

## Short Communication:

# A pilot-study on the occurrence and probable factors influencing the population decline of House Sparrow (*Passer domesticus*) along an urbanization gradient in Coimbatore district, India

YASHASWINI NARAYANAPPA, ANAMIKA GAUTAM, KUNAL MAHOBIYA, ASHUTOSH SINGH\*

Division of Avian Physiology and Genetics, Sálim Ali Centre for Ornithology and Natural History, Post Anaikatti, Coimbatore 641108, Tamil Nadu, India. Tel./fax.: +91-422-2203100, \*email: apgsacon@gmail.com

Manuscript received: 17 June 2022. Revision accepted: 13 July 2022.

**Abstract.** Narayanappa Y, Gautam A, Mahobiya K, Singh A. 2022. Short Communication: A pilot-study on the occurrence and probable factors influencing the population decline of House Sparrow (*Passer domesticus*) along an urbanization gradient in Coimbatore district, India. *Biodiversitas* 23: 3884-3889. The House sparrow is a widely distributed, human-commensal bird species across the globe. Over the past few decades, the population of this species has been reported to be declining at an alarming rate. The primary factor postulated to cause this decline is urbanization which leads to the unavailability of suitable nesting sites, a dearth of invertebrate food, the advent of phone towers, and electromagnetic radiation. The current study aims to document the occurrence, abundance and scrutinize the reasons for the decline of House Sparrows along a gradient of urban to rural in Coimbatore district, India. To estimate the abundance of House Sparrows, we counted them in 16-points within a three 3km-radius along an urban-rural gradient. Information on gender, cluster size, detection distance, an angle from the observer, etc. were collected. The questionnaire survey was conducted to understand people's perceptions about the importance of the species and its current status. Along the gradient, we observed an average of 69.8 ( $\pm 24.9$ ) individuals. The species were abundant in rural and semi-urban areas, which is attributed to the availability of nesting sites, such as roof cavities, eaves, mud-walls, adequate feeding sources, presence of open scrub patches and garbage dumping sites adjacent to the residential spaces. However, sparrows were not present in the urban areas, even in their preferred habitats. According to the questionnaire survey, the likely causes for their absence are an increase in vehicle traffic, modern buildings, high-rise structures, and electromagnetic radiation from cell phone towers.

**Keywords:** House sparrow, occurrence, point-count, questionnaire survey

## INTRODUCTION

House Sparrows (*Passer domesticus*) are the most widely distributed birds in the globe, belonging to the family Passeridae (Mahesh and Lanka 2021). *Passer* is a genus of Old-World sparrows with twenty-eight species found across Eurasian and Afrotropical regions (Päckert et al. 2021). Its native range spans most of Europe and Central Asia, which has now expanded to all continents, excluding the poles, due to human introduction (Schrey et al. 2011), since they are a human-commensal species that have historically been associated with human settlements (Summers-Smith 1988). Due to their global distribution and abundance, they have been categorized as "Least Concern" by the IUCN Red List and as a Schedule IV species by the Wildlife (Protection) Act, 1972 of India. A drastic decline in the population of House Sparrow has been recorded in many parts of the world over the last decade (Mahesh and Lanka 2021).

Several hypotheses have been proposed to explain the decline of House Sparrow populations, including rampant urbanization (Shaw et al. 2008; Modak 2017), unavailability of nesting sites due to the prevalence of modern architecture, air pollution, increase in vehicular

traffic, intolerable changes in its optimal habitat (Murgui 2009), indiscriminate use of pesticides, paucity in invertebrate food especially during breeding season (Peach et al. 2008; Pandian 2021), intra-specific and interspecific competition for resources (Ghosh et al. 2010), and predation by feral cats. Electromagnetic radiation and unleaded petrol exhaust are also likely caused these species to undergo local extinction, according to Balmori et al. (2007). However, no study clearly demonstrates how far electromagnetic radiation impacts sparrow behaviour and nesting (Mahesh and Lanka 2021). Studies also indicate that human socioeconomic status may provide a partial explanation for the patchy distribution of House Sparrows inside metropolitan settings (Shaw et al. 2008). The alarming decline in their population in the regional level is unnatural, providing an early warning indicating ecological imbalance. Sparrows are infamous as "nuisance species" attributed to their invasive nature and agricultural pests as they predate on commercial crops, but their ecological significance is lesser known. House Sparrows may be useful in identifying the mechanisms in which they alter their behaviour and physiology in response to ambient temperature (Andrew et al. 2018; Hanson et al. 2020). By their feeding behaviour, they form the secondary

consumers and play a crucial role in agroecosystems as a natural pest controller. House sparrow is an omnivore and it feeds on grains, fruits, cereals, insects and insect larvae. Studies have shown that sparrows feed on plant seeds, weed seeds, seeds from animal dung and also depend on protein-rich food. During the formative stages, sparrow chicks are fed with insect larvae, weevils, grasshoppers, and caterpillars (Crick et al. 2002).

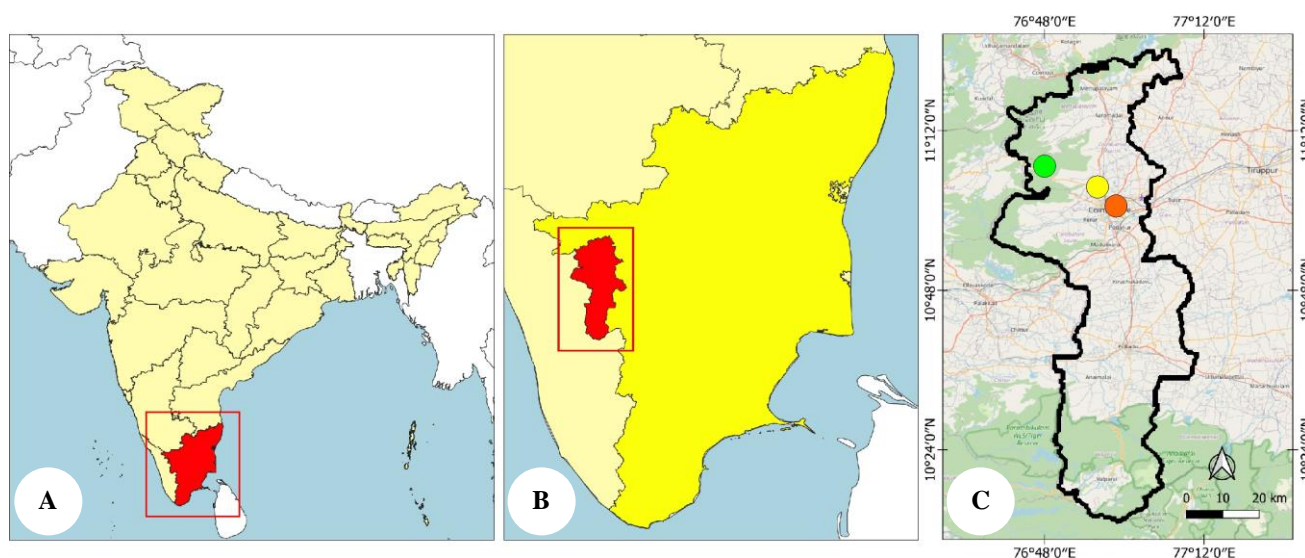
The loss of habitat is the dominant perspective linking the physical urban expansion to the disappearance of species. The State of India's Birds 2020 reported a gradual decline in the abundance of house sparrows in urban areas. There has been a marked decline in the global population of House sparrows in the United Kingdom and other western countries. In India, according to ICAR (Indian Council for Agricultural Research), the sparrow population in Andhra Pradesh has dropped by 80% and there is 20% decline in Kerala, Gujarat and Rajasthan (Sharma and Binner 2020). Population growth in the urban centres contributes to the transformation of natural habitats, which leads to the loss of native biodiversity and habitat (Czech et al. 2000). Findings from Khera et al. (2010) concluded that urbanization leads to increased bird density but reduced bird richness. According to Modak (2017), Greater Kolkata, particularly in the planned city region, has a low abundance of house sparrows. House sparrows were found in greater numbers in low-density urban areas with less than 50% multi-story buildings and frequent open spaces than in high-density urban areas with more than 80% multi-story buildings and infrequent open spaces, according to Modak (2017). Loss of suitable habitats that provide nesting sites in modern structures is regarded to be the key factor in sparrow population decline in urban areas, as modern roofs hardly provide any cavities than older roofs

(Summers-Smith 2003). The intense developmental activity and habitat changes in densely populated, highly industrialized parts of urban centres influence the foraging success, nesting success, and predation risk and the population dynamics of House Sparrows (Shaw et al. 2008). This study was undertaken primarily to assess the presence or absence of house sparrows along the urban-rural gradient, mainly to observe if the rural, semi-urban and urban areas are providing suitable habitats for the survival of sparrows. The current preliminary study aims to document the occurrence, abundance, and probable reasons for the decline of House Sparrows along an urbanization gradient in Coimbatore district, India.

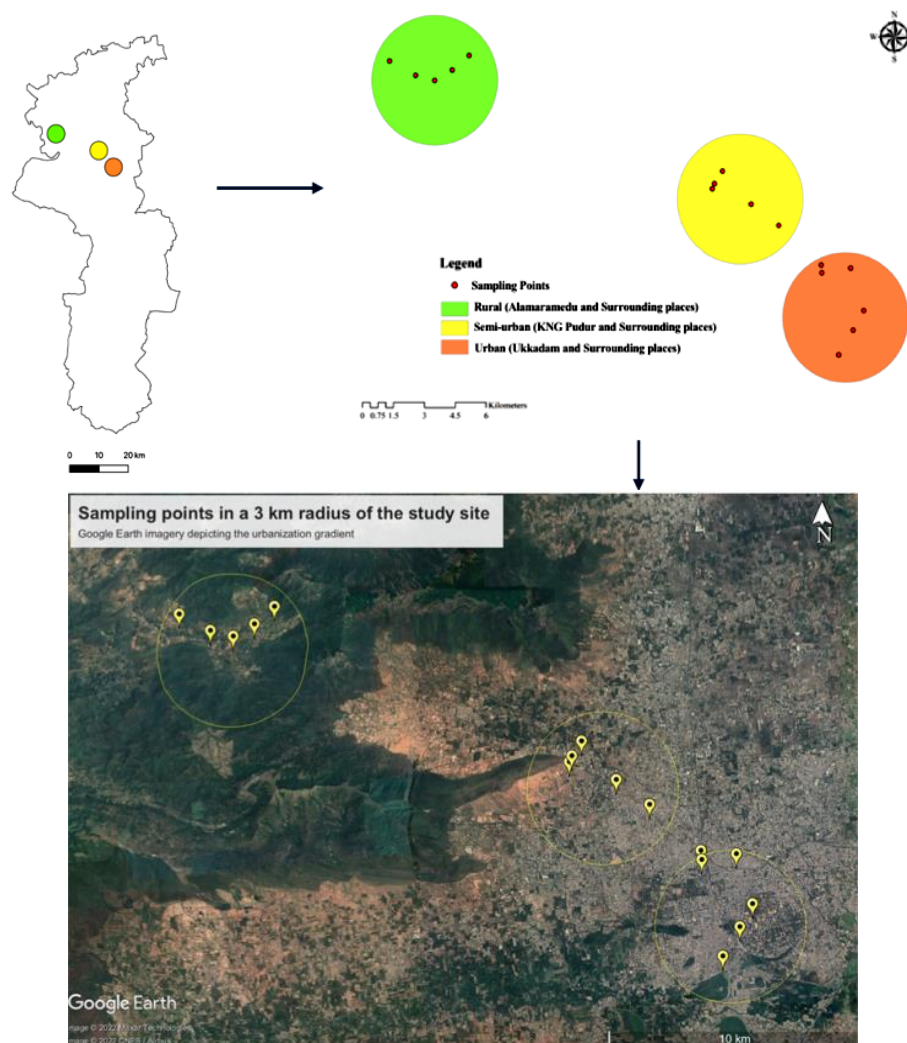
## MATERIALS AND METHODS

### Study area

The study was conducted in Coimbatore district ( $11^{\circ}0'16.4016''\text{N}$ ,  $76^{\circ}57'41.8752''\text{E}$ ), the third largest city in the state of Tamil Nadu (Figure 1). The main aim of the study was to estimate the occurrence and status of the species from the urban to rural gradient using point count method, following Dhanya (2011) and questionnaire survey. The study area was chosen based on the varied types of habitats found along an urban to the rural gradient of the Thadagam road in one of Coimbatore's cardinal directions. The Thadagam road emerges from the center of the city and connects Anaikatti, a town on the Kerala state border, 28-kilometer away from the Coimbatore city center (Dhanya 2011). In this study, the Gandhipuram central bus station was identified as the city's focal point.



**Figure 1.** A. Map of India, with Tamil Nadu state highlighted; B. State map of Tamil Nadu with Coimbatore district highlighted; C. Map of Coimbatore district, showing study sites



**Figure 2.** Sampling points in a 3 km radius of the study site

### Procedures

We followed the definition of urban, semi-urban and rural classification based on the Census of India 2011, where urban areas were defined as all places having a municipality, corporation, cantonment board or notified town area committee, etc. (Census of India 2011); semi-urban or suburban areas defined as areas falling outside the Municipal Corporation limits and those are governed by Town Panchayats (Commissionerate of Town Panchayats 2016); while rural areas are defined as villages (National Sample Survey Organization) with clear surveyed boundaries but no municipal board and are governed by village panchayats. The study areas representing rural, semi-urban, and urban regions were identified and 3 km radius zones were generated around these regions using Google Earth Pro and QGIS (version 3.10). (Figure 2). Based on the vehicular traffic and intensity of human activities, five points in each zone were selected, mostly around hotels, food grain warehouses, vegetable and meat markets, scrub patches and garbage dumping sites (as sparrows are known to prefer these habitats, according to Rajashekhar and Venkatesha (2008)) for observation, accounting for a total of 16 points. An extra study point

was considered from an urban area near Gandhipuram Railway station, as suggested by the interviewees.

The survey was carried out during the month of February-April 2022. Five repetitive surveys were carried out at all the 16 points, with an interval of a week between each survey session. At each site, bird counts were made for 10 minutes within the visible radius (50-100m), following Dhanya (2011). The fieldwork was conducted in the morning hours, just after the sunrise from 6:30 hours to 11:00 hours and in the evening hours, when the sparrows usually return to their roosting sites just before the sunset, from 16:00 hours to 18:00, when the House sparrows were found to be most active. Sampling was performed by a two-person team, the observer was the same during the entire sampling period. We recorded individuals and groups of individuals detected, as well as their gender, cluster size and detection distance from the observer. We measured each detection distance (in meters) using a Nikon Prostaff 3i Rangefinder®. Questionnaire survey was also conducted, an informal survey was taken up to gather information on House Sparrow conservation, the current status of House Sparrows, perceptions on population declination of House Sparrows and perceptions on the

importance of sparrows in the ecosystem/ usefulness of sparrows to humans (Table 1). All age groups from 18 to 60 years were targeted.

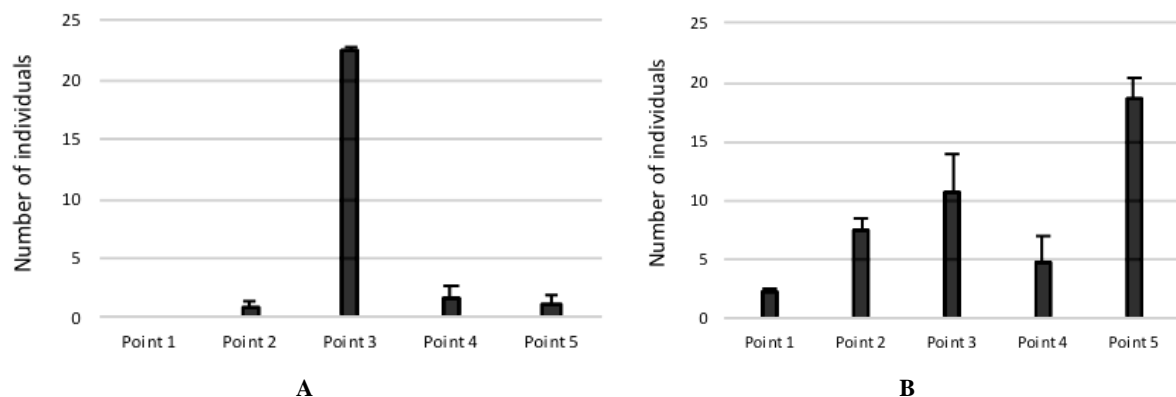
Point count method was adopted to estimate the abundance of House Sparrows. Point count is a method where an observer needs to stand at a place for a fixed time period, in this case for 10 minutes and record all the sparrows seen within or without a fixed radius (Bibby et al. 2000). In this case, it was a variable radius point count, where a fixed radius was not considered, as our sampling points included a variety of landscapes from residential areas to open scrublands. Hence to acquire a higher detection probability, a fixed radius was not considered. Further, the distance to individuals from the point was also measured. The climate conditions and the habitat variables were also recorded. The great advantage of point count is that they are advantageous over transects as the observer gets slightly more time to detect and identify difficult birds (Bibby et al. 2000).

## RESULTS AND DISCUSSION

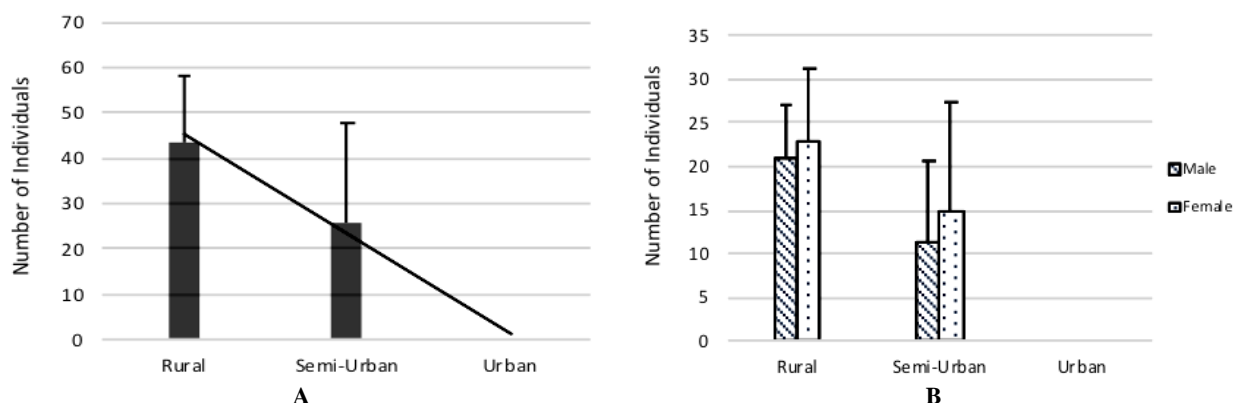
During the survey, only 9 out of the 16 points selected along the gradient recorded House sparrow occurrences. The highest number of individuals was seen in the rural region (Figure 3b and Figure 4a). Sparrows were seen at all 5 sampling points of the rural region with an average of about  $43.8 (\pm 19.3)$  individuals. Whereas, in the semi-urban area, the species was sighted at four points with an average of  $26 (\pm 5.6)$  individuals. Female individuals were sighted more frequently in both rural and semi-urban areas in comparison to male individuals (Figure 4b). No sparrows were recorded at any sites in the urban area. Opportunistic interviews from the urban area indicate that the House Sparrows thrived in the past (Table 1), whereas presently declining staggeringly, especially from the cities. Interviewees opined that the House Sparrows have disappeared since the advent of cell-phone towers, modern buildings and urbanization.

**Table 1.** Opportunistic interviews on the cause of decline of House Sparrows in the Urban region

| Age group | Number | Comment   |
|-----------|--------|---|
| 20-40     | 4      | Sparrows are seen only in villages. Never seen in the cities. High vehicular traffic and modern buildings have taken away their nesting spaces.                   |
| 40-60     | 5      | Decrease in sparrow population since the advent of cell-phone towers and electromagnetic radiations.  |
| 60-70     | 2      | Sparrows used to visit houses, ten to twenty years back. Presently they have disappeared due to use of mobile phones. Major decrease in population for ten years. |



**Figure 3.** A. Average of the count of House Sparrows in the Rural region; B. Average of the count of House Sparrows in the Semi-Urban region



**Figure 4.** A. Average of the count of House Sparrows along urban-rural gradient; B. Male-Female sex ratio of House Sparrows along urban-rural gradient





**Figure 5.** A. A female House Sparrow in semi-urban region; B. A male House Sparrow in a rural area; C. Group of House Sparrows in a scrub patch at a rural region; D. Roosting site of House Sparrow in a semi-urban area

## Discussion

In the current pilot study, the House Sparrow sightings were higher in the rural regions, followed by semi-urban areas. The occurrence of the species in rural areas could be attributed to the availability of conventional human-made structures (Tile-roofed houses, brick houses), which they prefer for nesting, such as roof cavities, eaves, walls and nest boxes (Grinnell 1919). Individuals were also sighted near small hotels, eateries and provisional shops as they offer plenty of food items. In semi-urban areas, individuals were observed more frequently in the open lands with scrub vegetation and garbage dumping sites adjacent to residential spaces. These green spaces could potentially be providing nesting sites and insect food for the young (Summers-Smith 1988), as sparrows living near residential areas consume more of human refuse and household scraps (Summers-Smith 1988). During the survey, two nesting sites of the semi-urban area were in the open land with shrubs near a residential space and another in the rural region, in an abandoned well adjacent to household wastes and livestock dung dumping site. No individuals were observed in the urban sampling points during the survey. In urban areas, the study points also comprised of vegetable markets and food grain shops, as these places are a good source of spill-over food materials and are mostly preferred by sparrows. But, the absence of potential nesting sites at these places could be the key factor for the disappearance of sparrows from urban regions. Usually, there seem to be no significant variations in the sex ratio in the population

structure of house sparrows (Rana and Idris 1986). However, Rajashekhar and Venkatesha (2008) observations show that females exceed males, contrary to the findings of Rana and Idris (1986), who found that males outnumbered females. In comparison, we saw more females than males during our observations. According to a study by Husby et al. (2006), house sparrows have the potential to adjust their sex ratio in response to environmental changes that may have an impact on the relative fitness of the offspring's sexual differences.

In recent years, it has been reported that the population of House Sparrows has been declining in many parts of the world, mainly from urban areas (Patel and Dodia 2021). The decline of House Sparrows from the urban areas was also highlighted in the State of India's Birds Report (SoIB), 2020. According to Bokotey and Gorban (2005), one of the main reasons for the population declination of House Sparrows is the lack of nesting sites due to modern architecture urbanization. Another reason for the decline in the population being the unregulated use of pesticides resulting in a paucity of invertebrate food for the sparrows. Several other factors that explain the disappearance of House Sparrows include electromagnetic radiation and the exhaust of automobiles running on unleaded petrol (Balmori and Halberg 2007). However, still the actual causes of their population decline are being debated. The availability of various food sources for both adults and nestlings and essential nesting sites around the food sources primarily play an important role in the abundance of House

Sparrow populations. The current study suggests providing of suitable nesting sites to House Sparrows by retaining green space, scrub vegetation, native and traditional buildings in the city, artificial nest boxes, regulation on pesticide use are necessary for sustaining the House Sparrow populations as recommended by Rajashekhar and Venkatesha (2008). Rural and semi-urban areas are under less development pressure than urban areas but yet provide ample room for urban sprawl. As a result, these places are more vulnerable to development pressure in the coming days, and sparrows may lose their habitat in rural areas. However, in order to prevent local extinction of the species and build better conservation measures, we need to conduct regular monitoring of the species to compare and evaluate population fluctuations along the urban-rural gradient as modern building practices are being preferred by people.

## ACKNOWLEDGEMENTS

We greatly acknowledge the funding support of the Ministry of Environment, Forest and Climate Change, Government of India through the Grant-in-Aid. We Also thank to the Director-in-charge for permitting to use the SACON facility to conduct the work. We also thank Mr. Surendra T. for helping in the field activity during the work.

## REFERENCES

- Andrew SC, Awasthy M, Griffith AD, Nakagawa S, Griffith SC. 2018. Clinal variation in avian body size is better explained by summer maximum temperatures during development than by cold winter temperatures. *The Auk Ornithol Adv* 135 (2): 206-217. DOI: 10.1642/AUK-17-129.1.
- Balmori A, Hallberg Ö. 2007. The urban decline of the house sparrow (*Passer domesticus*): A possible link with electromagnetic radiation. *Electromagn Biol Med* 26 (2): 141-151. DOI: 10.1080/15368370701410558.
- Bibby CJ, Burgess ND, Hillis DM, Hill DA, Mustoe S. 2000. *Bird Census Techniques*. Elsevier, Netherlands.
- Bokotey AA, Gorban IM. 2005. Numbers, distribution and ecology of the House Sparrow in Lvov (Ukraine). *Intl Stud Sparrows* 30: 7-22.
- Census of India. 2011. Provisional Population Totals Urban Agglomerations and Cities. [https://www.censusindia.gov.in/2011-prov-results/paper2\\_vol2/data\\_files/India2/1.%20Data%20Highlight.pdf](https://www.censusindia.gov.in/2011-prov-results/paper2_vol2/data_files/India2/1.%20Data%20Highlight.pdf).
- Coimbatore District Census. 2011. Government of India. <https://www.census2011.co.in/census/district/32-coimbatore.html>.
- Commissionerate of Town Panchayats. 2016. Government of Tamil Nadu. <https://www.tn.gov.in/dtp/>.
- Crick HQ, Robinson RA, Appleton GF, Clark NA, Rickard AD. 2002. Investigation into the causes of the decline of starlings and house sparrows in Great Britain. *BTO Res Rep* 290: 1-305.
- Czech B, Krausman PR, Devers PK. 2000. Economic associations among causes of species endangerment in the United States: Associations among causes of species endangerment in the United States reflect the integration of economic sectors, supporting the theory and evidence that economic growth proceeds at the competitive exclusion of nonhuman species in the aggregate. *BioScience* 50 (7): 593-601. DOI: 10.1641/0006-3568(2000)050[0593:EAACOS]2.0.CO;2.
- Dhanya R. 2011. Status and Ecology of House Sparrow *Passer domesticus* along an Urban to Rural Gradient in Coimbatore India. [Dissertation]. Bharathiar University, India.
- Ghosh S, Kim KH, Bhattacharya R. 2010. A survey on house sparrow population decline at Bandel, West Bengal, India. *J Korean Earth Sci Soc* 31 (5): 448-453. DOI: 10.5467/JKESS.2010.31.5.448.
- Grinnell J. 1919. The english sparrow has arrived in death valley: An experiment in nature. *Am Nat* 53: 468-472. DOI: 10.1086/279725.
- Hanson HE, Zolik JE, Martin LB. 2020. 11 House Sparrow (*Passer domesticus* Linnaeus, 1758). *Invasive Birds: Global trends and impacts* 85. URL: <https://scholar.sun.ac.za/bitstream/handle/10019.1/121270/Downs%20bird%20book%202020%2020203560779.pdf?sequence=2#page=102>.
- Husby A, Saether BE, Jensen H, Ringsby TH. 2006. Causes and consequences of adaptive seasonal sex ratio variation in house sparrows: Adaptive seasonal sex ratio variation. *J Anim Ecol* 75 (5): 1128-1139. DOI: 10.1111/j.1365-2656.2006.01132.x.
- Khera N, Das A, Srivasatava S, Jain S. 2010. Habitat-wise distribution of the House Sparrow (*Passer domesticus*) in Delhi, India. *Urban Ecosyst* 13 (1): 147-154. DOI: 10.1007/s11252-009-0109-8.
- Mahesh V, Lanka S. 2021. Global scenario and Conservation Status of House Sparrow (*Passer domesticus*). ESN Publisher, Aruppukkottai.
- Modak BK. 2017. Impact of urbanization on house sparrow distribution: A case study from Greater Kolkata, India. *Proc Zool Soc* 70 (1): 21-27. DOI: 10.1007/s12595-015-0157-4.
- Murgui E. 2009. Seasonal patterns of habitat selection of the House Sparrow *Passer domesticus* in the urban landscape of Valencia (Spain). *J Ornithol* 150 (1): 85. DOI: 10.1007/s10336-008-0320-z.
- Päckert M, Hering J, Belkacem AA, Sun YH, Hille S, Lkhagvasuren D, Islam S, Martens J. 2021. A revised multilocus phylogeny of Old-World sparrows (Aves: Passeridae). *VZ* 71: 353-366. DOI: 10.3897/vz.71.e65952.
- Pandian M. 2021. Population, nesting, and conservation issues of house sparrow *Passer domesticus* (Linn., 1758) in Rural Arakkonam, Vellore District, Tamil Nadu, India. *J Bombay Nat Hist Soc* 118: 132501. DOI: 10.17087/jbnhs/2021/v118/132501.
- Patel FP, Dodia PP. 2021. Roosting patterns of House Sparrow *Passer domesticus* Linn., 1758 (Aves: Passeridae) in Bhavnagar, Gujarat, India. *J Threat Taxa* 13 (14): 20209-20217. DOI: 10.11609/jott.6631.13.14.20209-20217.
- Peach WJ, Vincent KE, Fowler JA, Grice PV. 2008. Reproductive success of house sparrows along an urban gradient. *Anim Conserv* 11 (6): 493-503. DOI: 10.1111/j.1469-1795.2008.00209.x.
- Rajashekhar S, Venkatesha MG. 2008. Occurrence of house sparrow, *Passer domesticus* indicus in and around Bangalore. *Curr Sci* 94 (4): 446-449.
- Rana BD, Idris MD. 1986. Population structure of the house sparrow, *Passer domesticus indicus* in western Rajasthan Desert. *Pavo* 24 (1): 91-96.
- Schrey AW, Grispo M, Awad M, Cook MB, McCOY ED, Mushinsky HR, Albayrak T, Bensch S, Burke T, Butler LK, Dor R, Fokidis HB, Jensen H, Imboma T, Kessler-Rios MM, Marzal A, Stewart IRK, Westerdahl H, Westneat DF, Zehindjiev P, Martin LB. 2011. Broad-scale latitudinal patterns of genetic diversity among native European and introduced house sparrow (*Passer domesticus*) populations: Latitudinal Genetic Variation of House Sparrows. *Mol Ecol* 20: 1133-1143. DOI: 10.1111/j.1365-294X.2011.05001.x.
- Sharma P, Binner M. 2020. The decline of population of house sparrow in India. *Intl J Agric Sci* 5: 4. DOI: 10.1111/j.1365-294X.2011.05001.x.
- Shaw LM, Chamberlain D, Evans M. 2008. The House Sparrow *Passer domesticus* in urban areas: Reviewing a possible link between post-decline distribution and human socioeconomic status. *J Ornithol* 149 (3): 293-299. DOI: 10.1007/s10336-008-0285-y.
- Summers-Smith JD. 1988. *The Sparrows: A Study of the Genus Passer*. T & AD Poyser, Staffordshire, England.
- Summers-Smith JD. 2003. The decline of the House Sparrow: A review. *Br Birds* 96 (9): 439-446.