fishing
6	Kattankulathur-Near maraimalai nagar (Kanchipuram)	12° 48' 25.13" N, 80° 01' 24.42" E	Seasonal/intermittent freshwater lakes	Fishing
7	Karikilli (Kanchipuram)	12° 33' 25.58" N, 79° 56' 58.23" E	Seasonal/intermittent freshwater lakes (WLS)	Occasional poaching and fishing
8	Kilkattalai (Kanchipuram)	12° 56' 53.48" N, 80° 10' 45.42" E	Coastal brackish/saline lagoon	Poaching, fishing
9	Muttukadu (Kanchipuram)	12° 48' 18.32" N, 80° 14' 32.53" E	Seasonal/intermittent freshwater lakes	Poaching, fishing, tourism
10	Periakanmai (Ramanathapuram)	09° 22' 00" N, 78° 52' 00" E	Seasonal/intermittent freshwater lakes (TN-03)	Fishing
11	Sakkarakotai Kanmai (Ramanathapuram)	09° 23' 00" N, 78° 54' 00" E	Seasonal/intermittent freshwater lakes (TN-03)	Poaching, fishing
12	Chitragudi & Kanjirankulam (Ramanathapuram)	09° 19' 48" N, 78° 28' 60" E	Seasonal/intermittent freshwater lakes (WLS/ TN-06)	Occasional poaching,
13	Gulf of Mannar (Ramanathapuram)	09° 40' 00" N, 78° 10' 00" E	Permanent shallow marine waters (MNP/ TN-09)	Fishing
14	Melaselvanur-Keelaseivanur (Ramanathapuram)	09° 12' 32.7" N, 78° 33' 01" E	Seasonal/intermittent freshwater lakes (WLS)	Occasional poaching
15	Kottamangalam-near sayalkudi (Ramanathapuram)	09° 10' 24.37" N, 78° 42' 13.39" E	Seasonal/intermittent freshwater lakes	Fishing
16	Kalimangalam-near sayalkudi (Ramanathapuram)	09° 13' 24.37" N, 78° 42' 13.39" E	Seasonal/intermittent freshwater lakes	Fishing
17	kanmai-Ervadi (Ramanathapuram)	09° 13' 24.37" N, 78° 42' 13.39" E	Seasonal/intermittent freshwater lakes	Poaching, fishing
18	Periyakulam-coimbatore (Coimbatore)	11° 01' 45.41" N, 77° 06' 51.83" E	Seasonal/intermittent freshwater lakes	Fishing

19	Periyakulam-sulur (Coimbatore)	11° 01' 45.41" N, 77° 06' 51.83" E	Pond	Fishing
20	Chinnakulam-sulur (Coimbatore)	11° 01' 56.57" N, 77° 07' 33.77" E	Pond	Occasional/regular poaching, fishing
21	Singanallur (Coimbatore)	11° 00' 00" N, 77° 01' 11" E	Seasonal/intermittent freshwater lakes	Occasional/regular poaching, fishing
22	Kuniamuthur lake (Coimbatore)	10° 57' 59.76" N, 76° 57' 55.95" E	Seasonal/intermittent freshwater lakes	Occasional/regular poaching, fishing
23	Selvapuram Lake (Coimbatore)	10° 58' 53.67" N, 76° 57' 27.82" E	Seasonal/intermittent freshwater lakes	Occasional/regular poaching, fishing
24	Perur (Coimbatore)	10° 58' 08.13" N, 76° 55' 47.72" E	Seasonal/intermittent freshwater lakes	Fishing
25	Ukkadam (Coimbatore)	12° 58' 08.13" N, 76° 57' 27.75" E	Seasonal/intermittent freshwater lakes	Fishing
26	Kullur Sandai-Reservoir (Virudunagar)	09° 33' 30" N, 78° 00' 34" E	Water storage areas (TN-16)	Occasional/regular poaching, Fishing
27	Watrap periakulam (Virudunagar)	09° 31' 60" N, 77° 31' 00" E	Seasonal/intermittent freshwater lakes (TN-32)	Occasional/regular poaching, fishing
28	Viraka samuthrakulam (Virudunagar)	09° 31' 66" N, 77° 31' 00" E	Seasonal/intermittent freshwater lakes (TN-32)	Fishing
29	Vembakottai Dam (Virudunagar)	08° 45' 00" N, 77° 43' 00" E	Water storage areas	Occasional poaching, noise pollution
30	Vaduvoor (Tiruvarur)	10° 42' 19" N, 79° 18' 53" E	Seasonal/intermittent freshwater lakes (WLS/ TN-28)	Poaching
31	Muthupettai (Tiruvarur)	10° 23' 00" N, 79° 29' 37" E	Salt exploitation sites	
32	Udayamarthandapuram (Tiruvarur)	10° 26' 56" N, 79° 33' 10" E	Seasonal/intermittent freshwater lakes (WLS)	
33	Theroor lake (Kanyakumari)	08° 04' 60" N, 77° 30' 00" E	Seasonal/intermittent freshwater lakes (TN-24)	Fishing
34	Vembanoor lake (Kanyakumari)	08° 04' 60" N, 77° 30' 20" E	Seasonal/intermittent freshwater lakes (TN-24)	Fishing
35	Putherry (Kanyakumari)	08° 13' 02.78" N, 77° 26' 10.47" E	Seasonal/intermittent freshwater lakes	Fishing
36	Kaliveli tank (Villupuram)	12° 10' 00" N, 79° 49' 60" E	Coastal brackish/ saline lagoon (TN-12)	Poaching, Fishing
37	Yedayanthittu Estuary (Villupuram)	12° 12' 00" N, 79° 49' 40" E	Estuarine waters (TN-12)	Poaching, Fishing
38	Koonthangulum (Tirunelveli)	08° 28' 12" N, 77° 43' 48" E	Seasonal/intermittent freshwater lakes (WLS/ TN-14)	

39	Venthakulam (Tirunelveli)	08° 40' 00" N , 77° 43' 00" E	Pond	Fishing
40	Athiramapattinam (Tanjore)	10° 19' 31" N , 79° 23' 00" E	Seasonal/intermittent freshwater lakes	Fishing
41	Pattukkottai near (Tanjore)	10° 22' 07" N , 79° 20' 49" E	Seasonal/intermittent freshwater lakes	Fishing
42	Great Vedaranyam Swamp (Nagappattinam)	10° 20' 00" N , 79° 46' 00" E	Permanent shallow marine waters	Poaching, Poaching,
43	Point Calimere (Nagappattinam)	10° 18' 00" N , 79° 50' 60" E	Permanent shallow marine waters (WLS/ TN-20)	Poaching,
44	Vandioor (Madurai)	09° 55' 17" N , 78° 09' 14" E	Seasonal/intermittent freshwater lakes (TN-27)	Fishing
45	Kunnathur (Madurai)	09° 55' 17" N , 78° 10' 14" E	Seasonal/intermittent freshwater lakes (TN-27)	Fishing
46	Wellington Reservoir (Cuddalore)	11° 25' 00" N , 79° 52' 00" E	Water storage areas (TN-33)	Poaching, fishing
47	Veeranam Lake (Cuddalore)	11° 15' 00" N , 79° 32' 30" E	Seasonal/intermittent freshwater lakes (TN-30)	Poaching, fishing
48	Karaivetti lake (Ariyalur)	10° 58' 01" N , 79° 11' 07" E	Seasonal/intermittent freshwater lakes (WLS/ TN-13)	Occasional poaching and fishing,
49	Venganur lake (Ariyalur)	10° 58' 51" N , 79° 11' 60" E	Seasonal/intermittent freshwater lakes	Poaching, fishing
50	Chervaikaran madam (Tuticorin)	08° 44.7' N , 78° 3.2' E	Seasonal/intermittent freshwater lakes	Poaching
51	Palaverkkadu-pulicate lake TN portion (Thiruvallur)	13° 24' 58" N , 80° 19' 24" E	Coastal brackish/ saline lagoon	Poaching, fishing
52	Vettangudi (Sivaganga)	10° 05' 53" N , 78° 32' 23" E	Seasonal/intermittent freshwater lakes (WLS/ TN-31)	Poaching, fishing
53	Bhavanisagar Dam (Erode)	10° 18' 00" N , 79° 18' 00" E	Water storage areas	Poaching, fishing, pollution
54	Adayar (Chennai)	13° 01' 01.00" N , 80° 16' 30.85" E	Estuarine waters	Poaching, fishing, pollution

WLS - Wildlife Sanctuary, MNP - Marine National Park, RF - Reserved forest, TN - # - IBA Code

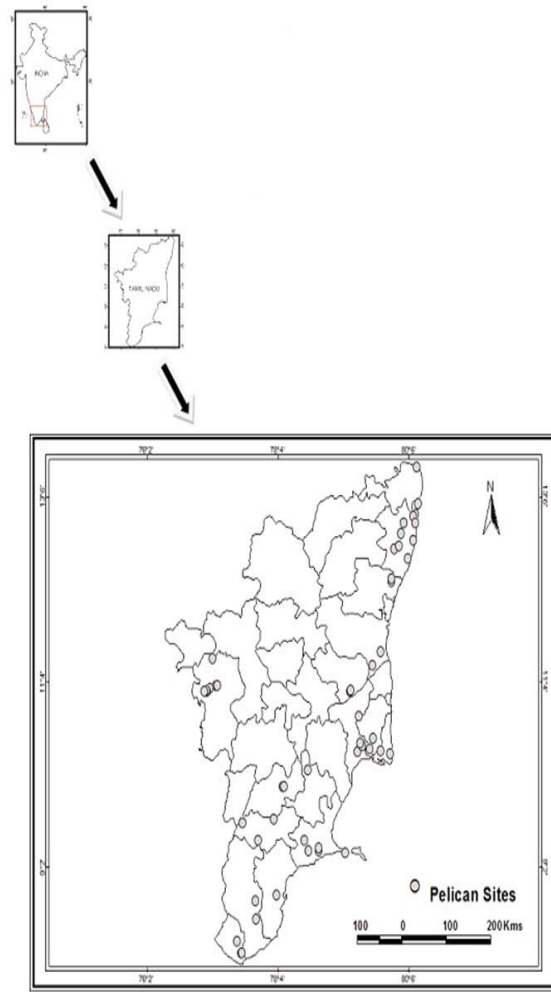


Figure 1. Distribution of wetlands with Spot-billed Pelican sightings in various districts of Tamil Nadu during 2007-2010 (N=54).

no means an indication of an absence of SBP in other districts as six visits may not be sufficient enough to indicate the absence. Moreover, there are still unexplored/unknown wetlands in each district.

Majority of the SBP foraging sites are clustered near the distribution of rivers in Tamil Nadu as major wetlands occur in this region (Figure 3). Subramanya (2005) reported that major heronries in Tamil Nadu are distributed along rivers that coincide with the distribution of major tanks, indicating the importance of foraging grounds for the species nesting in the heronries of the state. Hence, the distribution of SBP largely depends on the distribution of tanks and heronries.

The SBP, to forage, prefers largely inland wetlands than the other wetland types viz., marine/coastal wetlands and Human-made wetlands (Figure 4). In general, SBP was largely sighted foraging in freshwater lakes.

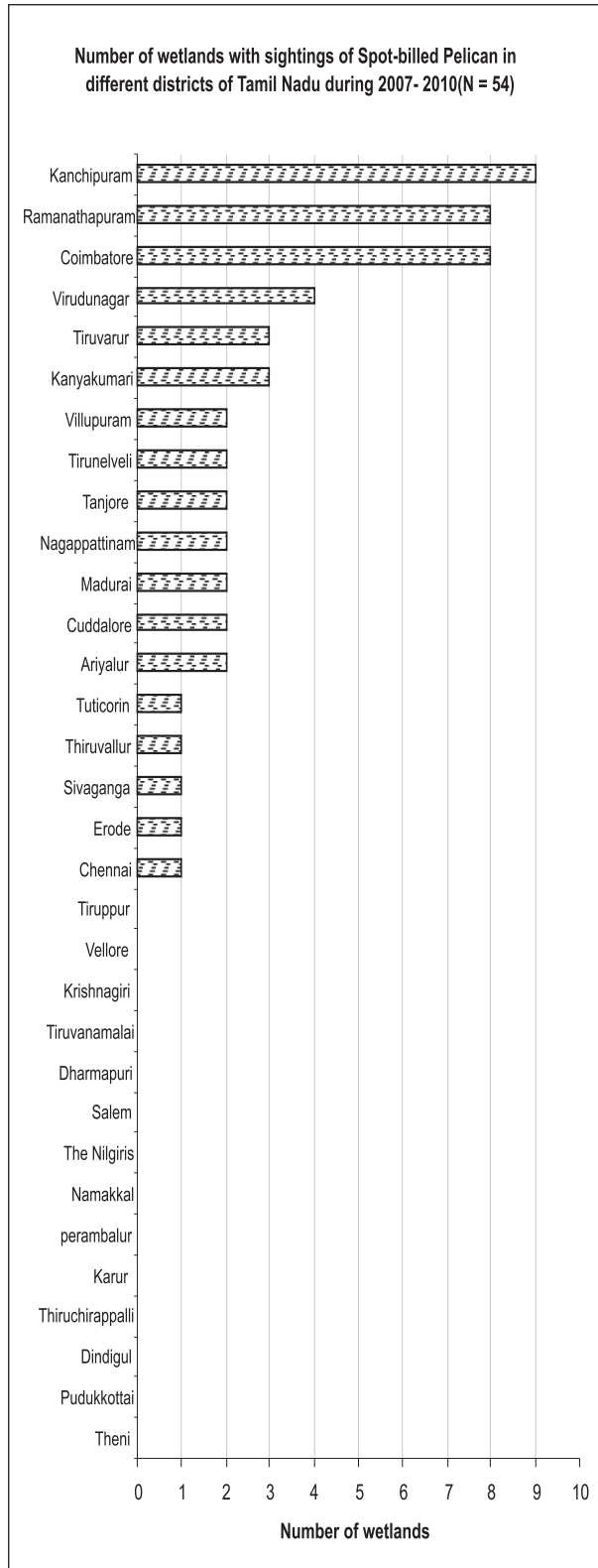


Figure 2. Distribution of wetlands with Spot-billed Pelican in different districts of Tamil Nadu during 2007-2010 (N=54).

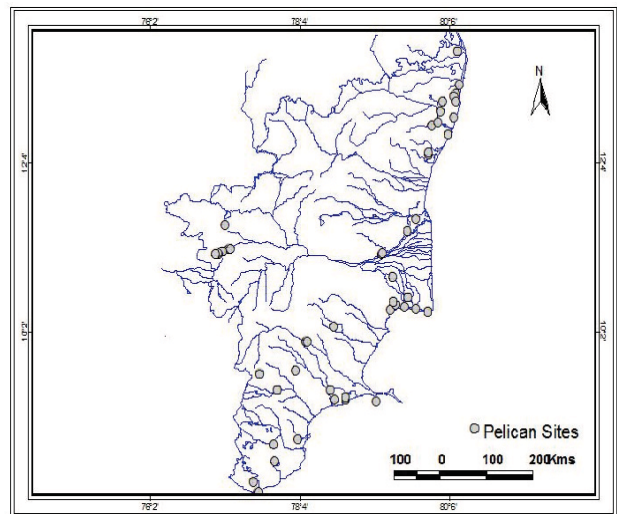


Figure 3. Distribution of wetlands with Spot-billed Pelican sightings with respect to the distribution of rivers in Tamil Nadu during 2007- 2010 (N=54).

However, SBP was also sighted foraging in marine/ saline water during the study period. Among the human-made wetlands, reservoirs and salt exploitation sites were highly preferred.

Pallikaranai marsh has been one of the largest foraging sites for SBP during the breeding season. However, the area was reduced to about 600ha from an earlier extent of 4000-5000 ha (Care Earth, 2002; Joint Committee Report, 2003; The Hindu, 2006) and recently to 420ha (Care Earth, 2005). A fall of about 30% in the wetland area within a span of three years is indeed detrimental to SBP. The Pallikkaranaï marsh was very effectively utilized by SPB during the present study period for foraging. However, over 250 acres of prime marsh lands have already been choked by the wastes dumped by Chennai metropolis. Besides, real estate ventures, fire, pollution, and various other developmental activities are further aggravating the wetland depletion. Although the government of Tamil Nadu (Gazette notification GO. Ms. No. 52, dated 9 April 2007), declared a part of the Pallikaranai marsh (317.00ha) as a reserve forest (under section 4 of the Tamil Nadu Forest Act, 1882), rejuvenation of this wetland ecosystem in a sustained manner is an urgent need to preserve SBP population. Although, the pylons present amidst the marsh has largely been used as resting sites by SBP, mortality of SPB due to electrocution was also noticed during the study period.

There are currently four relatively stable large breeding colonies in Tamil Nadu: Vedanthangal Bird Sanctuary, Koonthangulam Bird Sanctuary, Karaivetti Bird Sanctuary, and Karikilli Bird Sanctuary. The Melaselvanur and Kelaselvanur Bird Sanctuary,

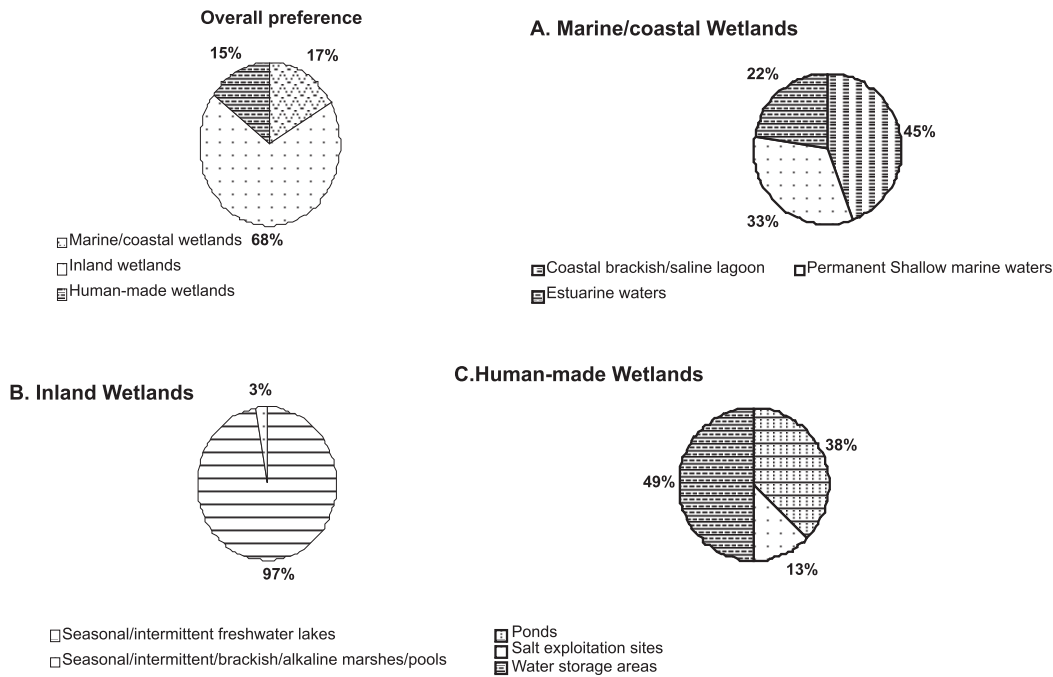


Figure 4. Foraging habitat preference shown by Spot-billed Pelican in Tamil Nadu during 2007-2010 (N=54).

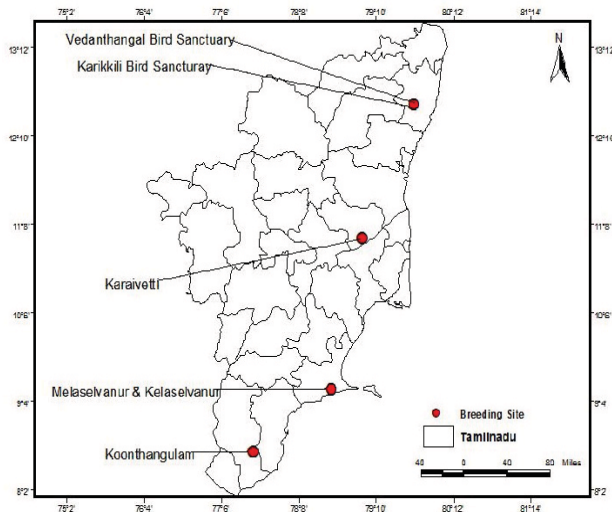


Figure 5. Distribution of breeding sites of Spot-billed Pelican in Tamil Nadu during 2007-2010.

another breeding site in Tamil Nadu is also expected to be stabilizing in near future (Figure 5). However, Kannan and Manakadan (2005) reported only two breeding colonies (Koonthangulam and Karaivetti), four occasional breeding colonies (Edayur, Sakarakottai, Watrup Big tank and Vedanthangal) and two abandoned breeding colonies at Kanjirankulam-chitragudi and Moondradaippu. Similarly, Subramanya (2005) reported as many as 13 active breeding sites of SBP in Tamil Nadu based on the earlier literature. However, I could not record any breeding

activities in the above mentioned sites (Arignar Anna Zoological Park, Vettangudi Patti Tank, Watrup Big Tank, Edyaur, Parai Kanmoi, Kanjirankulam, Chitragudi, and Ariyakulam) during the entire study period. The local people also confirmed the lack of nesting activities by SPB in recent years in the above mentioned places.

Among the breeding sites, regardless of years, more number of breeding pairs were found in Vedanthangal Bird Sanctuary (258 pairs in 2007-08, 358 in 2008-2009, and 359 in 2009-10) than the other sites. Koonthangulam was the second largest holder of pelican breeding colony in Tamil Nadu followed by Karaivetti (except 2007-08), Karikilli, Melaselvanur and Kelaselvanur. Kannan and Manakadan (2005) estimated a population size of 1,600-2,000 SBP for the entire Tamil Nadu. The current population of breeding SBP alone was 3487 in 2010 in Tamil Nadu (Table 3). It shows that the population estimates in the 1980s by Neelakantan (1980), Nagulu (1983), and Kannan and Manakadan (2005) are either underestimates or the population has seen a rise over the years due to conservation measures or other unknown factors. Li *et al.*, (2009) also reported an increasing trend of population of SPB in the global level for the last two decades (1987-2007). A vital factor in the existence and survival of many of the pelicanries in southern India has been the traditional support of local communities. And, of concern, is the change in attitude of locals in support to pelicanries in some areas due to increasing human related pressures and other

Table 2. Number of Spot-billed Pelican sighted in various wetlands in Tamil Nadu during September 2007 to September 2010.

S.No	Locations	Nov-2007 to April 2008						Nov-2008 to April 2009						Nov-2009 to April 2010					
		N	Min	Max	Mean	SE	SD	N	Min	Max	Mean	SE	SD	N	Min	Max	Mean	SE	SD
1	Karaivetti	6	80	116	93.3	6.9	16.9	6	178	265	208.8	17.2	42.1	6	186	295	226.3	20.7	50.7
2	Venganur	6	0	4	1.7	0.6	1.5	6	0	2	1.0	0.4	1.1	6	0	2	0.7	0.4	1.0
3	Adaiyar	6	0	21	8.2	3.8	9.4	6	0	46	16.3	8.2	20.0	6	0	48	32.8	8.6	21.2
4	Periyakulam	6	0	3	1.2	0.5	1.2	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
5	Periyakulam-sulur	6	2	16	10.8	2.3	5.6	6	0	16	10.8	3.0	7.3	6	0	57	28.2	12.6	30.9
6	Chinnakulam-sulur	6	0	12	6.2	2.3	5.6	6	0	4	3.0	0.7	1.7	6	0	9	2.8	1.8	4.4
7	Singanallur	6	0	65	17.3	10.4	25.5	6	0	77	29.7	13.8	33.7	6	0	220	91.0	41.1	100.7
8	Kuniyamuthur lake	6	0	4	1.5	0.8	2.0	6	0	0	0.0	0.0	0.0	6	0	22	4.7	3.6	8.8
9	Selvapuram Lake	6	0	3	0.8	0.5	1.3	6	0	2	0.3	0.3	0.8	6	0	6	1.3	1.0	2.4
10	Perur	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0	6	0	1	0.2	0.2	0.4
11	Ukkadam	6	12	43	23.2	4.6	11.2	6	0	48	27.2	7.3	17.8	6	0	72	30.7	13.9	34.1
12	Veeranam Lake	6	0	1	0.2	0.2	0.4	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
13	Wellington Reservoir	6	0	4	1.0	0.6	1.5	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
14	Bhavisagar Dam	6	2	4	2.7	0.4	1.0	6	0	20	7.7	2.9	7.2	6	0	16	9.0	2.4	6.0
15	Vedanthangal	6	968	1384	1154.7	84.0	205.8	6	978	1550	1245.3	95.3	233.4	6	1012	1484	1266.5	74.8	183.2
16	Edayur	6	0	4	2.7	0.8	2.1	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
17	Pallikaranai	6	42	124	90.5	11.1	27.3	6	48	216	150.3	23.7	58.1	6	56	234	144.7	33.7	82.5
18	Kalavai lake	6	0	13	4.3	2.2	5.4	6	0	14	3.0	2.3	5.6	6	0	12	8.0	1.7	4.1
19	Annamalaicherry	6	0	4	0.7	0.7	1.6	6	0	2	0.3	0.3	0.8	6	0	2	0.3	0.3	0.8
20	Kattankulathur-	6	0	2	0.7	0.3	0.8	6	0	1	0.8	0.2	0.4	6	0	0	0.0	0.0	0.0
21	Karikilli	6	66	131	96.8	11.2	27.4	6	78	139	103.2	10.2	24.9	6	98	158	121.8	10.3	25.1
22	Kilkattalai	6	0	4	0.7	0.7	1.6	6	0	0	0.0	0.0	0.0	6	0	4	2.7	0.8	2.1
23	Muttukadu	6	0	56	14.8	9.4	23.1	6	0	36	15.5	5.1	12.5	6	12	23	18.3	2.0	4.9
24	Theroor	6	0	6	1.7	1.1	2.7	6	2	34	13.8	5.6	13.8	6	0	26	4.3	4.3	10.6
25	Vembanoor	6	0	2	0.3	0.3	0.8	6	0	4	1.2	0.7	1.8	6	0	2	0.7	0.4	1.0
26	Putherry	6	0	8	1.3	1.3	3.3	6	0	0	0.0	0.0	0.0	6	0	3	0.5	0.5	1.2
27	Vandoor	6	0	6	3.3	1.1	2.7	6	0	6	2.0	0.9	2.2	6	0	0	0.0	0.0	0.0
28	Kunnathur	6	0	3	0.8	0.5	1.3	6	0	3	1.5	0.7	1.6	6	0	4	1.3	0.8	2.1
29	Point Calimere	6	10	26	22.2	2.5	6.0	6	34	87	63.0	10.3	25.2	6	56	108	83.8	9.5	23.3

30	Great Vedaranyam Swamp	6	12	52	24.3	5.9	14.5	6	89	226	129.8	22.6	55.3	6	68	145	114.2	13.9	34.1
31	Periakanmai	6	0	9	4.3	1.4	3.5	6	0	26	13.5	3.4	8.3	6	6	18	10.3	2.1	5.1
32	Sakkarakotai Kanmai	6	0	9	3.7	1.6	3.9	6	0	15	6.3	2.5	6.2	6	0	9	2.2	1.5	3.7
33	Chitrangudi & Kanjirankulam	6	12	24	19.7	1.8	4.3	6	2	16	11.3	2.0	4.8	6	2	16	11.0	1.9	4.7
34	Gulf of Mannar	6	0	5	2.2	1.0	2.4	6	15	34	29.2	3.1	7.6	6	0	28	11.3	3.8	9.3
35	Melasevanur-Keelasevanur	6	4	16	7.7	1.7	4.3	6	19	28	24.2	1.4	3.5	6	23	41	32.0	3.2	7.8
36	Kottamangalam	6	0	0	0.0	0.0	0.0	6	0	1	0.8	0.2	0.4	6	1	2	1.2	0.2	0.4
37	Kalimangalam	6	0	0	0.0	0.0	0.0	6	0	1	0.2	0.2	0.4	6	1	2	1.5	0.2	0.5
38	Ervadi	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0	6	0	4	1.3	0.7	1.6
39	Vettangudi	6	0	2	0.5	0.3	0.8	6	0	6	1.2	1.0	2.4	6	0	2	0.3	0.3	0.8
40	Athiramapattinam	6	1	12	3.8	1.7	4.3	6	0	6	3.0	1.0	2.4	6	0	8	3.0	1.4	3.5
41	Pattukkottai near	6	0	1	0.3	0.2	0.5	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
42	Palaverkkadu	6	0	3	1.2	0.6	1.5	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
43	Koonthangulum	6	613	1008	796.5	77.0	188.7	6	801	1438	1088.2	124.7	305.5	6	767	1509	1067.3	115.9	283.9
44	Venthakulam	6	0	1	0.2	0.2	0.4	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0
45	Vaduvoor	6	0	0	0.0	0.0	0.0	6	0	2	0.3	0.3	0.8	6	0	65	11.5	10.7	26.2
46	Muthupettai lagoon	6	0	68	29.0	10.9	26.8	6	2	87	40.8	11.3	27.6	6	0	69	38.3	12.8	31.3
47	Udayamarthandapuram	6	0	2	0.5	0.3	0.8	6	0	2	0.8	0.3	0.8	6	0	2	1.0	0.4	1.1
48	Chervaiakaran madam & Kovampallam	6	0	12	4.5	2.4	5.9	6	0	12	5.0	1.8	4.5	6	0	9	3.7	1.7	4.2
49	Kaliveli tank	6	23	42	28.5	3.2	7.9	6	32	48	40.5	3.1	7.6	6	34	46	40.0	2.4	5.9
50	Yedayanthittu Estuary	6	0	23	12.2	3.5	8.5	6	0	12	2.8	2.0	4.9	6	12	32	19.8	3.3	8.2
51	Kullur Sandai-Reservoir	6	0	4	2.7	0.8	2.1	6	0	65	24.0	11.5	28.1	6	0	82	28.7	14.0	34.2
52	Watrap periakulam	6	0	4	0.7	0.7	1.6	6	0	2	0.3	0.3	0.8	6	0	0	0.0	0.0	0.0
53	Viraka smuthrakulam	6	0	1	0.5	0.2	0.5	6	0	4	2.7	0.8	2.1	6	0	2	0.7	0.4	1.0
54	Vembakottai Dam	6	0	6	1.0	1.0	2.4	6	0	0	0.0	0.0	0.0	6	0	0	0.0	0.0	0.0

Maximum number of SBP sighted during the entire study period was in bold letters, N = Number of census, Min = Minimum number of SBP sighted, Max = Maximum number of SBP sighted, SD = Standard Deviation, SE = Standard Error, Maximum number of pelican sighted in each wetland is in bold letter

Table 3. Number of individuals sighted at five breeding wetlands in Tamil Nadu during Sep. 2007 to Sep. 2010

Name of the Wetlands	Seasons		
	Nov - 2007 to April 2008	Nov - 2008 to April 2009	Nov - 2009 to April 2010
Karaivetti Bird Sanctuary	116 (86 Adults, 30 Chicks)	265 (185 Adults, 80 Chicks)	295 (203 Adults, 92 Chicks)
Vedanthangal Bird Sanctuary	1384 (968 Adults, 416 Chicks)	1550 (1102 Adults, 448 Chicks)	1484 (1020 Adults, 464 Chicks)
Karikilli Bird Sanctuary	131 (79 Adults, 52 Chicks)	139 (89 Adults, 50 Chicks)	158 (102 Adults, 56 Chicks)
Melaselvanur-Keelaselvanur Bird Sanctuary	16 Adults	28 (23 Adults, 5 Chicks)	41 (26 Adults, 15 Chicks)
Koonthangulum Bird Sanctuary	1008 (628 Adults, 380 Chicks)	1438 (826 Adults, 612 Chicks)	1509 (901 Adults, 608 Chicks)
Total	2655 (1770 Adults, 885 Chicks)	3420 (2225 Adults, 1195 Chicks)	3487 (2552 Adults, 1235 Chicks)

Table 4. Number of nests of Spot-billed Pelicans found in various wetlands in Tamil Nadu during Sep. 2007 to Sep. 2010

Name of the wetlands	Number of nests found in different years		
	Nov. 2007 to April 2008	Nov. 2008 to April 2009	Nov. 2009 to April 2010
Karaivetti Bird Sanctuary	18	50	56
Vedanthangal Bird Sanctuary	258	358	359
Karikilli Bird Sanctuary	24	27	31
Melaselvanur-Keelaselvanur Bird Sanctuary	0	2	6
Koonthangulum Bird Sanctuary	201	258	260
Total	501	695	712

reasons. This has resulted in disinterest in protection of the species, loss of nesting trees and over exploitation of foraging grounds which have affected pelicans. Hence, a people participatory approach has to be developed in all the five breeding sites to conserve SPB.

February to April being the crucial months of growing young ones of SPB, proper steps have to be taken to sustain the water level for the conservation of SPB during the mentioned months in all the breeding sites. As nesting trees are not sufficient enough to support all the members of the birds during the breeding season, erection of artificial nest poles or stages would invite more number of SPB in immediate future. In addition, planting of trees would ensure the long term sustainability.

The status of the Spot-billed Pelican in southern India (and indeed in the rest of its range) is poorly known. It was previously believed to be sedentary or subject to local seasonal movements, and it was presumed not to undertake long-distance movements regularly (Ali and Ripley 1987, del Hoyo *et al.*, 1992). Kannan and Manakadan (2005) suggested that the species may

travel long distances to foraging grounds and there may also be movements between colonies. The present study substantiates their opinion as there were movements of SBP in large numbers from unknown location to Karaivetti between the month of May and July during the study period. A total of 351, 243 and 216 individuals of SBP moved from unknown sites to Karaivetti Lake in the years 2008, 2009 and 2010, respectively. As the colony comprised largely adults and months old chicks, it is assumed that they would have come from nearby breeding sites. As the breeding population in other four sites was stable during the same period, it may be assumed that the population would have migrated from other states or from Sri Lanka, an adjacent country, which falls within the movement limits. Movements up to 75 km (Findholt and Anderson 1995) and 100 km (Hatzilacou 1996) from colonies to foraging areas have already been reported in the American White Pelican *P. erythrorhynchos* and Great White Pelican *P. onocrotalus*, respectively. Hence, it is probable that Pelicans sighted all over the Tamil Nadu would presumably be derived from the existing five breeding sites in Tamil Nadu and to a certain extent from the Pulicate Lake of Andhra Pradesh and Sri Lanka.

CONCLUSION

The status of population Spot-billed Pelican appears strongly to be increasing and surviving well in recent years in Tamil Nadu. It prefers largely inland wetlands to breed and forage. There are currently four relatively stable large breeding colonies in Tamil Nadu: Vedanthangal Bird Sanctuary, Koonthangulam Bird Sanctuary, Karaivetti Bird Sanctuary, and Karikilli Bird Sanctuary. Lack of awareness, poaching of eggs/chicks, pollution, fire, and extensive fishing activities, cutting of nesting trees and drought are the existing major threats to SPB and its habitats. Although, casualties due to collision with above-ground high density power lines were also observed in some breeding and foraging sites, it needs further detailed investigation. A synchronized census is recommended at every wetland during the early and late breeding seasons of the Spot-billed Pelican.

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REFERENCES

- Ali, S. and Ripley, S. D. 1987. Compact handbook of the birds of India and Pakistan. Delhi: Oxford University Press.
- Anonymous report: <http://envfor.nic.in/soer/state/SoE%20report%20of%20Tamilnadu.pdf>
- Azeez, P.A., S. Bhupathy., J. Ranjini., R. Dhanya & Raj, P.P.N. 2007. *Management Plan for the Eco-restoration of Pallikaranai Reserve Forest*. Report. Salim Ali Centre for Ornithology and Natural History, Coimbatore, 62pp.
- BirdLife International. 2001. Threatened birds of Asia: the BirdLife International Red Data Book. Cambridge, U.K.: BirdLife International.
- BirdLife International. 2011 Species fact sheet: *Pelecanus philippensis*. Downloaded from <http://www.birdlife.org> on 06/05/2011.
- Care Earth. 2002. Conservation of Urban Wetlands – Pallikaranai Marsh. Tamil Nadu Pollution Control Board, 31pp.

- Care Earth. 2005. Current status of the Marsh and recommendations for restoration. Unpublished document. Dartmouth College: Dartmouth Flood Observatory. Hanover/USA. Online access:<http://www.dartmouth.edu/~floods/archives/index.html>.
- del Hoyo, J. Elliot, A. and Sargatal, J. 1992 Handbook of the birds of the world. Vol. 1. Barcelona: Lynx Editions.
- Feedhole, S. L., and Anderson, S. H. 1995 Foraging areas and feeding habitat selection of American White Pelicans *Pelecanus erythrorhynchos* nesting at Pathfinder Reservoir, Wyoming. Colonial Waterbirds 18(1): 47–57.
- Hatzilacou, D. 1996 Feeding ecology of the Great White Pelican *Pelecanus onocrotalus* nesting at Lake Mikri Prespa (northern Greece) Colonial Waterbirds 19: 190–206.
- Islam, M. Z & Rahmani, A.R. 2004. Important Bird Areas in India: Priority Sites for Conservation. Indian Bird Conservation Network: Bombay Natural History Society, Bombay, India and BirdLife International, Cambridge, UK
- Joint Committee Report. 2003. Threats to Pallikaranai wetland and need for its immediate remedial measures. Joint Committee, Ministry of Environment and Forest, Government of India, New Delhi.
- Kannan, V. and Manakadan, R. 2005. Status and distribution of Spot-billed Pelican in southern India. Forktail (21):9-14
- Li, Z.W.D., Bloem, A., Delany S., Martakis G. and Quintero J.O. 2009. Status of waterbirds in Asia – Results of the Asian Waterbird Census: 1987-2007. Wetlands International, Kuala Lumpur, Malaysia.
- Pittie, A. 2005. *A bibliographic index to the ornithology of the Indian Subcontinent*. CDRom published by the author.
- Raj.P.P.N., Ranjini, J., Dhanya, R., Subramanian, J., Azeez, P.A., & Bhupathy, S 2010. Consolidated checklist of birds in the Pallikaranai Wetlands, Chennai, India. Journal of Threatened Taxa 2(8):1114-1118.
- Ramsar Convention Secretariat, 2006 *The Ramsar Convention Manual: a Guide to the Convention on Wetlands (Ramsar, Iran, 1971)*, 4th ed. Gland, Switzerland:.
- Subramanya. S. 2005. Heronries of Tamil Nadu. Indian Birds Vol. 1. No.6. pp: 126-140
- The Hindu. 2006. *The marshland gone waste* (report by J Vencatesan). <http://www.thehindu.com/thehindu/pp/2006/07/01/stories/006070100040100.htm>.
- Wetlands International. 2002. Waterbird population estimates. Third edition. Wetlands International Global Series No.12. Wageningen, Netherlands: Wetlands International.