BVG Trust

J. Sci. Trans. Environ. Technov. 2015, 9(1) : 50-54

Scientific Transactions in Environment and Technovation

Do salt-pans functions as viable habitat for migratory shorebirds? - A Case study in the east coast of Tamil Nadu, southern India

https://doi.org/10.20894/STET.116.009.001.009
www.stetjournals.com

J.Pandiyan, G.Karthikeyan and R.Nagarajan

PG and Research Department of Zoology and Wildlife Biology, AVC College (Autonomous), Mannampandal, Mayiladuthurai-609 305, Tamil Nadu, India

Abstract

Shorebirds are long distance annual migrants. Conservation of migratory shorebirds is the need of the hour to maintain the sustainable link of international migratory flyways routes. Salt pans are the most important alternate and viable habitats for the migratory shorebirds. Hence the status of shorebirds was studied from July 2012 to March 2015 in the five different salt pans of east coast of southern India. Total count was applied to count the shorebirds in five different salt pans. Totally 18 species of migratory shorebirds were recorded, in which two are under 'Near Threatened' category. The Little stint showed more turn over than other species recorded in the salt pans. Maximum bird abundance and diversity were recorded during the monsoon seasons of the three years. The bird abundance and diversity of species varied significantly among the habitats and years ($P<0.001$). The present study reveals that salt pans are the most vital habitat seasonally for the migratory shorebirds as feeding and roosting habitat.

Key words : Shorebirds-salt pans – habitat interactions-conservation.

INTRODUCTION

Shorebirds migrate thousands of kilometers every year to meet out their daily energy requirement and for migration (Pandiyan and Asokan, 2015). Estuaries are the vital habitats for shorebirds during the winter and migration (van de Kam *et al.,* 2004). In fact, many shorebirds are well adapted to the tidally structured environment of estuarine habitats. The shorebirds use the intertidal mudflats as foraging habitats during low tide (where they prey mainly upon macrobenthic invertebrates), and the shorebirds shift into other habitats to rest when the tide rises (Burger *et al.,* 1977).

But, most of the estuaries are under sever human pressure, mainly related with land reclamation (Goss-Custard and Yates, 1992), pollution (Wolff, 2000), and other disturbances (Stillman *et al.,* 2007) throughout the world. Shorebirds play a significant role on the estuarine food web as secondary consumers (Kuwae *et al.,* 2012) and, for that reason, are particularly vulnerable to changes in the estuarine environment (Sutherland *et al.,* 2012). In such cases, the existence of alternative feeding habitat for shorebirds may equalize the decrease on the availability and quality of their natural (mudflat) feeding grounds (Masero, 2003). In fact, many birds use alternate habitats such as human-made salt pans, as a complementary feeding habitat (Yasue and Dearden, 2009). In addition some species may even prefer to feed in salt pans instead of mudflats during the low tide period (Dias, 2009).

Therefore, saltpans can potentially act as an alternative and viable feeding habitat for migratory shorebird species in case of reduction or degradation of the intertidal flat area (Sripanomyom *et al.* 2011). The present article deals with the analysis of the man made salt pans with the perspective of alternative/viable feeding habitat for migrating shorebirds in India.

STUDY AREA

The study was carried out in the Kodikkarai saltpans of the east coast of Tamilnadu, southern India. The saltpans in the study area comprised 930 ha. and divided into five different saltpan areas viz., Chemplast (250 ha. 10° 019.678'N, 79° 49.809'E), Kovilthalvu (190 ha. 10° 20.793'N, 79° 048.163'E), Nandupallam (170 ha. 10 ° 20. 394'N, 79° 50.714'E), Nedunthittu (160 ha. 10° 20.520'N, 79° 50.203'E) and Pushkarani (160 ha. 10° 20.444'N, 79° 48.989'E). These saltpans are located on the east coast of India near an important water bird wintering area: Point Calimere Wildlife Sanctuary, which is the only RAMSAR site located in Tamilnadu (Figure 1).

The saltpans primarily comprise of reservoir ponds (which are mainly used to store sea water), evaporation ponds (which are mainly used for increasing the salinity of the water) and crystallization ponds (these are true saltpans in which the sea water crystallizes into salt particles), which differ mainly in their salinity, vegetation and water levels. The salinity of the first (reservoir) pond type is very similar to that of the marine environment (35-38%), whereas the last pond type (crystallization ponds) reaches more than 250% of salinity. This region is subjected to the Northeast monsoon, with most of the rainfall occurring during October–December. However, in the past decade, rainfall declined remarkably and, in the recent years, most of the rainfalls were over a period of 2–3 weeks except 2015. In fact, these study areas are important and are acting as stopover sites for the migratory birds during their migratory periods (Sampath and Krishnamoorthy, 1989; Pandiyan *et al.,* 2010)

*Corresponding Author
email: dunlinpandiyan@gmail.com

Fig.1 Map showing the saltpan areas of Kodikkarai, Tamilnadu, South India.

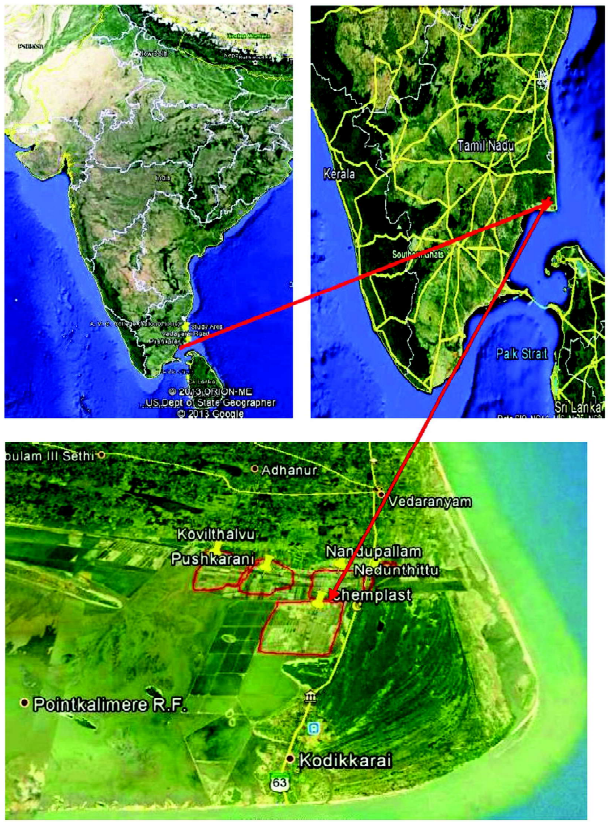


Fig.2. Abundance of migratory shorebirds recorded in the different salt pans of Kodikkarai regions, Tamil Nadu, Southern India from July 2012- March 2015.

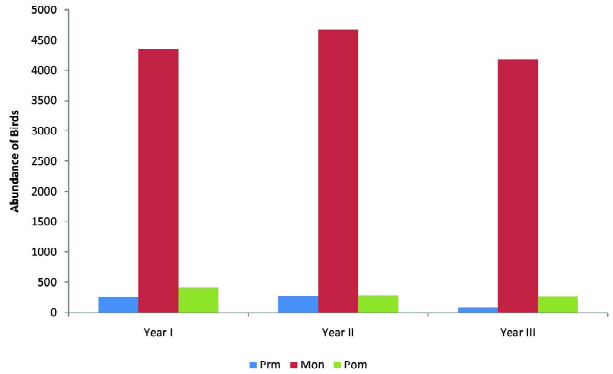
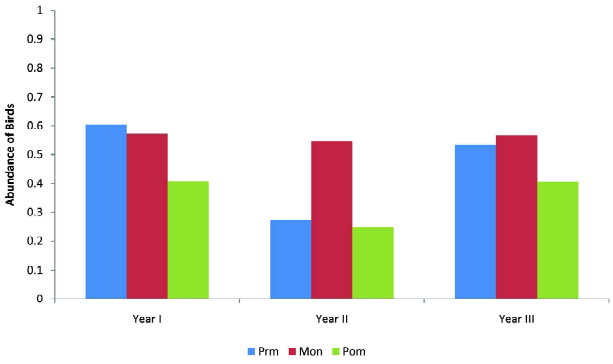


Fig.3. Diversity of migratory shorebirds recorded in the different salt pans of Kodikkarai regions, Tamil Nadu, Southern India from July 2012- March 2015.



MATERIALS AND METHODS

Bird count

Since all the saltpans appeared relatively homogenous, the study area was divided into five different areas, and their names were based on their nearby location to categorize the spatial variations of birds and density of benthic organisms. Birds were counted with the help of 7 × 50 binocular and 20 x 60 spotting scope from vantage points on the saltpans. Birds were counted individually using the 'direct count' method which gave a total count of birds in each area (Yates and Goss Custard, 1991). On each day, two counts of 3.00 h duration were carried out, and as far as possible, counts were made on clear and sunny days to minimize bias arising from variation in weather. All the study areas were entirely open and had very scanty vegetation and birds could be seen and counted without difficulty. During the census, any arrival or departure of birds in the areas were also counted to avoid missing or duplicating records.

RESULTS

Totally 1461 of shorebirds consisting of 18 species were recorded in the five different salt pans of Kodikkarai regions of Tamil Nadu, from July 2012 – March 2015. Among the 18 species two species fall under Near Threatened category (IUCN, 2015). Highest bird abundance was recorded during the Year II i.e. 4673 (Table 1, Fig.2). But the maximum diversity was recorded during the Year I (Fig. 3). The Little stint (7720) and Dunlin (5091) showed more turn over of bird abundance than other species recorded in the salt pans. The Spotted Redshank showed the lowest abundance (37) when compared to the other species recorded (Table 1). The abundance and diversity of species varied significantly among the habitats and years ($P<0.001$).

DISCUSSION

Since most of the coastal wetlands are degraded due to various reasons, migratory shorebirds are shifting their foraging grounds from tidal mudflats to inland wetlands (Mohanraj and Pandiyan, 2015 a,b). The present study reveals that the salt pans are also one of the viable alternate habitats for the migratory shorebirds during their migration. There were 18 species of migratory shorebirds recorded in the salt pans in which two species were under Near Threatened category (IUCN, 2015). The high densities indicate the highest use of this salt pans by some of the most abundant shorebird species, such as the Little stint and Dunlin; and other small sized species such as the plovers. Besides larger species Heuglins gull, Yellow legged gull, Black headed gull and Sand Wichtern mainly used these saltpans. The Little stint is one of the small sized species, that was found in higher densities in the saltpans during the monsoon season across the years. Generally during

Table. 1. Abundance of Migratory shorebirds recorded in the five different saltpans of Kodikkarai region from August 2012- March 2015.

S. No.	Species name	Year I			Year II			Year III			Overall
		Prm	Mon	Pom	Prm	Mon	Pom	Prm	Mon	Pom	
1	Little stint*Calidris minuta*	121	2146	235	214	2456	234	42	2148	124	7720
2	Temminck's stint*Calidris termminckii*	42	124	12	16	86	9	18	86	0	393
3	Red necked stint**Calidris ruficollis*	9	47	0	0	49	0	0	8	0	113
4	Curlew sandpiper**Calidris ferruginea*	0	9	1	0	25	0	0	11	0	46
5	Dunlin*Calidris alpine*	56	1578	154	32	1652	28	12	1458	121	5091
6	Spotted redshank*Triga erythropus*	0	12	0	0	9	0	0	12	0	33
7	Marsh sandpiper*Triga stagnatilis*	0	121	0	0	98	0	0	19	0	238
8	Common greenshank*Triga nebularia*	0	19	0	0	16	0	0	23	2	60
9	Green sandpiper*Tringa ochropus*	0	21	0	0	16	0	0	17	0	54
10	Wood sandpiper*Tringa glareola*	0	21	0	0	16	0	0	15	0	52
11	Terek sandpiper*larus heuglini*	0	15	0	0	12	0	0	12	0	39
12	Red necked phalarope *Plalaropus lobatus*	0	19	0	0	19	0	0	26	0	64
13	Ruddy turnstone*Arenaria interpres*	0	18	0	0	21	0	0	19	0	58
14	Pacific golden plover *Pluvialis fulva*	0	19	0	0	18	0	0	21	0	58
15	Heuglins gull*Larus heuglini*	12	86	12	2	92	2	0	97	6	309
16	Yellow legged gull*Larus cachinnans*	0	19	0	0	21	0	0	112	4	156
17	Black headed gull*Chroico cephalus ridibundus*	12	49	1	0	51	3	12	86	2	216
18	Sand wichtern*Thalasseus sandvicensis*	0	21	1	0	16	0	0	9	0	47

Prm=Premonsoon; **Mon** = Monsoon and **Pom** = Post monsoon; * Near Threatened Species

the low tide, use of man-made saltpans is detrimental to the natural habitat, which had already been recorded in previous studies (Dias, 2009), and it is probably related with the low availability of mudflats and with their confined characteristics. It was also confirmed in and around the study areas, Pazhaiyar, Thirumullaivasal, Chinnangudi, Tranqubar, Karaikkal and Niravi tidal flats (Pandiyan *et al.* 2011). On the other hand, by feeding on saltpans, birds avoid to move between feeding and resting areas, when the saltpans are not submerged during high tides (Yasueì and Dearden, 2009).

The other factor which influences the distribution of the shorebirds is prey abundance (Yates *et al.,* 1993 and Pandiyan *et al.,* 2006). Saltpans typically hold a community dominated by few, super abundant prey species (Pedro and Ramos, 2009), whose densities have usually showed a nonlinear relationship with other factors such as salinity (Warnock *et al.,* 2002), but under optimal conditions they were probably above the threshold limit at which intake rates are expected to decline (following the Holling type II functional response model typical of the shorebird species as proposed by Goss-Custard *et al.* (2006)). By providing alternative and complementary foraging habitats for shorebirds, saltpans have the potential to minimize the impact of mudflats degradation on some species. Nevertheless, it

is important to note that the available foraging area within the saltpans can vary several folds, depending on the environmental conditions found in the pans that can limit their carrying capacity, both through availability and accessibility to prey species (Dias *et al*., 2006). In fact the shorebirds use the salt pans as foraging grounds during high tides. Besides it is also important to highlight that their importance as alternative habitats during low tide, and interestingly saltpans can also act as important supplementary habitats during high tide (Pandiyan *et al*., 2013 a,b), a fact that enhances the importance of their correct management of shorebirds. In fact most of these species are long-distance migrants, whose abundance is highly in consistent due to the range of environmental conditions found in several different areas, some located thousands of kilometers apart (Delany *et al*., 2009).

Implication for the shorebird conservation

Saltpans, constitute an important alternative habitat for some species during monsoon season. Nevertheless, the salt pans are acting as a alternate potential feeding habitat for shorebirds during their migration. The salt pans in the Indian context are different from Western or Europe countries i.e. the extraction of salt in the southern region takes place during the summer but not in winter or monsoon seasons (October to January). During the monsoon season most of the salt pans in the southern India no salt extraction takes place and these salt pans will be filled with rain water during North East and South West Monsoon. According to the range of the rainfall, the salts pans would be enriched with soil parameters and benthic organisms, and the shorebirds could use the salt pans as feeding ground during monsoon. Since this is the first study in these regions further it has been planned to explore the in between traditional salt pans and natural coastal mud flats to understand the ratio of bird abundance in relation to these two habitats. In addition to that quantification of benthic prey should be further monitored in the salt pans to know the effects of prey and shorebirds in the salt pans in near future. Further the water level, soil nutrients and water chemistry also should be evaluated to know the relationship with the bird characteristics features and prey abundance.

ACKNOWLEDGEMENTS

We thank the University Grants Commission, New Delhi, for the Major Research Project entitled "Spatial and temporal fluctuations of benthic prey and its influence on shorebirds population dynamic in the salt pans of east coast of Tamil Nadu, Southern India" Ref. No. F.No.41-115/2012 (SR) dated 11 July 2012. We thank the Principal, Faculty of Zoology and Wildlife Biology, AVC College (Autonomous), Mannampandal, Mayiladuthurai for their constant support throughout the study. We thank to Dr. R. Saravanamuthu, Director, R&D Cell, STET Women's College, Mannargudi, for critical comments on this manuscript.

REFERENCES

Burger, J., Howe, M., Hahn, D. and Chase, J. 1977. Effects of tide cycles on habitat selection and habitat partitioning by migrating shorebirds. *Auk* 94:743–758

Delany, S. Scott, D., Dodman, T. and Stroud, D. 2009. *An atlas of wader populations in Africa and western Eurasia.* Wetlands International and International Wader Study Group, Wageningen

Dias, M.P. 2009. Use of saltpans by wintering shorebirds along the tidal cycle. *Waterbirds* 35:531–537.

Dias. M.P., Granadeiro, J.P., Lecoq, M., Santos, C.D. and Palmeirim, J.M. 2006. Distance to high tide roosts constrains the use of foraging areas by dunlins: implications for the management of estuarine wetlands. *Biol Cons* 131:446–452.

Goss-Custard, J.D. and Yates, M.G. 1992. Towards predicting the effect of salt-marsh reclamation on feeding bird numbers on the wash. *J Appl Ecol* 29:330–340

Goss-Custard, J.D., West, A. and Yates, M.G. 2006. Intake rates and the functional response in shorebirds (Charadriiformes) eating macro-invertebrates. *Biol Rev* 81:501–529.

IUCN. 2015.The *IUCN Red List of Threatened Species*. http://www.iucnredlist.org/

Kuwae, T., Miyoshi, E., Hosokawa, S., Ichimi, K., Hosoya, J., Amano, T., Moriya, T., Kondoh, M., Ydenberg, R.C. and Eln, R.W. 2012. Variable and complex food web structures revealed by exploring missing trophic links between birds and biofilm. *Ecol Lett* 15:347–356.

Masero, J.A. 2003. Assessing alternative anthropogenic habitats for conserving waterbirds: salinas as buffers against the impact of natural habitat loss for shorebirds. *Biodivers Conserv* 12:1157–1173.

Mohanraj, S. and Pandiyan, J. 2015a. Invasion of shorebirds into inland wetlands of Periyakulam Lake, Tiruchirappalli, Southern India. *J. Sci. Trans. & Env. Tech.* 7 (3): 113-117

Mohanraj, S. and Pandiyan, J. 2015b. Seasonal diversity of diving birds in the Periyakulam Lake, Tiruchirappalli, Tamil Nadu, India. *J. Sci. Trans. & Env. Tech.* 9(3): 132-135

Pandiyan, J., Asokan, S. and Nagarajan, R. 2010 Habitat utilization of migratory shorebirds at the stop over sites of southern India, *Stilt* 58: 36-44

Pandiyan, J., Asokan, S. and Nagarajan, R. 2011. Sea level rise and shorebirds, (ed. Sasireka) *Proc. Intnl Conf. on Impacts of climate change on Coastal Ecosystem* (ICC-ECO11-12th of November2011) at Sathyabama University, Chennai, Tamil Nadu.

Pandiyan, J., Naresh, B. and Nagarajan, R. 2013a Spatial variations of shorebird community in the saltpans of east coast of southern India. *J. Sc. Tran. & Env. Tech.* 7(1): 51-58

Pandiyan, J., Naresh, B. and Nagarajan, R. 2013b Temporal variations of shorebird and benthic community in the saltpans of east coast of southern India. *J. Pure and Applied Zoology*. 2(1): 51-58

Pandiyan, J. and Asokan, S. 2015. Habitat use of pattern of tidal mud and sandflats by shorebirds (Charadriiformes) Wintering in southern India. *J. of Coast. Conser*. Doi10/1007/11852-015-0413-9.

Pandiyan, J., Asokan, S., Thiyagesan, K. and Nagarajan, R. 2006 Shorebirds use of tidal flats in the Cauvery Delta region of SE India. *Wader Study Group Bull*. 109 : 95-105

Pedro, P. and Ramos, J.A. 2009. Diet and prey selection of shorebirds on salt pans in the Mondego estuary, *western Portugal. Ardeola* 56:1–11

Sampath, K. and Krishnamurthy, K. 1989. Shorebirds of the salt ponds at the Great Vedaranyam Salt swamps, Tamilnadu, India. *Stilt* 15: 20–23.

Sripanomyom, S., Round, P.D., Savini, T., Trisurat, Y. and Gale, G. 2011. Traditional salt-pans hold major concentrations of overwintering shorebirds in Southeast Asia. *Biol Conserv* 144:526–537.

Stillman, R.A., West, A.D., Caldow, R.W.G. and Durell, S.E.A.V. 2007. Predicting the effect of disturbance on coastal birds. *Ibis* 149:73–81.

Sutherland, W.J., Alves, J.A., Amano, T., Chang, C.H., Davidson, N.C., Finlayson, C.M., Gill, J.A., Gill, R.E., Gonzalez, P.M., Gunnarsson, T.G., Kleijn, D., Chris, C.J., Szekely, T. and Thompson, D.B.A. 2012. A horizon scanning assessment of current and potential future threats to migratory shorebirds. *Ibis* 154:663–679.

van de Kam, J., Ens, BJ., Piersma, T. and Zwarts, L. 2004. *Shorebirds. An illustrated behavioural ecology.* KNNV Publishers, Utrecht.

Warnock. N., Page, G., Ruhlen, T.D., Nur, N., Takekawa, J.Y. and Hanson, J.T. 2002. Management and conservation of San Francisco bay salt ponds: effects of pond salinity, area, tide, and season on Pacific flyway waterbirds. *Waterbirds* 25:79–92

Wolff, W. 2000. Causes of extirpations in the Wadden sea, an Estuarine area in The Netherlands. *Conserv Biol* 14:879–885.

Yasue, M. and Dearden, P. 2009. The importance of supratidal habitats for wintering shorebirds and the potential impacts of shrimp aquaculture. *Environ Manag* 43:1108–1121.

Yates, M.G. and Goss-Custard, J.D. 1991. A comparison between high-water and low-water counts of shorebirds on the Wash, east England. *Bird Study* 38: 179–187

Yates, M.G., Goss-Custard, J.D. and McGrorty, S. 1993. Sediment characteristics, invertebrate densities and shorebird densities on the inner banks of the wash. *J Appl Ecol* 30:599–614