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Cover: Orange Oakleaf *Kallima inachus* with colour pencils and watercolor wash by Elakshi Mahika Molur adapted from a workshop by Lenin Raj.

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COMMUNICATION

Studies on the response of House Sparrow *Passer domesticus* to artificial nest-boxes in rural Arakkonam and Nemili taluks, Vellore District, Tamil Nadu, India

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Abstract: This study evaluated the response of House Sparrows *Passer domesticus* to artificial nest-boxes installed in human dwellings in 30 villages in Arakkonam and Nemili taluks, Vellore District, Tamil Nadu between February and July 2019, with help of school students who installed 245 artificial nest-boxes in their houses. House Sparrows attempted to build nests in 32 nest-boxes by frequent visits, built partial nests in 51, and built active nests followed by successful breeding in 32 nest-boxes; there was no response to the remaining 130. A significant relationship was detected between the type of house and the adoption of boxes by the birds. The maximum response was seen in tiled houses, followed by concrete and thatched houses. House Sparrows preferred nest-boxes placed at heights between 3 and 4 m. At the end of the breeding season, a total of 80 chicks successfully emerged from 32 active nests. Some mortality in adult birds due to ceiling fans and predatory animals such as House Crows and Domestic Cats was reported. Active nests in nest-boxes and birds were found in villages where mobile phone towers were installed. Of 32 active nests enumerated in nest-boxes, 22 were found within a 500 m radius of mobile phone towers, two from 500–1,000 m and eight from 1,000–2,000 m. Further study is planned to examine the relationship between mobile towers and nest site selection by sparrows. A survey done through a questionnaire reveals that 95% of residents were aware of and concerned about the declining populations of House Sparrow.

Keywords: Active nests, Electromagnetic radiations, Mobile-phone towers, Nesting sites, Predatory animals.

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INTRODUCTION

The House Sparrow *Passer domesticus,* a native of Eurasia, is the most widespread bird in the world (Anderson 2006) and its geographical range extends over Europe, North Africa, and parts of Asia including the Indian subcontinent (Ali & Ripley 1987). These sparrows prefer holes or crevices near roofs of human residences as nesting sites (Ali & Ripley 1987). They have been declining since the 1980s in several parts of the world, including Europe (Kelcey & Rheinwald 2005; Kekkonen et al. 2011), where the decline may be due to changes in farming practices, use of pesticides/herbicides, and predation. The species was red-listed in the U.K. in 2002 as a result of population decline (Summers-Smith 1988, 2005). Loss of suitable nesting sites and foraging habitats are the reasons for declining populations of House Sparrow in urban and suburban landscapes (Robinson et al. 2005).

In India, sparrow populations are reported to have decreased considerably in Bengaluru, Delhi, Mumbai, and Hyderabad (Rajashekar & Venkatesha 2008; Daniels 2008; Khera et al. 2010; Bhattacharya et al. 2010; Ghosh et al. 2010). Rahmani et al. (2013) have stated that House Sparrows and their nests were found in fewer places in India during 2005–2012 when compared to the time before 2005. This is because the bird prefers holes or crevices near roofs of human residences as nesting sites (Ali & Ripley 1987). The declining trend is consistent in all the regions and major cities except Coimbatore (Rahmani et al. 2013). The IUCN Red List has evaluated the House Sparrow's conservation status as 'Least Concern' (BirdLife International 2018).

House Sparrows are flexible in selection of nesting sites, and will build nests in places such as artificial nest-boxes when modern buildings lack suitable nesting sites (Shaw et al. 2008). Availability of nesting sites is a major factor that determines House Sparrow populations in urban areas (Anderson 2006). In India, the response of House Sparrow towards artificial nest-boxes has been poorly studied. In India, maximum numbers of active nests were found in wall cavities followed by artificial/man-made nest boxes (Rahmani et al. 2013). In view of urbanization and lack of nesting sites in the modern buildings the House Sparrow populations had preferred artificial nest-boxes in Udhagamandalam urban areas in Nilgiris District (Jayaraman et al. 2017).

In view of the growing concern over the decline of House Sparrow population in India, in this paper I sought answers to the questions considering their habitats, with specific reference to Arakkonam and Nemili taluks in Vellore District, Tamil Nadu, India. The following objectives were kept in mind: 1. How do House Sparrows respond towards artificial nest-boxes? 2. What types of houses are preferred by the bird and heights preferred to build nests? 3. What are the impacts of electrical appliances and predatory animals on House Sparrows?, and 4. What is the correlation between mobile towers and site selection by House Sparrows?

MATERIALS AND METHODS

Study Area

Arakkonam (13.07 N & 79.67 E) and Nemili (12.58 N & 78.50 E) taluks, Vellore District occur in the northeastern part of Tamil Nadu, 70 km from Vellore Town (12.25–13.25 N and 78.25–79.83 E) and 71 km west from Chennai (13.08–80.28 E) covering 828 km^2 with a human population of c. 500,000 (2011 census). The present study was undertaken in 30 villages in Arakkonam and Nemili taluks (Figure 1). The principal occupation of residents here is agriculture followed by weaving. The average elevation from the sea level is about 81 m. The maximum and minimum annual temperatures in the district are 34.1 °C and 22.4 °C, respectively. The average annual rainfall is 1,000 mm (www.tn.gov.in).

Methods

With help of four school teachers and five informants/field assistants, I identified 30 villages having House Sparrow populations. Artificial nest-boxes (245) made of hard cardboard (12 X 12 X 12 cm size) were distributed to 245 students (6th to 12th standard) of three higher secondary schools (one in Nemili Taluk and two in Arakkonam Taluk) during the first week of December 2018. Supplementary cushion materials like fibres, leaves, twigs or any other plant materials were not placed inside the nest boxes because birds would place nest materials once it selects the nest-boxes for nesting. The students were briefed about the life cycle of House Sparrows including breeding period and were instructed to hang the nest-boxes in their houses at reasonable heights (above 3 m) beyond the reach of human beings and predatory animals. Out of 300 nest-boxes distributed, students had placed 245 nest-boxes in their houses at the end of the third week of December 2018. Students had placed 80% of nest-boxes (195) facing outwards/exteriors from the houses and in the remaining 20% nest-boxes (50) the entrances were facing inwards to the houses. The remaining 55 students had not responded and did not place nest-boxes in

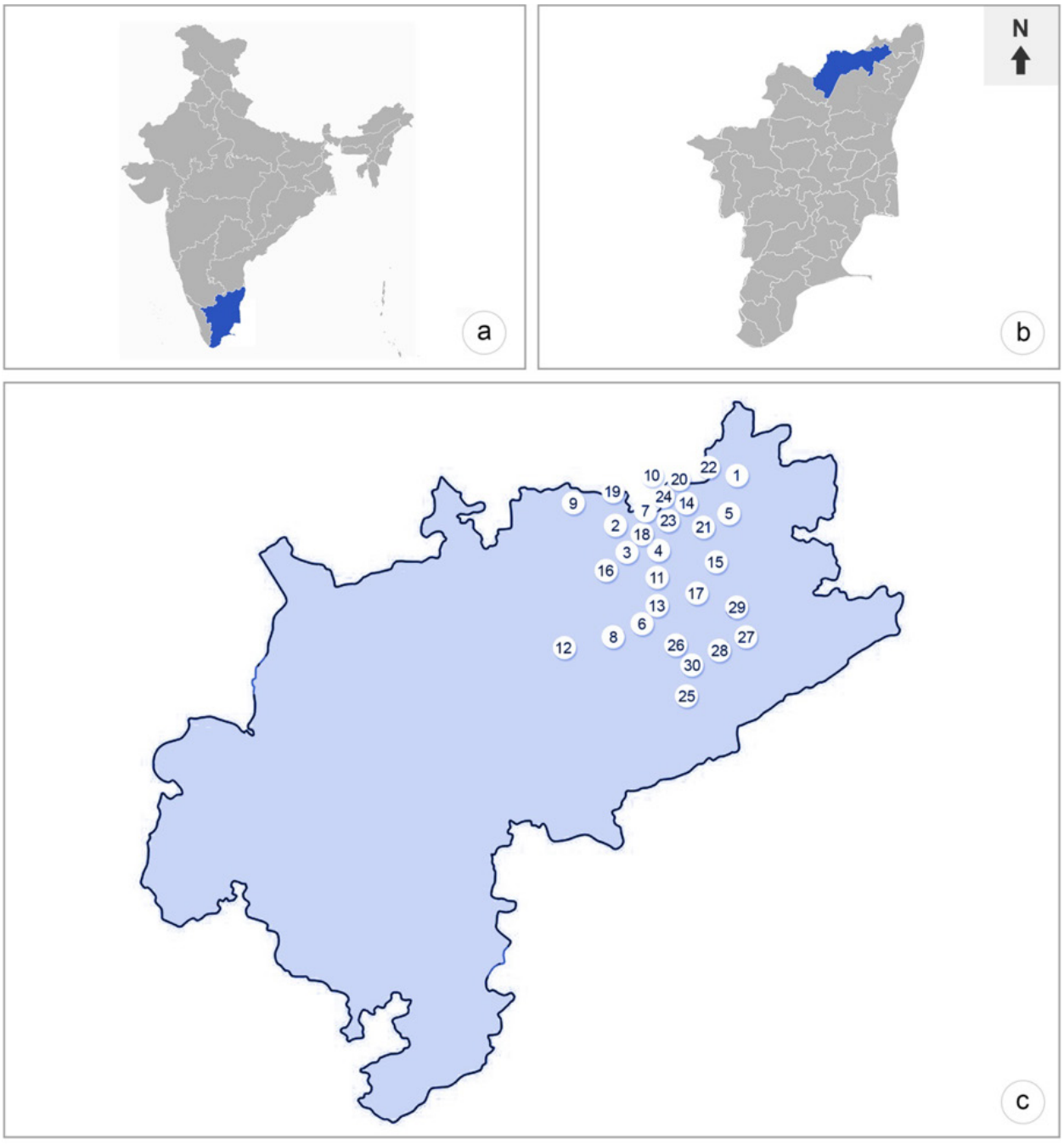

Figure 1. Study area: a—India map showing Tamil Nadu (blue colour) | b—Tamil Nadu map showing Vellore District (blue colour) | c—Eastern part of Vellore District map showing villages having nests of House Sparrows. List of villages: 1—Ayyanthangal Kandigai | 2—Chinna sembedu | 3—Gandhinagar | 4—Guruvarajapetai | 5—Ichiputhur | 6—Kailasapuram | 7—Kannigapuram | 8—Minnal | 9—Nandhiveduthangal | 10—Periyakadambur | 11—Perumalrajapet | 12—Ramapuram | 13—Salai | 14—Sembedu | 15—Chithambadi | 16—Soganur | 17—Vedal | 18—Viswanathapuram | 19—Chinna kadambur mottur | 20—Periya kadambur mottur | 21—Gadavari kandigai | 22—Karthikeyapuram | 23—Kesavarajapettai | 24—Chinna kadambur | 25—Arumbakkam | 26—Arumbakkam | 27 —Melandurai | 28—Nagavedu | 29—Paruthiputhur | 30—Ochalam.

their houses. The students placed nest-boxes at various heights ranges from 3–8 m depending on their type of houses. Nest boxes placed at 7–8 m height was in the upper floor of concrete houses. Hence, the study was carried out only on those 245 houses where nest-boxes were installed. Between February and July 2019, all the houses (245) were visited and the response of House Sparrows towards nest-boxes was studied.

The nest-boxes and birds were surveyed between 0600 h & 0900 h and 1500 h & 1800 h over the mentioned six months. Students who received and placed nest-boxes had spent time to observe the nest boxes in the morning (0600–0830 h) and in the evening (1600–1800 h) and during holidays they spent more time (0600–1800 h) to monitor the activity of birds. Then they were interviewed within the age group (between 11–17 years) at the end of the breeding season, i.e., during July 2019 and concluded during 20 August 2019. Elderly persons (age 60–70 y) were interviewed using a questionnaire in Tamil language.

The breeding of this species occurred between February and July 2019. Details such as types of houses, responses of birds toward nest-boxes such as number of attempts to visit nest-boxes, number of partially built nests, number of active nests and successful breeding, number of chicks grown and flown from each successful nest, impact of electrical ceiling fans, accidental fall of eggs/chicks, extent of increase or decrease in the populations of House Sparrow and impact of predatory animals. The heights of nest-boxes from the floor of the houses were measured using measuring tape. The study on the breeding biology of House Sparrows such as number of eggs laid, incubation, and hatching in the active nests was not done, as it would cause harm to the breeding of this species. The numbers of mobile phone towers in the villages were verified and listed. Photograph was made using a digital camera without disturbing the nests and birds.

Chi-Square test was applied to determine whether any significant differences exist between the types of houses (namely concrete flat-terraced houses and tile-rooftop houses) and the selection of nesting sites by House Sparrows. For analysis, SPSS (Statistical Package for Social Sciences) software was used. The test of significance was assessed at $p<0.05$. Since the number of thatched houses (6) and shops (2) were few in number, they were ignored and not taken for analysis. Collected data were tabulated, analysed, and given as graphical representations.

RESULTS

Of 245 nest-boxes placed in 30 villages, House Sparrows responded to 47% (115) and no response was found towards the remaining 53% (130). The House Sparrows visited 32 nest boxes but did not nest, in 51 nest-boxes birds built partial nests, and 32 pairs built complete and active nests (Table 1). Maximum response of birds to nest-boxes was reported in tiled houses (64 nest-boxes), followed by concrete houses (47). Similarly, maximum numbers of attempts occurred in concrete houses (21), followed by tiled houses (10). Successful breeding occurred in 21 nest-boxes installed in tiled houses followed by 10 in concrete house and a solitary case reported in thatched house.

House Sparrows preferred to nest (65%) in nest-boxes which were placed between 3 m and 4 m height. Sparrows did not inhabit or lay eggs in nest-boxes which were installed above 7 m height. In these limited observations, the birds preferred to select artificial nest-boxes in the ground floor for the construction of nests (Figure 2).

Out of 245 nest-boxes, the entrance of 80% (195) were found facing outwards/exteriors from the houses and in the remaining 20% (50) the entrances were facing inwards. At the end of the breeding season, the response of House Sparrows towards nest-boxes which were facing outward from the houses were found higher (50%; 97) than the nest-boxes facing interior of the houses (36%; 18). Though the nest-boxes installation was skewed, proportionately the birds preferred a greater number of nest-boxes facing exterior from the houses than the nest-boxes facing interior of the houses in the study area (Table 2).

A significant relationship exists between the type of house and attempts to use nest-boxes ($X^2 = 7.069$; $p <0.008$) and partially built nests ($X^2 = 4.155$; $p <0.042$). But no significant relationship exists between the types of houses and construction of active nests ($X^2 = 2.548$; $p <0.11$) (Table 3). Study revealed that the birds had shown more preference towards artificial nest-boxes placed in tiled houses than concrete houses in the studied villages. The existence of many entry/exit spaces between roof & wall, wall cavities, and scaffold holes in the walls in tiled houses might have been the probable reasons for the preference of tiled houses and these entry/exit spaces seldom found in concrete houses. However, House Sparrow's preference of houses need further studies in larger areas covering urban and rural habitats. In the present study the observation of fewer chicks, i.e., one to two chicks per active nest (18 out of 32 nests) could be considered a matter of great concern (Table 4).

Incidents of adult House Sparrows suffering mortality by collision with the blades of ceiling fans occurred in 10 houses, i.e., two birds in concrete houses and eight in tiled houses in the study area. Three incidents of accidental fall of chicks in concrete houses and two incidents of fall of eggs in tiled houses were also reported. In the present study, incidents of predators visiting

Table 1. Type of houses and response of House Sparrow in the construction of nests in artificial nest-boxes in the study area.

Type of Building	Total no. of nest-boxes placed	% of nest boxes placed	No. of nest-boxes in which birds attempted	No. of nest-boxes where partially built nests	No. of active nests built	Total no. of positive response	% of positive response
Tiled houses	129	52.65 %	10	33	21	64	26.12 %
Concrete houses	108	44.08 %	21	16	10	47	19.18 %
Thatched houses	6	2.45 %	1	1	1	3	1.22 %
Grocery shops	2	0.82 %	0	1	0	1	0.41 %
Total	245	100%	32	51	32	115	46.94%

Table 2. Relationships between orientation of entrance of nests boxes and response of House Sparrows.

Orientation of nest entrance	Total no. of nest-boxes placed	%	Total no. of responses of House Sparrows	%	No. of mere attempts	%	No. of partially built nests	%	No. of active nests	%
Entrance of nest-boxes facing out wards from houses	195	79.6	97	39.59	28	11.43	42	17.14	27	11.02
Entrance of nest-boxes facing in wards to houses	50	20.4	18	7.35	4	1.63	9	3.67	5	2.04
Total	245	100	115	46.94	32	13.06	51	20.82	32	13.06

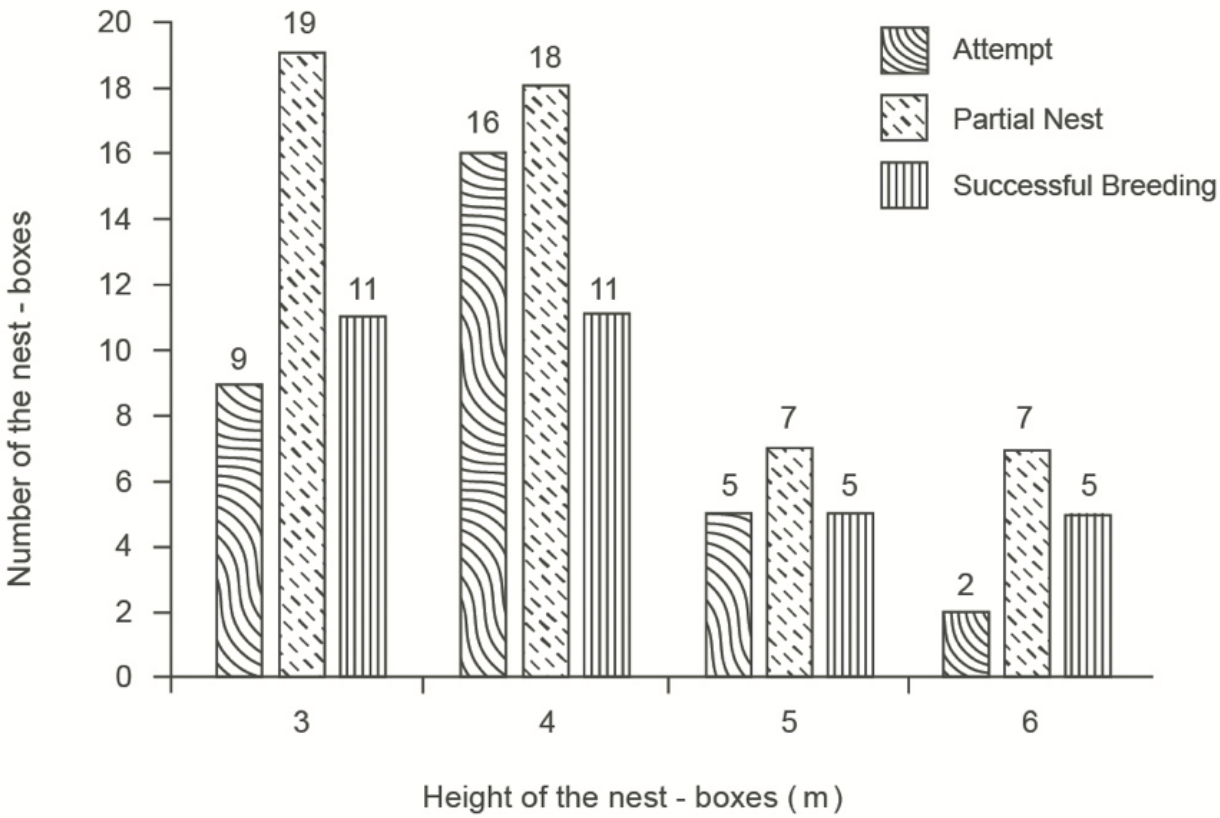

Figure 2. Relationship between heights of nest-boxes and House Sparrows' mere attempts, built partial nests, and built complete nests by successful breeding in the nest-boxes.

Table 3. Chi-square test between type of houses and response of House Sparrow to artificial nest-boxes.

Types of houses	House Sparrows attempted to adopt nest-boxes				House Sparrows partially built nests				House Sparrows built active nests and bred successfully			
	Merely attempted		Nil attempts		No. of houses where partially built nest		Nil partial nests		Active nests Successful breeding occurred		Nil breeding occurred	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Tiled house	10	7.8	119	92.2	33	25.6	96	74.4	21	16.3	108	83.7
Concrete House	21	19.4	87	80.6	16	14.8	92	85.2	10	09.3	98	90.7
	$X^2 = 7.069$; $p < 0.008$				$X^2 = 4.155$; $p < 0.042$				$X^2 = 2.548$; $p < 0.11$			

Table 4. Details of number of chicks fledge after successful breeding from nests built in artificial nest-boxes of House Sparrow.

	No. of active nests	No. of chicks that came out from active nests
1.	6	1
2.	12	2
3.	8	3
4.	4	4
5.	2	5
Total	32	80

nest-boxes and causing disturbance to adult birds were found in 39 houses (concrete house 21; tiled house 18). Residents reported that House Crows *Corvus splendens* and Domestic Cats *Felis catus* had caused disturbances to House Sparrows. These predatory animals disturbed adult House Sparrows during nest-building and delivery of food to chicks. Residents stated that House Crows in 30 houses and Domestic Cats in nine houses had caused disturbances to House Sparrows by chasing the latter.

In the present study active nests and birds were found in villages where mobile-phone towers were installed. The analysis on the locations of active nests found in nest-boxes and their proximity to mobile-phone towers in the villages revealed that 22 active nests were found within 500 m radius from mobile-phone towers, two active nests occurred between 500 m and 1,000 m radius and another two nests beyond this up to 2,000 m radius from mobile-phone towers. In case of remaining six nests, no mobile towers were found within 2,000 m radius from the nesting sites.

A closed type questionnaire survey revealed that 95% of the adult residents were aware of and concerned about the declining populations of House Sparrow in general, and particularly in their villages.

DISCUSSION

The response of House Sparrow towards artificial nest boxes was greater in Udhagamandalam, Tamil Nadu (Jayaraman 2017). The number of House Sparrow breeding pairs in the nest boxes was increased to 50% over a period of five years in Poland (Dulisz et al. 2022). In India, next to wall cavities, maximum numbers of nests were found in the artificial/man-made nest boxes (Rahmani 2013). In the present study, the response of *P. domesticus* to 47% of the total artificial nest-boxes matches with the views of Jayaraman (2017), Rahmani (2013), and Dulisz et al. (2022). The British Trust for Ornithology has suggested that the heights of nest-boxes should be 3 m above the ground. In the present study also, responses of *P. domesticus* were found maximum in the nest-boxes which were placed between 3 m and 4 m heights.

House Crows predate nests of House Sparrow in Delhi (Khera et al. 2010) and Domestic Cats in Bandel region of West Bengal and Chennai in Tamil Nadu (Daniels 2008; Ghosh et al. 2010). Similarly, in the present study, incidents of nest predation by House Crows and Domestic Cats were recorded and hence, it corroborates with the earlier mentioned findings.

Clutch size is determined by various environmental factors, age of the female, breeding density, and the usual clutch size is composed of 4–5 eggs (Summers-Smith 1988; Anderson 2006). In all the active nests (32), 1–5 nestlings came out at the end of their breeding. Cases of eggs not hatched and mortality of chicks within the nest-boxes were not studied in the present investigation. Detailed study alone will throw more light on the causes for such reduced number of nestlings, i.e., one or two per active nest in the study area.

Electromagnetic radiations from mobile-phone towers are linked to population declines of House

Sparrow in Europe (Crick et al. 2002; Balmori & Hallberg 2007; Everaert & Bauwens 2007). Although equal numbers of nest-boxes were not installed at equal distance from mobile-phone towers, considerable number of active nests occurred within 500 m radius from mobile-phone towers. However, in the event of existence of mobile-phone towers in almost all villages, the exact impact of mobile-phone towers on the breeding of House Sparrows in the larger geographical areas need further study.

CONCLUSION

The present study reveals that the rural Arakkonam and Nemili taluks in Vellore District are potential breeding grounds of the House Sparrow. The birds show a considerable response to artificial nest-boxes. Efforts need to be taken to create further awareness among the general public, including students, about the need to save House Sparrows and create more nesting sites in newly constructed houses, government buildings, schools, and colleges, besides placing nest-boxes. Predatory animals and accidental fall of eggs and broods, and ceiling fans in human dwellings pose threats to the House Sparrow populations. The impact of ceiling fans on the House Sparrow needs further study as ceiling fans have become ubiquitous in rural areas. In order to mitigate such mortality, installation nest-boxes near ceiling fans or halls having ceiling fans may be avoided. A special management plan for Vellore district must be established and it is essential to conduct sustained surveys and monitor the nesting sites during the subsequent breeding seasons and efforts should be taken to create suitable nesting habitats by installing more artificial nest-boxes in the villages for successful breeding. The present study was a model study of conservation of such a semi domesticated natural avian population. Community participation to ensure installation of sufficient number cavities in the newly constructed modern buildings and also participation of like school/college students to place more number of nest-boxes in the government buildings should be encouraged.

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