



Study on Ecology of House Sparrow, *Passer domesticus* (Linnaeus, 1758)

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Abstract: The House Sparrow is native to all the Indian States. A non-migratory species, House Sparrows are closely tied to human activity. This sparrow is usually absent from extensive woodlands and forests and from grasslands and deserts. In the far northern parts of its range and in arid regions. House Sparrows are typically present only in the vicinity of human habitation. In agricultural areas, an average of 60 percent of its food comes from livestock feed, 36 percent from weed seeds, and 4 percent from insects. In urban areas, bird feeders provide more food for House Sparrows. House Sparrows are abundant near human habitations. In these areas they serve as an important prey base for birds of prey and they may have an impact on plant communities because they consume large quantities of seeds.

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Introduction:

The house sparrow is not only among the most commonly found bird species in urban cities, but also the most loved. It is a small brown-coloured bird, not bigger than a tennis ball, with black streaks on its back. The male and female are easily distinguishable, not in size but in coloration. The male is dark brown, with a black bib, grey chest and white cheeks, whereas the female is light brown throughout its body, with no black bib, crown or white cheeks. It is a social species, found in groups of eight to 10, chirping and chattering to communicate with each other. True to its love for urban spaces, the house sparrow is known to nest in buildings, finding crevices and holes in walls, or at best, using the bird houses and nest boxes put out by humans in their gardens. It feeds mostly on seeds, but in the breeding season, adults feed their young with insects.

House Sparrow is a small song bird, males and females can be differentiated distinctly; the male have black throat white cheeks and black Bib while the female have brown colour with eyestripe. The average size is 14-16 cms. and weight is nearly 26-32 grams. It is a small bird and beak is thick. Legs short. Chest unstreaked. Dust-bathing in new seedbeds has been a common characteristic of this bird. House sparrows have always prefer to stay near human populations. They prefer to make nests in small holes in buildings, thatched roofs and even street lamps.

The combined chirping of the occupants is very familiar. Another house sparrow feature is departure to the cornfields during August.

House sparrows are small, sexually dimorphic birds in the family Passeridae. The species is one of the most widely distributed and common birds in the world, represented by 12 different subspecies (Summers-Smith, 2009). House sparrows can be found living and breeding in climactically extreme environments from deserts in southern California to cities above the Arctic circle, where they are found almost exclusively in close proximity to human habitation (Hanson et al., 2020b). Considered anthrodependent, some populations have gone extinct locally without human presence (Ravinet et al., 2018; Summers-Smith, 1988). It is for this relationship with people that they received their species identifier *domesticus*, which derives from the Latin *domus* or 'house', from Carl Linnaeus in 1758 (Jobling, 2009; Anderson, 2006). Their ubiquity and close association with humans have undoubtedly led to their detailed study across biological and even sociological disciplines. Here, we explore the natural history of house sparrows and the contributions that these birds have made to basic biology and beyond. The scientific classification of House Sparrow is:

Domain: Eukaryota
Kingdom: Metazoa
Phylum: Chordata
Subphylum: Vertebrata

Class: Aves
 Order: Passeriformes
 Family: Ploceidae
 Genus: Passer
 Species: *Passer domesticus*

Distribution:

House sparrows are native to parts of Asia, North Africa and most of Europe, (with the exception of Italy which is occupied by the Italian sparrow *P. italiae*; Animation 1). Becoming commensal some 10,000 years ago, house sparrows are now strongly associated with habitats that have been modified by humans. However, they also continue to increase their geographic range by exploiting ongoing and accelerating anthropogenic change (Ravinet et al., 2018; Saetre et al., 2012). A reliance on humans is evident from their colonization of Northern Europe, Eastern Europe and Central Asia in the early 1800s, as agriculture spread and urbanization increased (Summers-Smith, 1963). Though still widespread, significant declines have been reported in the native range of the species since the 1970s. This topic remains contentious (Box 1), but these declines have been attributed to a multitude of factors, including infectious disease, pollution, pesticide use, predator dynamics, new building methodologies and more efficient grain harvesting and storage (Shaw et al., 2008; Summers-Smith, 2003; Singh et al., 2013; Bell et al., 2010; Dadam et al., 2019).

House sparrows are one of the most ubiquitous birds in the world (Anderson, 2006). In approximately 170 years, they colonized the globe such that they now reside in every continent except Antarctica and occupy an estimated 76,600,000 km² (Birdlife international, 2018). There have been over 250 introduction or translocation events recorded worldwide (Table 1), with the first deliberate successful introduction occurring in 1851 in New York City (Summers-Smith, 1988). Many introductions stemmed from colonial acclimatization societies purposefully releasing birds for cultural reasons or as failed attempts at biological control. More recently, introductions have been accidental. Ship-assisted dispersal (e.g., cargo ships, cruise liners) has been documented, and other types of vehicle-assisted dispersal are also likely (Sainz-Borgo et al., 2016; Schrey et al., 2014; Clergeau et al., 2004; Szent-Ivány, 1959; Summers-Smith, 1963).

Morphology:

Male house sparrows tend to be heavier and larger than females (Hanson et al., 2020b). Plumage coloration differs between the sexes. Males have gray crests and black post-ocular stripes with conspicuous

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white spots behind the eyes (Figure 1b). Male abdomens are gray whereas bills, tails, wings and body feathers are black or dark brown. Plumage in females is drabber, with crests that are dark brown and post-ocular stripes that are light brown. Females lack black head markings and have gray-brown to light brown cheeks, bills and feathers. Female plumage resembles juveniles and females from other *Passer* species so much that distinguishing them visually is often difficult (Anderson, 2006). Subspecies also differ in size, mass and male plumage (See Summers-Smith, 1988).

The most conspicuous morphological difference between male and female sparrows is the large black throat badge of males. Arguably, this badge is one of the factors that made this species a model in behavioral ecology (Sánchez-Tójar et al., 2018). Large badge size has been thought to convey an individual's propensity to win in male-male competitive interactions; the logic was that possessing information *a priori* about a competitor could save both the badge-holder and his opponents from wasted energy and risk of injury (Rohwer, 1975). Recently, however, the largest meta-analysis to date revealed that badge size is at best an unreliable signal of dominance status (Sánchez-Tójar et al., 2018). The currently favored hypothesis for badge size is that it serves some role in mate choice, as females tend to choose males with large badges, and badge size is positively correlated with male sexual behaviors (Veiga, 1996).

Importantly, many morphological characteristics also vary geographically. Most well-known through the pioneering work of Richard F Johnston and Robert K Selander, plumage color and aspects of body size (wing, tail and tarsus length, skeletal characteristics, and body mass) were found to vary within and between native and introduced populations (Selander and Johnston, 1967; Johnston and Selander, 1964; Johnston and Selander, 1971; Johnston, 1969; Johnston, 1973). Introduced populations in North America were discovered to have pale coloration in hot, arid climates, but darker coloration in cooler, humid climates (Johnston and Selander, 1964). Body size of birds also increased with latitude, and perhaps most interestingly, all of these geographic trends in biological traits arose rapidly in the introduced populations (Johnston and Selander, 1964; Selander and Johnston, 1967; Johnston and Selander, 1971).

Habitat:

This species lives in a vast array of different habitats. Some of the natural habitats that they live in include forests, meadows, grasslands, deserts, desert

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edges, woodlands, and more. The vast majority of their population lives in urban areas.

House sparrows tend to reside near villages and farmyard buildings. Their nesting and roosting sites often revolve around people and infrastructure, however they will tend to choose rural locations due to availability of food and less disturbance.

Diet and Foraging:

These birds are omnivores, and they eat a variety of plants and small animals, primarily invertebrates. Seeds make up the majority of their diet, but they also eat some insects and other invertebrates. Despite their label as an agricultural pest, these birds usually eat wasted seed, primarily those passed through the digestive system in livestock dung.

Birds in cities eat birdseed from bird feeders, and also feed on the seeds of weeds and other plants, as well as human food scraps. They forage for food by hopping along the ground.

Nestling house sparrows are fed an insect-based diet for the first three days after hatching. Later, following fledging, they favor grains, especially outside urban areas (Anderson, 2006). Adult house sparrows have a fairly opportunistic diet throughout much of the year, especially in cities and suburbs where human refuse is plentiful (Summers-Smith, 1988). One of the reasons house sparrows are so adept at exploiting diverse diets might involve plasticity in the release of digestive enzymes (Brzek et al., 2009). Behaviorally, responses to food also seem to play a role in range expansions, another reason this species has been used as a model. For example, house sparrows in the roughly 40-year-old Panama population consume unfamiliar foods more quickly than birds from a much older invasive population in New Jersey in the United States (Martin and Fitzgerald, 2005). A similar pattern is observed among Kenyan sparrows such that birds living at the expanding range edge of that colonization approach and eat novel foods more quickly than birds from the core of the population (Liebl and Martin, 2014).

A tendency to eat novel foods may benefit birds in habitats where resources are scarce or unfamiliar, but such behavior could also come with risks. Spoiled foods or exposure to novel toxins, for example, may activate the immune system (Martin and Fitzgerald, 2005). This notion is supported by the observation that populations differ quite extensively in how their immune systems are organized and what parasites they harbor throughout their lives (Kilvitis et al., 2019; Martin et al., 2015; Martin et al., 2014; Coon and Martin, 2014; Coon et al., 2014).

House Sparrows eat various kinds of seed supplemented by some insects. Rural birds tend to eat more waste seed from animal dung and seed from fields, while urban birds tend to eat more commercial birdseed and weed seed. Studies of the contents of House Sparrow stomachs in Alabama, Conn., Illinois, Iowa, Mass., Michigan, Miss., Penn., and Vermont have shown approximate amounts of seed to be 60% livestock feed (corn, wheat, oats, etc.), 18% cereals (grains from storage or from fields), 17 % weed seed, and 4% insects.

Breeding Biology:

Sparrows tend to build nests in pre-existing cavities, but they also routinely nest in roofs, eaves and walls of human-built structures (Figure 1c) as well as in densely branched trees and shrubs (Anderson, 2006; Sheldon and Griffith, 2017; Manna et al., 2017). Nests are comprised mostly of vegetation but some clay, sand, cloth and even dung may be used (Heij, 1986). In some cities, nests also contain aromatic plants or even cigarette butts that contain antiparasitic secondary compounds (Sengupta and Shrilata, 1997). Males initially choose nesting sites and subsequently advertise for mates by vocal and visual displays (Summers-Smith, 1963). However, unlike many songbirds, males exhibit aggressive, territorial behavior only in a very small area around the nest site. Females select males based on visual and vocal displays and the location of nest sites (Anderson, 2006). Once paired, males and females often remain together for the entire season or even multiple years. Pairs also commonly use the same nest site for several years (Summers-Smith, 1963), however, as is typical in most bird species, males are more likely to stay in, or habitually return to, the area around a nest site than females (Morrison et al., 2008). Both sexes defend the nest, brood the eggs and care for the young, though females put more effort into the brooding than males (Figure 1d; Anderson, 2006). Pairs are socially monogamous, however, the proportion of offspring that are fathered by an extra-pair male (extra-pair paternity) can reach 26%, particularly if food is scarce and the environment is harsh (Stewart et al., 2015). House sparrows typically begin breeding during the first year of life, but breeding success is comparatively low in younger breeders (Hatch and Westneat, 2007).

Reproductive biology has been another reason this species has been used as a model, in particular to understand the cues that influence the onset of breeding. Towards the global poles, house sparrows, like other species, rely on changes in the number of hours of daylight and temperature to ensure that breeding coincides with peak food availability (Hau, 2001). Nearer to the equator,

however, both light levels and temperature are fairly stable year-round (Hau et al., 1998), and house sparrows in this region seem to use changes in precipitation regimes to time breeding. In Panama, India and Malawi, for instance, house sparrows breed predominantly during the dry parts of the year, but in Zambia, sparrows breed both five months prior to the peak of the rains, and again when the rains are ongoing (Nhlane, 2000; Hanson et al., 2020b).

Perhaps the main reason that house sparrows have been a model organism in basic ornithology involves the variation they show in life history and associated physiological traits along gradients in their geographic range. Known as clinal variation, in house sparrows, this phenomenon has been documented for metabolic rates (Hudson and Kimzey, 1966; Kendeigh and Blem, 1974; Blem, 1973), hormone regulation (Romero et al., 2006; Breuner and Orchinik, 2001; Liebl and Martin, 2012), and immune defenses (Kilvitis et al., 2019; Martin and Fitzgerald, 2005; Martin et al., 2004). These trends are best-reflected by clinal variation in clutch size; just as in most songbirds, house sparrow clutches are small near the equator and increase pole-ward (Anderson, 2006). This pattern, which exists in both the native and non-native distribution, is intriguing because of the recency of most introductions. Such recency means that new populations would have had little time for genetic adaptation as well as being exposed to founder effects and other genetic challenges (i.e., bottlenecks) inherent to introductions (Baker, 1995; Lowther, 1977).

Conclusion:

The house sparrow has evolved with humans, known only to live in close contact with us, instead of forests. For years, it has peacefully coexisted with us in our buildings and gardens, but in the last two decades, their population is on the decline in almost every city. The reasons attributed are: rapidly changing cities are no longer a suitable habitat for the house sparrow, as the new and modern designs of infrastructure does not give any room for the sparrow to nest; pollution caused by microwave towers and pesticides; the house sparrow loses its foraging grounds (natural grasslands) as the green spaces in our cities give way to more concrete constructions. WWF-India has been involved in raising awareness about the declining population of house sparrows. Custommade nest boxes for sparrows are distributed in various states to encourage sparrow breeding. A special study was commissioned in 2007 on the status of sparrow population in Delhi.

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