Journal of Threatened Taxa

Building evidence for conservation globally

10.11609/jott.2021.13.14.20143-20310
www.threatenedtaxa.org

26 December 2021 (Online & Print)
Vol. 13 | No. 14 | Pages: 20143–20310

ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road, Saravanampatti,
Coimbatore, Tamil Nadu 641035, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scope
For Article Submission Guidelines, visit https://threatenedtaxa.org/index.php/JoTT/about/submissions
For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

Caption: Large Indian Civet *Viverra zibetha*, Tricoloured Munia *Lonchura malacca* and *Hoya wightii* (Medium—pencil crayon on watercolour paper) © Supriya Samanta.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 December 2021 | 13(14): 20209–20217
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.6631.13.14.20209-20217
#6631 | Received 27 August 2020 | Final received 11 November 2021 | Finally accepted 08 December 2021
OPEN ACCESS
COMMUNICATION

Roosting patterns of House Sparrow *Passer domesticus* Linn., 1758 (Aves: Passeridae) in Bhavnagar, Gujarat, India

Foram P. Patel [1] & **Pravinsang P. Dodia** [2]

[1,2] Department of Zoology, Sir P.P. Institute of Science, MKBU University, Bhavnagar, Gujarat 364002, India.
[1] patelforam9795@gmail.com, [2] pravinsangdodia@gmail.com (corresponding author)

Abstract: The House Sparrow *Passer domesticus* is widely distributed across the world, and local alarming declines in sparrow populations have prompted studies focused on this species. An understanding of fundamental life history aspects such as roosting patterns is necessary for the development of efficient conservation strategies. This study examined House Sparrow roosting patterns in urban, suburban and rural areas of Bhavnagar during 2017–2018. Potential roosting sites were identified, and peak arrival/ departure times and roosting duration of sparrows were recorded. We found that peak arrival and departure times were correlated with solar timings, indicating a strong influence of photoperiod on sparrow behaviour. Little variation was observed in sparrow arrival and departure times across the urban, suburban and rural gradient. However, arrival duration was significantly larger in urban and suburban areas. This may be due to the restricted availability of suitable patches within these habitats, requiring birds to spend more time foraging. House Sparrows mostly preferred thick vegetation for pre-roosting activities and roosting, and the loss of thick vegetation poses a threat to sparrow populations worldwide. In addition to increasing nesting opportunities by providing artificial nest sites, the importance of retaining appropriate habitats should be a major focus of conservation strategies.

Keywords: Arrival & departure pattern, habitat, nesting, Passeriformes, pre-roosting.

Editor: V. Gokula, National College, Tiruchirappalli, India.

Date of publication: 26 December 2021 (online & print)

Citation: Patel, F.P. & P.P. Dodia (2021).Roosting patterns of House Sparrow *Passer domesticus* Linn., 1758 (Aves: Passeridae) in Bhavnagar, Gujarat, India. *Journal of Threatened Taxa* 13(14): 20209–20217. https://doi.org/10.11609/jott.6631.13.14.20209-20217

Funding: None.

Competing interests: The authors declare no competing interests.

Author details: Currently, Foram P. Patel is working as an Assistant Professor at D K V Arts & Science College Jamnagar, Gujarat. She has recently completed her doctorate from MKBU University, Bhavnagar, Gujarat. Her research work was focused on analyzing the impact of anthropogenic pressures on House Sparrow with reference to different scale of habitat in Bhavnagar, Gujarat. Her current works focuses on exploring avian diversity across different patches of Jamnagar, Gujarat. Dr. Pravinsang P. Dodia is working as an Associate Professor at Sir P P Institute of Science, MKBU University, Bhavnagar, Gujarat. His keen interest is in avian biology.

Author contributions: FPP—conception & design of the work, data collection, data analysis and interpretation, drafting the article. PPD—supervisor, critical revision of the article.

Acknowledgements: We would like to express our special thanks of gratitude to Dr. A H Shukla, head of Zoology Department, Sir P.P. Institute of Science, Bhavnagar, for his sincere support. Sincere thanks to P. Chudasama, D. Solanki, J. Kanejiya, D. Kunapara, D. Mehta, K. Tadha, D. Trivedi, K. Joshi, S. Gohel, J. Pandya, and Rajendra for assisting in field work. We would also like to thank Dr. N. Chavada who helped us in identification of plant species.

INTRODUCTION

The House Sparrow *Passer domesticus* is one of the most widely distributed avian species on Earth, possibly due to its adaptation to human settlements. Nevertheless, significant declines in its populations have recently been reported from many parts of the world (Gulati 2005). These declines have prompted studies of sparrow breeding biology worldwide (Gokula et al. 2014). However, key habitat needs of the species will not end by finding suitable nest sites only. Understanding of other fundamental life history traits of the species such as the roosting pattern is inevitable, in constructing an efficient frame work for conservation of the species to maintain a healthy sustainable population.

Roosting can be defined as a period of inactivity analogous to human sleep (Ehrlich et al. 1988). Roosting is one of the fundamental life history traits of avian species. Small passerine birds such as sparrows roost communally, which confers many probable advantages as well as disadvantages to the birds. According to Ehrlich et al. (1988) some species change their roosting habits seasonally: male Red-winged Blackbirds *Agelaius phoeniceus*, normally roost solitarily on their territories during the breeding season, but roost in large numbers for the rest of the year. Communal roosting in avian populations probably helps in reducing the cost of thermoregulation and predation risk, and it is also likely to increase foraging efficiency of the individuals (Eiserer 1984; Ydenberg & Prins 1984). According to Ward & Zahavi (1973), roosting forms the centre to exchange information regarding food resources. However, Erwin (1983) opined that enhancement of food location takes place via local enhancement rather than by information exchanged at the roost. Besides, communal roost also provides potential mate selecting opportunities to birds lacking a partner. However, besides possible advantages, communal roost may be energetically costly to territorial species as they need to physically travel to and from roosts (Beauchamp 1999). Further, a large communal roost easily attracts potential predators due to significant vocalization (Beauchamp 1999). Thus, the significances of communal roosting are debatable (Richner & Hebb 1996). The aforementioned studies, stress the importance of investigating the roosting ecology of birds.

In the present study, an attempt has been made to understand the roosting pattern of the sparrow across urban, suburban and rural gradient of Bhavnagar and to identify key habitat requirements of the species. By monitoring roosting patterns of sparrows across different scales of habitat will shed light on understanding corresponding key habitat requirements for healthy and efficient survival of the species. Consequently efficient strategic plans can be framed to fulfil key habitat requirements of the species with respect to its conservation aspects.

Study area

The present study was undertaken in and around Bhavnagar city, Saurashtra region of Gujarat state, India. Bhavnagar is a coastal city, with the Gulf of Khambhat located to its west. A small non perennial river known as Kansara passes through the outer area of the city. Bhavnagar has a hot semi arid climate, with a hot dry summer, wet monsoon, and mild winters. Due to the proximity of Bhavnagar to the gulf, the climate remains fairly humid throughout the year.

To identify differential response of the sparrow towards different scales of habitat, the study area was divided into three gradients, i.e., urban, suburban and rural. After a pilot survey, three potential roosting sites were selected from each gradient by random stratified method. To avoid biases in the data due to population mixture of different sample sites, it was ensured that the selected sample sites were at least 2 km apart from each other – by assuming the sedentary nature of sparrows not migrating more than 2 km (Summers – Smith 1988). This was accomplished by creating 2 × 2 km grids over the study area with the help of Google earth pro software, where each sample site has been cited. Hence, nine study sites were selected to monitor roosting patterns and population of the sparrow throughout the study period. In the current study, within urban gradient (URB) – Barsomahadev (URB1) (21.774N,72.139E), Bharatnagar (URB2) (21.744N, 72.160E) and Anandnagar (URB3) (21.788N, 72.157E) study sites were selected for data collection. Within suburban gradient (SUB) – V P Society (SUB1) (21.759N, 72.170E), Forest colony (SUB2) (21.737N, 72.150E) and Fulsar (SUB3) (21.746N, 72.094E) study sites were selected for data collection. While within rural (RUR) – Akwada (RUR1) (21.739N, 72.180E), Nari (RUR2) (21.783N, 72.077E) and Sidsar (RUR3) (21.721N, 72.110E) study sites were selected (Image 1).

Image 1. Google Earth satellite image of Barsomahadev (URB1), Bharatnagar (URB2), Anandnagar (URB3), V P Society (SUB1), Forest colony (SUB2), Fulsar (SUB3), Akwada (RUR1), Nari (RUR2) and Sidsar (RUR3) study sites of Bhavnagar.

METHODS

The present study was conducted during the year December 2016 to November 2018 (24 months). For convenience, the study period was divided into four seasons, i.e., winter (December–February), summer (March–May), monsoon (June–August), and post monsoon (September–November). These categories aid in understanding seasonal variation in roosting patterns. For precise observation and data collection, instruments like Nikon Aculon A211 8 x 42 binocular and Nikon D500 digital SLR camera were used in the field.

In the year 2016, a pilot survey was carried out across the study area with the aim of identifying sites with a potential number of sparrows. Potential roosting sites were identified during the pilot survey by following flocks of sparrows from foraging grounds in the evening. The potential roosting sites were defined as places where more than a hundred sparrows were found to roost frequently during the pilot survey. Avian species, roosting together with sparrows at the same roosting plant were also recorded. During the study period, in some cases, sparrows left the original roosting site and preferred to roost at a different site – secondary roosting site. In these cases, locations of the secondary roosting place was determined by following the flock of sparrows from the original roosting site or from the foraging ground in the evening. The approximate distance of the secondary roosting site from the original roosting site was determined with the help of Google Earth pro software. Further, roosting plant species used by sparrows were identified with the help of standard field guides as well as experts in Botany. During this study, timings of roosting sounds were also recorded. Further, peak arrival and departure time periods along with arrival & departure durations were recorded during each visit. Here all timings are represented in hh:mm (hour: minutes) format. Sunset and sunrise time was noted by IST (Indian standard time, off set: UTC + 5: 30) from time and date. com website (https://www.timeanddate.com/). To be more precise in finding the relationship between solar movement and arrival as well as departure pattern of House Sparrows from roosting sites, different phases of twilight timings were also considered during the study

period. A total of three twilight timings were considered during this study, which included civil twilight (brightest phase of twilight - enough natural light to carry out most outdoor activities), nautical twilight (the horizon and the brighter stars are generally visible), and astronomical twilight (darkest phase of twilight).

Statistical analysis

Data was analyzed using IBM SPSS v.22.0 for Windows. Variance in peak arrival time, arrival duration, peak departure time, departure duration were analysed by gradients as well as by season using Independent-Samples Kruskal-Wallis Test – non parametric test. Spearman rank – order correlation coefficient test was used to correlate peak arrival and peak departure times with sunset, sun rise and day length respectively. Significance was set at P <0.05 for all statistical tests. For each test, degrees of freedom (df) and significance levels are reported. All results are presented as mean ± standard error (SE). All post hoc test results reported in compact letter display format in table as well as in chart, where groups are represented by superscript alphabetical letter. Groups with the same letter are statistically significantly similar and the others are statistically significantly different. Those groups, which are represented by more than one letter, are similar to groups represented by the same letter.

RESULTS

House Sparrows roost communally. Often large numbers of sparrows aggregate at night shelter and form a significant communal roost which can be easily identified from a distance by pronounced roosting vocalization of the sparrows. In the current study, *Ziziphus xylopyrus*, *Ziziphus jujube*, *Prosopis Juliflora*, *Acasia Senegal*, and *Bambusa vulgaris* were used as roosting plants by sparrows (Image 2). However, sparrows also used *Punica granatum*, *Morus alba*, *Syzygium cumini*, *Ficus religiosa*, and Banyan tree *Ficus benghalensis* for roosting purposes, often in the absence of the aforementioned roosting plant species (Table 1), sparrows often used empty nests for roosting purposes, i.e., roost nest (Image 3E). During the study, it was observed that roosting sparrows often visited or gathered at pre-roosting sites (other than roosting sites) before entering a roosting plant. Various maintenance activities such as sand baths, preening, rubbing bills and fluffing were observed during pre-roosting at all the sites (Image 3B). Sometimes collective motion (murmuration) was observed during aggregation of large numbers of sparrows at roosting sites (Image 3A). Collective motion of sparrows was common at urban and suburban sites, mainly when a large aggregation of sparrows occurred during the post-breeding season.

Table 1. List of different plant species used by House Sparrows for roosting during the study.

Roosting plant species			
	Scientific name	**Common name**	**Family**
1	*Ziziphus xylopyrus*	Moti boradi	Rhamnaceae
2	*Ziziphus jujuba*	Boradi	Rhamnaceae
3	*Prosopis Juliflora*	Gando baval	Fabaceae
4	*Acasia Senegal*	Gorad baval	Fabaceae
5	*Bambusa vulgaris*	Vans	Poaceae
6	*Punica granatum*	Dadam	Lythraceae
7	*Morus alba*	Shetur	Moraceae
8	*Syzygium cumini*	Jambu	Myrtaceae
9	*Ficus religiosa*	Peepal tree	Moraceae
10	*Ficus benghalensis*	Banyan tree	Moraceae

No significant statistical difference was found in mean peak arrival time of sparrows across urban, suburban and rural roosting sites for both the years (Figure 1). Peak arrival time of sparrows at different roosting sites was strongly correlated with sunset time, which was statistically significant, r_s (202)= 0.848, p <0.0001 (Figure 2). Similarly, there was a strong positive correlation between peak arrival time and day length, which was also statistically significant, r_s (202)= 0.819, p <0.0001 (Figure 3). During the observation, the peak numbers of House sparrows were recorded 0.5 h before sunset. House Sparrows arrived at roost sites in different flock size ranging 3–40. In 2017, there was a significant statistical difference in mean arrival duration across urban, suburban and rural gradients (H(2)= 16.99, p <0.0001). The Bonferroni post hoc test revealed that mean arrival duration at rural gradient was statistically significantly lower than urban (p <0.0001) and suburban gradient (p <0.05). There was no statistically significant difference in mean arrival duration between suburban and urban gradient (p >0.05) (Figure 4). Similarly, in 2018, there was a significant statistical difference in mean arrival duration across different gradient (H(2)= 7.05, p <0.05). The Bonferroni post hoc test revealed that mean arrival duration at suburban gradient was statistically significantly higher than urban gradient (p <0.05). There was no significant statistical difference in mean arrival duration between urban – rural gradients and rural –

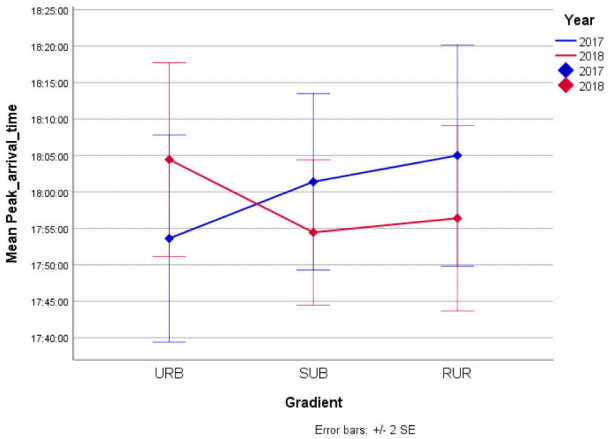

Figure 1. The mean peak arrival time of House Sparrow at different roosting sites across urban (URB), suburban (SUB), and rural (RUR) gradients of Bhavnagar during year 2017 and 2018.

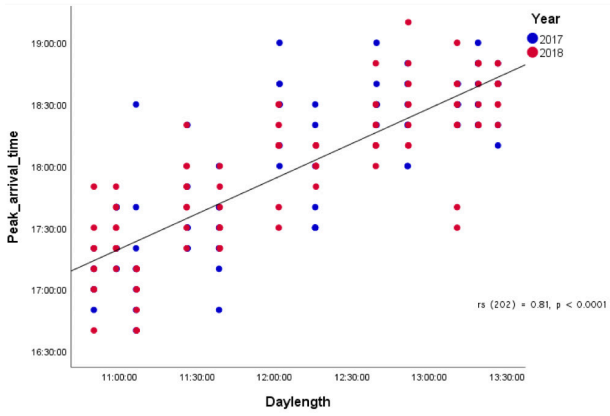

Figure 3. Correlation between peak arrival time of House Sparrow at different roosting sites and day length during study.

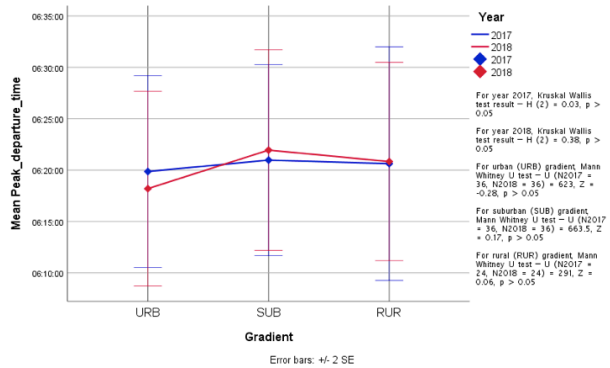

Figure 5. The mean peak departure time of House Sparrow from different roosting sites across urban (URB), suburban (SUB), and rural (RUR) gradients of Bhavnagar during year 2017 and 2018.

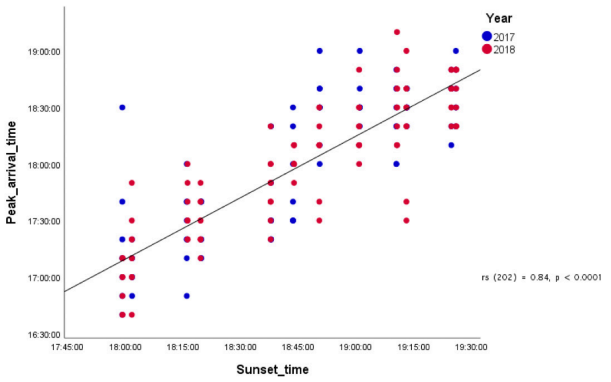

Figure 2. Correlation between peak arrival time of House Sparrows at different roosting sites and sun set time during the study.

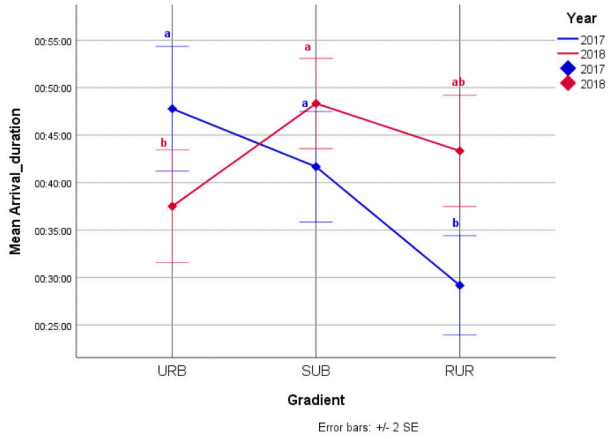

Figure 4. The mean arrival duration of House Sparrow at different sites across urban (URB), suburban (SUB) and rural (RUR) gradients of Bhavnagar during year 2017 and 2018.

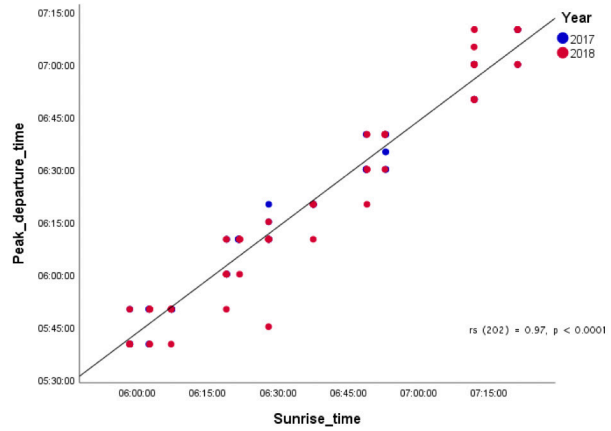

Figure 6. Correlation between peak departure time of House Sparrow from different roosting sites and sun rise time during the study.

Table 2. The mean distance of secondary roosting plant species from original roosting plant across urban, suburban and rural gradients.

Gradient	Distance of secondary roosting plants (km)
Urban (URB)	0.26 ± 0.05
Suburban (SUB)	0.21 ± 0.04
Rural (RUR)	0.17 ± 0.04
Total	0.22 ± 0.03

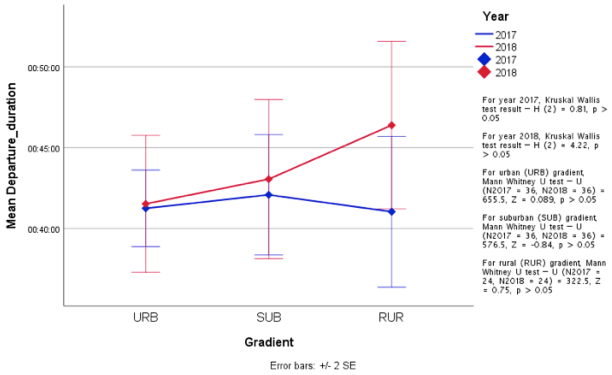

Figure 7. The mean departure time of House Sparrow across urban (URB), suburban (SUB), and rural (RUR) gradients of Bhavnagar during year 2017 and 2018.

suburban gradients (Figure 4). Besides, arrival duration varied significantly across the different seasons. Usually, maximum arrival duration was recorded during monsoon and post-monsoon seasons in the current study. House Sparrows presumably spent more time in foraging due to favourable feeding conditions during these seasons, consequently frequent back and forth movements from foraging ground to roosting sites increased arrival duration.

No significant statistical difference was found in mean peak departure time across urban, suburban and rural gradients for both the years (Figure 5). There was a strong positive correlation found between peak departure time and sunrise time, which was statistically significant, $r_s(202)= 0.977$, $p <0.0001$ (Figure 6). No significant statistical difference was found in mean departure duration across urban, suburban and rural gradients for both years (Figure 7).

The roosting sound started when House sparrows entered into roosting sites and lasted up to the end of nautical twilight. The roosting sound sometimes was interrupted by warning calls resulting in a sudden silence for a fraction of a minute. However, the roosting sound restarted immediately on reoccurrence of favorable conditions. It was observed that unlike the arrival pattern of sparrows, within 30 mins after sunrise, almost the maximum number departed together. Mostly departure occurred in the same direction from where flocks of House sparrows had arrived at the roosting site. Vocalization in the morning generally started during the nautical phase of sunrise and lasted up to approximately 10–15 min after the start of civil twilight. Further, it was observed that the House sparrow easily shares its roosting place with small passerine birds, these individuals may be of the same or different genus, i.e., heterospecific communal roosting.

Under certain circumstances, such as removal of roosting plant species or trimming of corresponding species locally, reduction in foliage density of roosting plants, presence of larger avian species at roost sites, House sparrows often change their roosting sites and opt for other suitable patches, generally found at a distance of 0.22 ± 0.03 km within the study sites. However, due to restricted availability of suitable patches within urban and suburban gradients, the distance of secondary roosting plants (0.26 ± 0.05 km and 0.21 ± 0.04 km) was relatively higher than in rural gradient (0.17 ± 0.04 km) (Table 2).

DISCUSSION

It was observed during the study that House sparrows mostly prefer to roost in dense bushy vegetation rather than in a tree with dense canopy. According to North (1968), tree height and the density of the foliage, rather than species of the plant are principle criteria for the selection of roosting sites. It was observed that often due to small disturbances sparrows opted for other suitable patches of plants found within the study sites for roosting purpose either temporarily or permanently. However, with the recurrence of favourable conditions part of the population returned to the primary roosting sites. Anderson (2006) opined that sparrows often change roosting sites if sites have less density of foliage. Pre-roosting gathering was also significant at all study sites. Under certain circumstances such as disturbance due to predators at the roosting sites, pre-roosting sites played an important role by providing temporarily better shelter to sparrows. In addition, various maintenance activities such as sand baths, preening, rubbing bills, and fluffing were significant during pre-roosting at all sites (Image 3B). Simmons (1964) considered preening as an essential and significant act performed by birds to maintain their feathers. For removing parasites, birds often shake their body or fluff their feathers. In the current study, sparrows

Image 2. Roosting sites of House Sparrows across different study sites: A—Barsomahadev (URB1) | B—Bharatnagar (URB2) | C—Anandnagar (URB3) | D—V P Society (SUB1) | E—Forest colony (SUB2) | F— Fulsar (SUB3) | G—Akwada (RUR1) | H—Nari (RUR2) | I—Sidsar (RUR3). © Foram P. Patel.

were found to preen their feathers regularly and it was significant during pre-roosting visits. Sand bath was also significant in the House sparrow population at the study area. Many studies have explained the importance of sand/dust bath by birds for removal of parasites, besides the sand bath is also essential as excess amounts of oil that birds daily preen on to their feathers to stay warm and fly is absorbed (Borchelt 1972). This stresses the importance of such characteristic habitats (e.g., sandy surface), where sparrows can efficiently perform various maintenance activities required for a healthy, sustainable life.

It was observed that sparrows arrived at their corresponding roosting sites 1–1.5 h before sunset. This was very similar to Anderson's (2006) observation, where he noted the arrival of sparrows at the roosting site two hours before sunset. No statistical significant difference was found in peak arrival times across different sites of each gradient between 2017 and 2018. However, peak arrival time was strongly correlated with sunset time, this indicated that the arrival of the House sparrows at the roosting site is totally influenced by photoperiod. However, presumably, various factors such as illumination (direct sun light), presence of raptors, and other larger avian species at the roosting site might play an important role in delaying arrival time at roosting sites. Variances in arrival duration of sparrows at roosting sites across urban, suburban and rural gradient could be explained as birds spent more time for last moment foraging. Statistically significant larger arrival duration in urban and suburban gradient was due to prevalence of restricted suitable patches across such gradients, where birds could spend more time for foraging. In 2018, the amount of suitable patches was significantly reduced at suburban sites such as V P Society (SUB1) and Forest colony (SUB2). Sometimes attacks by raptors such as Shikra *Accipiter badius* on sparrows during arrival at roosting sites made a pause in the arrival and increased the arrival duration. The peak departure time and departure duration of sparrows from roosting sites did not vary significantly across urban, suburban and rural gradients during the study period. In the evening,

Image 3. Pre-roosting activities and roosting of House Sparrows: A—Collective motion of House Sparrow (during arrival at roost site) | B—House Sparrows taking sand bath | C—Roosting House Sparrows | D—House Sparrows at roosting plant | E—Roost nest. © A–C—Foram P. Patel | D–E—Kajal R. Tadha.

the roosting vocalization of sparrows was distinct and significant at all sites through which communal roosting sites of sparrows could be located from a distance. However, sometimes on warning calls, the roosting sound was interrupted for a fraction of time which began again on the return of favourable conditions. Daanje (1941) reported that House Sparrows have social warning calls through which the whole colony quickly learns of the presence of an enemy in the vicinity.

It was observed that the departure of sparrows from different roosting sites started by sunrise; 0.5 h to 1 h after sunrise a maximum number of sparrows departed from roosting sites. Departure duration recorded in the current study was a bit longer than recorded by North (1968). However, peak departure occurred within 30 min after sunrise during the current study too. It was observed that unlike the arrival pattern of sparrows, within 30 min after sunrise, almost the maximum number of the population departed together. Mostly departure occurred in the same direction from where the flocks of sparrows arrived at the roosting site. North (1968) noted the beginning of vocalization of the sparrows about 30 min before sunrise, and they usually departed from the roost within 30 min after sunrise. These observations of North (1968) are also supported by the current study where during the nautical phase of sunrise vocalization started and lasted up to approximately 10–15 min after the start of civil twilight.

Heterospecific communal roosting was witnessed in the current study too, where House sparrows roosted with other small passerine birds on the same roosting plant. Heterospecific communal roosts of House sparrows with different avian species are reported across the globe. House sparrows were found to share roosting sites with European Starlings in Poland (Gorska 1975), with Spanish Sparrows in Spain (Alonso 1986), with European Starlings and Eurasian Tree Sparrows in North America (North 1968; Anderson 2006). In India, Rana (1989) observed communal roosts of House sparrows with Jungle Babblers *Turdoides striatus* and Common Mynas *Acridotheres tristis*. The above mentioned study supports the observation of the current study, where a

communal roost of House Sparrows has been observed with Large Grey Babbler *Turdoides malcolmi*, however, a record of sharing roosting sites with Common Myna *Acridotheres tristis* was lacking in the current study. Mahabal & Bastawade (1985) reported communal roosting of House sparrows near the communal roosting site of the Black Kite (*Milvus migrans govinda*). However, it was observed in the current study, that the presence of larger avian species such as Alexandrine Parakeet *Psittacula eupatria* forced House sparrows to roost on other plant species. Further, the opportunistic presence of larger avian species at the study site also influenced House Sparrows' behavioral patterns. Like, when Painted Stork *Mycteria leucocephala* was present at roosting sites—for collecting corresponding nest materials from the site—sparrows swiftly entered the roosting plant, without murmuration and without producing any roosting calls, thus indicating that larger avian species negatively influence roosting House Sparrows.

CONCLUSION

During the study, peak arrival and peak departure times of the House Sparrow did not vary significantly across urban, suburban and rural gradients of Bhavnagar. While arrival duration was significantly larger in urban and suburban gradients, such variation in the arrival duration could be explained by multiple factors such as restricted availability of suitable patches, lack of suitable foraging grounds near roost sites, and the presence of raptor birds. In the present study, dense bushy vegetation was found to be the most preferred habitat of the House sparrow for roosting and pre roosting purposes across urban, suburban and rural gradients of Bhavnagar. Besides providing better night shelter, bushy vegetation forms an ideal habitat with reference to maintenance activities of the House Sparrow such as sand baths. During the study it was observed that bushy vegetation was significantly reduced across urban and suburban sites which resulted in a drastic reduction of suitable habitat patches for the House Sparrow. Hence, conservative initiatives should not be restricted to complement nesting opportunities by providing artificial nest sites, but attention should also be given to preserving suitable habitats required for the species.

REFERENCES

Alonso, J.C. (1986). Ecological segregation between sympatric Spanish Sparrows (*Passer hispaniolensis* Temm.) and House Sparrows (*Passer domesticus* [L.]) during winter. *Ekologia Polska* 34: 63–73.

Anderson, T. (2006). *Biology of the Ubiquitous House Sparrow: From Genes to Populations*. Oxford University Press, New York. https://doi.org/10.1093/acprof:oso/9780195304114.001.0001

Beauchamp, G. (1999). The evolution of communal roosting in birds: origin and secondary losses. *Behavioral Ecology* 10(6): 675–687. https://doi.org/10.1093/beheco/10.6.675

Blanco, G. & J.L. Tella (1999). Temporal, spatial and social segregation of red-billed choughs between two types of communal roost: a role for mating and territory acquisition. *Animal Behaviour* 57 (6): 1219–1227. https://doi.org/10.1006/anbe.1999.1103.PMID10373254.S2CID7254376

Borchelt, P.L. (1972). Dust bathing in Bobwhite Quail (*Colinus virginianus*): A regulatory model. PhD Thesis, Michigan State University.

Daanje, A. (1941). Uber der Verhalten des Haussperlings (*Passer d. domesticus* [L.]). *Ardea* 50: 1–42.

Ehrlich, P.R., D.S. Dobkin & D. Wheye (1988). Communal roosting. Accessed on 10/02/2019. https://web.stanford.edu/group/stanfordbirds/text/essays/Communal_Roosting.html

Eiserer, L.A. (1984). Communal roosting in birds. *Bird Behavior 5*(2–3): 61–80.

Erwin, R.M. (1983). Feeding habitats of nesting wading birds: spatial use and social influences. *Auk* 100: 960–970.

Gokula, V., S. Palanivel & B. Sivagamy (2014) Nesting ecology of house sparrow *Passer domesticus* (Linnaeus 1758) in Punavasipatty and Kuthoor, Tamil Nadu, India. *Journal of Scientific Transactions in Environment and Technovation* 7(4): 193–200

Gorska, E. (1975). The investigations on the common roostings of the sparrow, *Passer domesticus* (L.) and starling, *Sturnus vulgaris* L. in Poznan in winters 1970/71 and 1971/72. *Przeglad Zoologiczny* 19: 230–238.

Gulati, V. (2005). House Sparrow on Verge of Extinction**,** Tribune News Service, Chandigarh. Accessed on 30.ix.2013.

Mahabal, A. & D.B. Bastawade (1985). Population ecology and communal roosting behaviour of pariah kite *Milvus migrans govinda* in Pune (Maharashtra). *Journal of the Bombay Natural History Society* 82: 337–346.

North, C.A. (1968). *A study of house sparrow populations and their movements in the vicinity of Stillwater, Oklahoma*. PhD Thesis. Oklahoma State University, Stillwater.

Rana, B.D. (1989). Population ecology of *Passer domesticus* in the Indian arid zone. *International Studies on Sparrows* 16: 1–7.

Richner, H. & P. Heeb (1996). Communal life: Honest signaling and the recruitment center hypothesis. *Behavioral Ecology* 7(1): 115–118. https://doi.org/10.1093/beheco/7.1.115

Simmons, K.E.L. (1964). Feather maintenance, pp. 101–105. In: Campbell B. & E. Lack (eds.). *A New Dictionary of Birds*. Buteo Books, Vermillion, South Dakota.

Summers-Smith, J.D. (1988). *The Sparrows*. T. & A.D. Poyser, Calton, UK.

Ward, P. & A. Zahavi (1973). The important of certain assemblages of birds as "Information Centers" for food- feeding. *Ibis* 115: 517–534.

Ydenberg, R.C. & H.H.T. Prins (1984). Why do birds roost communally in winter? Pp. 123–139. In: Evans, P.R., J.D.G. Custard & W.G. Hale (eds.). *Coastal Waders and Wildfowl in Winter*. Cambridge University Press, Cambridge.

Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road,
Saravanampatti, Coimbatore, Tamil Nadu 641035, India
ravi@threatenedtaxa.org

Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

December 2021 | Vol. 13 | No. 14 | Pages: 20143–20310
Date of Publication: 26 December 2021 (Online & Print)
DOI: 10.11609/jott.2021.13.14.20143-20310

Publisher & Host

WILD ZOOREACH
Threatened Taxa