

Sewage Treatment plants in Mannampandal, Southern India acts as refugia for rare winter visitor Grey-headed Lapwing *Vanellus cinereus* during post-migratory season

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Abstract

Due to global loss of natural wetlands, waterbirds have been depending on artificial wetlands as their alternate habitat. One such habitat is the Sewage Treatment Plants (hereafter, STP). One of the rare migratory waterbirds, Grey-headed Lapwing (*Vanellus cinereus*) was recorded to use the STP in Mannampandal, Tamil Nadu, Southern India as wintering ground from 29th January 2020 to 24th March 2020. The number of individuals increased and attained asymptote on 11 March 2020 and then declined and all the individuals left the area 24 March 2020. Prior to this there was no record on this species using artificial habitat as wintering ground and in this area of Tamil Nadu. Thus our findings suggest that this is the first record of sighting this species in the wetlands of Mayiladuthurai District and it is also important to conserve the artificial habitat for the protection of Grey-headed Lapwing and other migratory waterbirds.

Key words: alternate habitat, Grey-headed Lapwing, man-made wetlands, migratory waterbirds, Sewage Treatment Plant, stopover sites

INTRODUCTION

Waterbirds have been defined as “species of bird that are ecologically dependent on wetlands” (Wetlands International, 2010). Due to the global loss of natural wetlands by anthropogenic activities (Thiyagesan and Nagarajan, 1995), waterbirds have been depending on man-made artificial wetlands as alternative habitats, one such habitat being the Sewage Treatment Plant (STP). STP possess diverse habitats from wetlands to

artificial waste stabilization ponds with open mudflats to grasslands, including dry sites and areas periodically flooded by wastewater (Orłowski, 2013). The usage of such wetlands by waterbirds in the current scenario is important for their survival but little consideration has been given towards implications in wastewater treatment or waterbird conservation objectives (Murray *et al.*, 2014; Murray and Hamilton, 2014). Winter quarter selection plays a major role in the annual life cycle of birds (Chambon *et al.*, 2018).

Grey-headed Lapwing (*Vanellus cinereus*) is a migratory Lapwing which inhabits in cultivated wetlands and marshy areas, feeding mainly on insects, worms, and crustaceans (Cornell Lab of Ornithology, 2013). The population breeding in north-eastern China migrates to eastern India, southern China and south-eastern Asia and the birds breeding in northern Japan appear to be less migratory with most of the birds remaining within southern Japan during the non-breeding period to avoid the snow (Bamford *et al.*, 2008).

Point Calimere Wildlife Sanctuary is one of the Ramsar Sites in Tamil Nadu which supports a huge congregation of migratory birds during the season. The wide varieties of microhabitats available in sanctuary support numerous species of shorebirds with large turnover during the season (Sumathi *et al.*, 2011). Although, the sanctuary acts as a potential wintering ground for many species, a wide variety of migratory species use several inland waterbodies, and coastal wetlands as stop-over sites over the onward and return migrations (Nagarajan, 2011). Furthermore, the agricultural associated waterbodies plays a major role as alternative habitat for many waterbirds as foraging ground (Nagarajan and Thiyagesan, 1998).

We studied waterbird communities in the Sewage Treatment Plant (STP) in Mannampandal, Southern India from January 2019–March 2021 to document



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the migratory waterbirds visiting STP for wintering and for refueling through their stopover activity during their migration. Thus, we studied the importance of STP as important artificial habitat that acts as a home for wintering and stopover site for waterbirds. In this paper, we investigate usage of this STP by the rare winter visitor Grey-headed Lapwing *Vanellus cinereus* during migratory season.

MATERIALS AND METHODS

Study Area

The Sewage Treatment Plant (STP) in Mannampandal (11°6'32.51"N and 79°41'46.46"E) uses a waste stabilization pond system to treat sewage from **Mayiladuthurai** district. It functions under the Tamil Nadu Water Supply and Drainage Board of Mayiladuthurai district, Tamil Nadu. The STP is structurally divided into two habitats, one is a waste stabilization pond (WSP) which is a deeper and homogenous habitat and the other is a sewage marsh created due to water seepage from the WSP which is a heterogeneous habitat with different water levels and vegetation. Then the treated water in the sewage marsh

is let into a natural channel and utilized for agriculture. The total area of WSP is 6.4639 acres and the sewage marsh is about 4.5676 acres (Fig. 1).

The STP is surrounded by agricultural lands cultivated with large deciduous tree species such as teak, bamboo, etc., and also paddy field. A large group of poaceae family intermingled with climbers is also recorded. One side of the study area had attached to channel brining in the sewage water and to drain out the treated water. The WSP is concrete structure tanks in order to treat the sewage waters coming from the towns of the Mayiladuthurai district. The marsh is logged with treated water and later released at the other end via small channel for the agricultural purposes and it is surrounded by the *Calotropis gaigantica*. The water logged area is covered grasses and algal blooms are present in the water. *Typha angustifolia* is the dominant species in the marsh and it is used by birds for roosting and to hide away from humans when disturbed and other predators.

This STP acts as a home to many waterbirds and also acts as a wintering ground and stopover site for many migratory birds. So far it was recorded by Prasanth

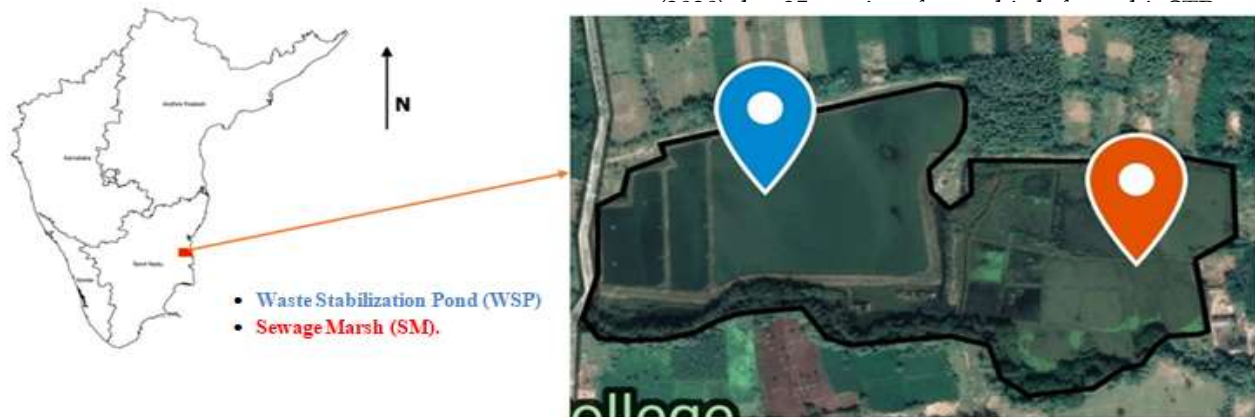


Fig. 1. Sewage Treatment Plant in Mannampandal, Tamil Nadu, Southern India showing the Waste Stabilization Pond and Sewage Marshes.

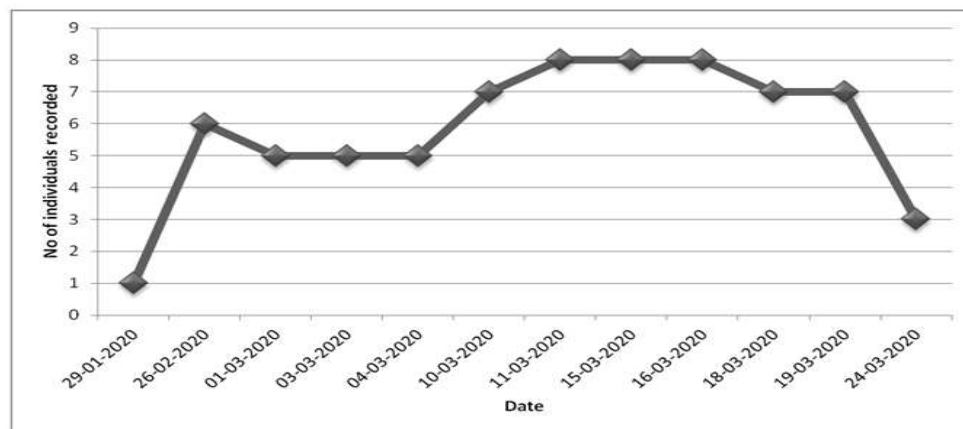


Fig. 2. Number of Grey-headed Lapwing found across the period between 29 January 2020 and 24 March 2020 in the STP marshes of Mannampandal area, Tamil Nadu, Southern India.



Fig. 3. A single individual of Grey-headed Lapwing was first recorded in the STP on 29 January 2020 (Photo: Prasath Selvaraj).



Fig. 4. A flock of Grey-headed Lapwing foraging together with Red-wattled Lapwing. (Photo: Prasath Selvaraj)



Fig. 5: A flock of Grey-headed Lapwing flying back to their roosting sites in the late evening (Photo: Prasath Selvaraj).

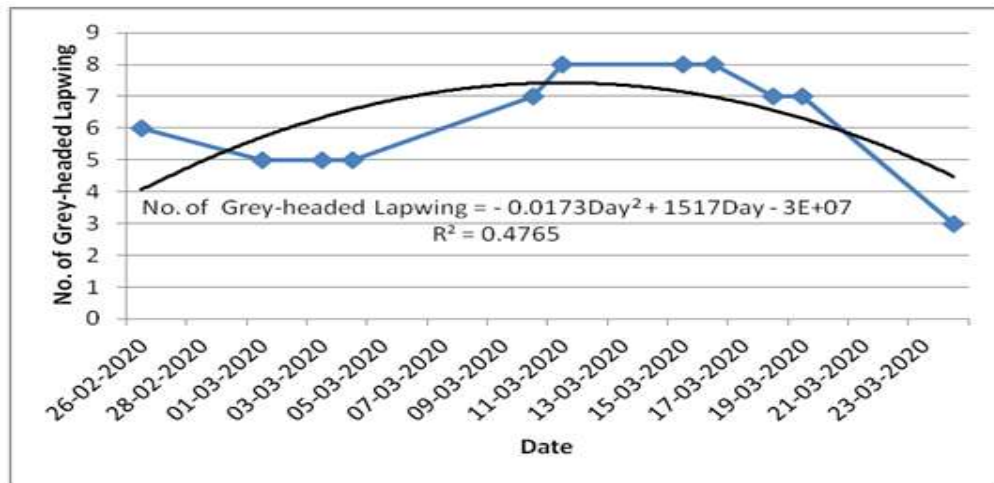


Fig. 6. Changes in the number of Grey-headed Lapwing found across the period between 26 February 2020 and 24 March 2020 in the STP of Mannampandal area, Tamil Nadu, Southern India. The quadratic equation is fitted which is significant and equation with R^2 are given.

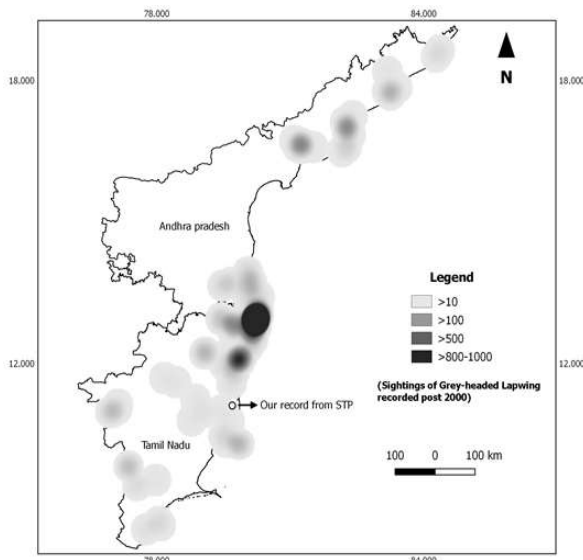


Fig. 7: Heat map explains about the distribution of Grey-headed Lapwing in Tamil Nadu and Andhra Pradesh states post 2000.

Among the 35 species of waterbirds, 16 species are regular migrants (CAF National Action Plan 2018 – India). In this, the Little Stint *Calidris minuta* and the Black-tailed Godwit *Limosa limosa* are among the species shortlisted for the formulation of a single species action plan.

Study Period

In the present study, systematic bird surveys were carried out in all the microhabitats of the study area from January 2019 to March 2020 by covering the Pre-Migratory, Migratory, Post-Migratory and Summering seasons in the STP.

Observations of Birds

Using the ground count method, the STP site is systematically covered, by walking the same route on each visit and stopping every 50 meters to scan with the binoculars to count the birds (Wetland International, 2010). A vantage point was used to visualize all the birds and total counts of individuals were made as described by Nagarajan and Thiyagesan (1996). Maximum care was taken to avoid the double count and flying birds were monitored strictly to be included in the count. The observations were made between 06h00 to 09h00 in the morning and evening from 16h00 to 18h30. A total of 92 surveys were made in the STP which includes 25 surveys from the morning session and 67 surveys in the evening session.

Equipment

The waterbirds in the STP were observed using 8'x42" Nikon waterproof binocular. The numbers of individuals of different species of waterbirds were counted and were recorded in the datasheet. The birds were photographed using Nikon COOLPIX P900 Digital Camera. The identification of birds was done using key features described in Grimmett *et al.* (2014) and Balachandran and Thirunavukararasu (2009).

Statistical Analysis

The number of Grey-headed Lapwing across the days from 29th January 2020 to 24th March 2020 were plotted which showed a non-linear trend. The regression model was developed as per the procedures of Nagarajan *et al.* (2002, 2006). The days last since 1st January 2020 as Day 1 and day 24th March became Day 83. The number of individuals of Grey-headed Lapwing was used as dependent variable and Days since 1st January as independent variable. The quadratic model became significant which is the final model. This model is depicted using the scatter plot

Table 1: Regression equation on the number of Grey-headed Lapwing found in the Sewage Treatment Plant Marshes of Mannampandal area, Tamil Nadu, Southern India. The quadratic equation is significant and equation with R² are given.

Dependent Variable	Variables	Co-efficient	SE	t-Value	P-Value	Model
						R ²
No. of Grey-headed Lapwing (26 February 2020 and 24 March 2020)	Constant	-79.6	31.9	-2.49	0.037	47.65 %
	Day	2.452	0.918	2.67	0.028	
	(since 1 January)					
	Day ²	-0.01728	0.00653	-2.65	0.029	

and multiple regression option in the computer software (Microsoft Excel, 2010) in order to understand the Changes in the number of Grey-headed Lapwing found across the period in the STP of Mannampandal area, Tamil Nadu, Southern India.

We collected the post-2000 eBird basic datasets (eBird 2020a,b) for the Grey-headed Lapwing distribution record in Tamil Nadu and Andhra Pradesh states. Using the QGIS 2.16 software, we prepared a heat map in order to understand the distribution of Grey-headed Lapwing in Tamil Nadu and Andhra Pradesh.

RESULTS

The number of Grey-headed Lapwing (*Vanellus cinereus*) found across the study period between 29 January 2020 and 24 March 2020 in the STP of Mannampandal area, Tamil Nadu, Southern India is shown in the figure 2. A single individual of Grey-headed Lapwing was first recorded in the STP on 29 January 2020 from 12h15 - 13h45 as a stopover record and in the same evening that bird was no longer seen (Fig. 3). Then from 26 February 2020 to 24 March 2020, during our regular surveys, a small flock of Grey-headed Lapwing was seen continuously ranging from three individuals to a maximum of eight individuals foraging along with Red-wattled Lapwings (Fig. 4). Late in the evening before the sunset, these birds flew back to their roosting sites (Fig. 5). The number of individuals gradually increased until 19 March 2020 and then declined to three individuals during 24 March 2020. After that all the individuals left the area.

Only one individual visited on 29 January 2020 and left from the area. On the changes in the number of individuals of Grey-headed Lapwing, across the period fluctuated and in which the regression equation model was developed with high order terms. The days elapsed since 1 January as variable “Day” in the regression equation. Population increased from 26 February 2020 and therefore, the population changes of Grey-headed Lapwing across the period between 26 February 2020 to 23 March 2020 were used as dependent variable and the regression equation model

was developed. The equation with quadratic term (Day and Day²) showed significant variation (Table 1). The number of individuals increased and attained asymptote on 11 March 2020 and then declined and all the individuals left the area 24 March 2020 (Fig. 6).

DISCUSSION

The regular occurrence of six to nine individuals from October to March in Point Calimere since 2001 is the southernmost wintering range for the Grey-headed Lapwing (*Vanellus cinereus*) (Balachandran and Thirunavukararasu, 2009). According to (Santharam *et al.*, 2006), sighting records of Grey-headed Lapwing showed that it was more frequent in coastal Tamil Nadu (Roshnat, 2017) suggests that like in the case of Tamil Nadu, Kerala also acts as a frequent wintering zone for Grey-headed Lapwing.

From the heat map prepared (Fig. 7), we understood that Grey-headed Lapwing was recorded mostly in the coastal zones of Tamil Nadu and Andhra Pradesh states. In Tamil Nadu, the majority of the sightings of this species are predominantly recorded from Chennai and Kancheepuram districts, in which Pallikarandai Marsh Land has recorded 1000 individuals in few occasions (Fig. 7). The heat map also shows the fewer birds reported from the western and southern parts of Tamil Nadu. There has been no previous record on sighting of Grey-headed Lapwing from the Mayiladuthurai district of Tamil Nadu. Hence, this is the first record of Grey-headed Lapwing from the Mayiladuthurai district and also first wintering record of this species using artificial alternative habitat like STP from Tamil Nadu and Andhra Pradesh.

The waste-stabilization ponds are particularly important as drought refuges for waterbirds because of their reliable water supply and nutrient values (Murray and Hamilton, 2012). Earlier, a pair of Grey-headed Lapwing was sighted by Siva and Neelanarayanan (2017) in the Koothappar Big Tank in Tiruchirappalli on 17 January 2017 which showed that the bird has extended its range to the central part of Tamil Nadu besides the coastal regions. There is no

earlier report on Grey-headed Lapwing using sewage treatment plants as wintering stop-over site in Tamil Nadu and other parts of Peninsular India. However, in this present short-term study from January 2019 to March 2020 (1.3 years), we found this rare visitor wintering from January 2020 in this area. This species is increasingly reaching the south of Tamil Nadu, as records have shown them being on the rise in the region in the last decade in the region (Wiersma and Kirwan, 2020). Thus, we further suggest that a long term study is required to understand the Grey-headed Lapwing using this artificial wetland. It is well established that the waterbird species richness and population are declining in different natural wetland habitats (e.g. Sandilyan *et al.*, 2010) and across the globe and there are several man-made and man induced threats in the natural wetland habitats (e.g. Sandilyan *et al.*, 2008; Nagarajan, 2011). It is also recorded that man-made alternate habitats are used as wintering ground by waterbirds (e.g. Nagarajan and Thiyagesan, 1998; Sandilyan *et al.*, 2010), and many shore birds increases their food intake rate by adopting various strategies (Goss-Custard *et al.* (2006) and it is high time that these man-made structures are conserved for waterbirds.

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