House sparrow (*Passer domesticus*) nesting behaviours in a rural habitat of the western Himalayas

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Abstract - This article presents different nesting strategies of the house sparrow (*Passer domesticus*) during the 2018 breeding season in a rural area of the outer western Himalayas of Uttarakhand state, India. These observations show house sparrows breeding in a usurped nest of red-rumped swallows (*Cecropis daurica*), probably the first such record from the western part of India. The unusual use of an anthropogenic object, a shoe, as a nest site was observed. However, more generally, a preference for secondary cavity-nesting strategies associated with the traditional, concrete, and modified traditional houses was found. Behavioural strategies associated with these breeding records have also been reported in this study, showing short-term adaptation or behavioural flexibility of the house sparrow to cope with intra- and interspecific pressures in the breeding season.

Keyword: secondary cavity nesters, anthropogenic object, nest usurpation, nest-site selection, nesting behaviour.

Riassunto - Comportamenti di nidificazione del passero domestico (*Passer domesticus*) in un habitat rurale dell'Himalaya occidentale.

Questo articolo presenta diverse strategie di nidificazione del passero domestico (*Passer domesticus*) durante la stagione riproduttiva 2018 in un'area rurale dell'Himalaya occidentale esterna dello stato di Uttarakhand, in India. Queste osservazioni mostrano passeri domestici che si riproducono in un nido usurpato di rondini rossicce (*Cecropis daurica*), probabilmente il primo record di questo tipo nella parte occidentale dell'India. È stato osservato l'uso insolito di un oggetto antropico, una scarpa, come sito di nidificazione. Tuttavia, più in generale, è stata riscontrata una preferenza per le strategie di nidificazione in cavità secondarie associate alle case tradizionali, in cemento e modificate. In questo studio sono state riportate anche le strategie comportamentali associate a questi record di riproduzione, che mostrano un adattamento a breve termine o una flessibilità comportamentale del passero domestico per far fronte alle pressioni intra- e interspecifiche nella stagione riproduttiva.

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Parole chiave: nidificatori secondari in cavità, usurpazione del nido, selezione del sito di nidificazione, comportamento di nidificazione.

INTRODUCTION

House sparrows *Passer domesticus* are widespread species in rural and urban ecosystems globally. House sparrows breed mainly in the months of March to June in the northern part of India and continue in the months of September and October in central India and all year round in the southern part of India (Ali & Ripley, 1974). This species is known worldwide as a facultative cavity nester, as it prefers cavity nest sites over non-cavity sites (Cink, 1976) and indiscriminately uses cavities for nesting, as well as nest boxes and sometimes building open nests. House sparrows are also closely associated with humans and their habitations, including cowsheds, farmhouses, and rural homes (Ali, 2002; Anderson, 2006; Chamberlain *et al*., 2007); a range of other studies have established the house sparrow as an urban specialist (Crick *et al*., 2002; Siriwardena *et al*., 2002; Summers-Smith, 2003; Ghosh *et al*., 2010; Sheldon & Griffith, 2017).

The house sparrow is extremely aggressive towards other wildlife species, exhibiting behaviours such as destroying eggs and killing native birds in agricultural landscapes (Newton, 1998; Lowther & Cink, 2006) and urban areas (Jawor, 2000), including infanticide of their own nestlings (Patil & Jathar, 2008). House sparrows will also compete with native birds for resources such as roosting sites, food (Liker & Barta, 2001; Khera *et al*., 2010), and nesting sites (Anderson, 2006). They are very flexible and innovative in nest site selection, adopting a range of nesting behaviours from using open tree nests to "secondary-cavity nests" and anthropogenic structures (Indykiewicz, 1991; Anderson, 2006; Sheldon & Griffith, 2017). House sparrows have been observed to usurp nests of a wide range of species (Indykiewicz, 1991; Lindell, 1996; Anderson, 2006; Davis & Roca, 2008; Wagner, 2012; Leasure, 2013; Bailey *et al*., 2020; Ieziekel & Yosef, 2020). This article presents the first observation of house sparrow occupation of a vacant or inactive nest of red-rumped swallow *Cecropis daurica* from the western part of India, as only one observation was reported in southern India (Samson *et al*., 2017). Furthermore, this study provides evidence for the diverse nesting strategies of house spar-

rows in a rural area of the outer western Himalayas, from nesting in anthropogenic objects to different secondary cavity-nesting behaviours.

MATERIALS AND METHODS

This article describes the different nesting behaviours of house sparrows during a breeding season between 5 April 2018 and 19 April 2018 at a site in the remote rural village of Patotiya (29º43'25'' N, 79º01'8'' E, 1585 m a.s.l) in Pauri Garhwal district in the state of Uttarakhand, part of the outer western Himalayas. This rural area has 15 to 17 houses, some of which are concrete and some houses of old traditional architecture made of coursed random rubble masonry, which is commonly used to make the walls. The roofs are made of slate with support from wooden trusses. The rural households have well-developed gardens full of seasonal legume varieties and fruit trees, with adjacent cowsheds and cultivated land with Rabi and Kharif crops in different seasons. This village shares its border with civil and reserved forest areas.

House sparrow nests were located by random surveys during the peak breeding season between 5 and 19 April 2018. These surveys were limited to the rural houses, grocery stores, and adjacent crop areas, cowsheds, and nearby vegetation such as shrubs, trees, bushes, hedges, and agricultural fields. I located the nests by surveying the area on foot during the day from 09.00 h to 11.00 h and in the evening from 16.00 h to 18.00 h. Nests were identified using binoculars and digital cameras by observing behavioural cues such as male and female movements in and out of the nest, parents carrying food for nestlings, and vocalizations of nestlings.

RESULTS

Observations

First observation. On 5 April 2018 at 10.35 h in the morning, I observed both male and female house sparrows feeding their nestlings in an abandoned red-rumped swallow's nest on a modern concrete building of the Government Degree College in Patotiya (Fig. 1A and B).

Second observation. On 6 April 2018, additional nests were located about 300 m south-east of the Government Degree College building in one of the old, unused traditional houses (Fig. 2A). In the evening at 16.10 h, I found a pair nesting between cavities in the walls (Fig. 2 B and C), and about 2 to 3 other pairs nesting in the spaces between the walls and the slate roof (Fig. 2D), and on a wooden ventilator near the roof.

Third observation. Around 16.19 h in the evening on 6 April, I also found a male perched (Fig. 2E and F) near his nest, which was located in the crevices of the concrete roof of the porch of a small post office; itself a traditional house, whose front part, i.e., veranda has been modified.

Fourth observation. On 19 April, in the afternoon at 12.05 h, I found another pair of house sparrows in a cowshed with traditional stone walls covered in cement and a traditional roof made of slate tiles (Fig. 3A and B). This pair of house sparrows were either breeding (Fig. 3C) or competing for the nest site adjacent to the second observation site (Fig. 3D).

Fifth observation. On the night of 19 April, at around 20.35 h, I found a house sparrow nestling inside a shoe and another between the shoes covered by other shoe boxes (Fig. 4A and B). These were located on a 5-foot-high cement slab in a grocery store. All of these five observations are within a distance of 305 m in the village of Patotiya.

DISCUSSION AND CONCLUSIONS

The first observation shows a house sparrow pair using the abandoned nest of a red-rumped swallow, which demonstrates inter-species nest usurpation as described by Lindell (1996). Sumasgutner *et al*. (2016) provide a clearer definition that nest usurpation may be restricted to the use of inactive or abandoned nests or may involve aggressive occupation. The red-rumped swallow is a widespread resident with local and altitudinal migration in India (Grimmett *et al*., 2011) and begins

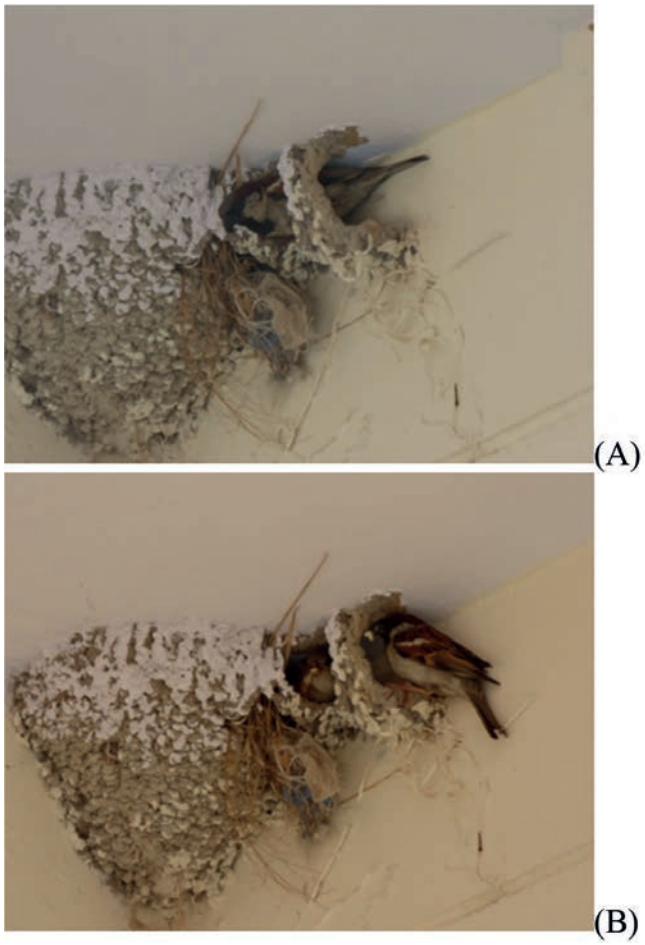

Fig. 1 – A) House sparrow male at entrance of red-rumped swallow *Cecropis daurica* usurped nest; B) male and female of house sparrow feeding their nestlings in the same swallow nest (Photo: Mohan Kukreti). / A) Maschio di passero domestico all'ingresso del nido usurpato alla rondine rossiccia *Cecropis daurica*; B) maschio e femmina di passero domestico che nutrono i loro nidiacei nello stesso nido di rondine (Foto: Mohan Kukreti).

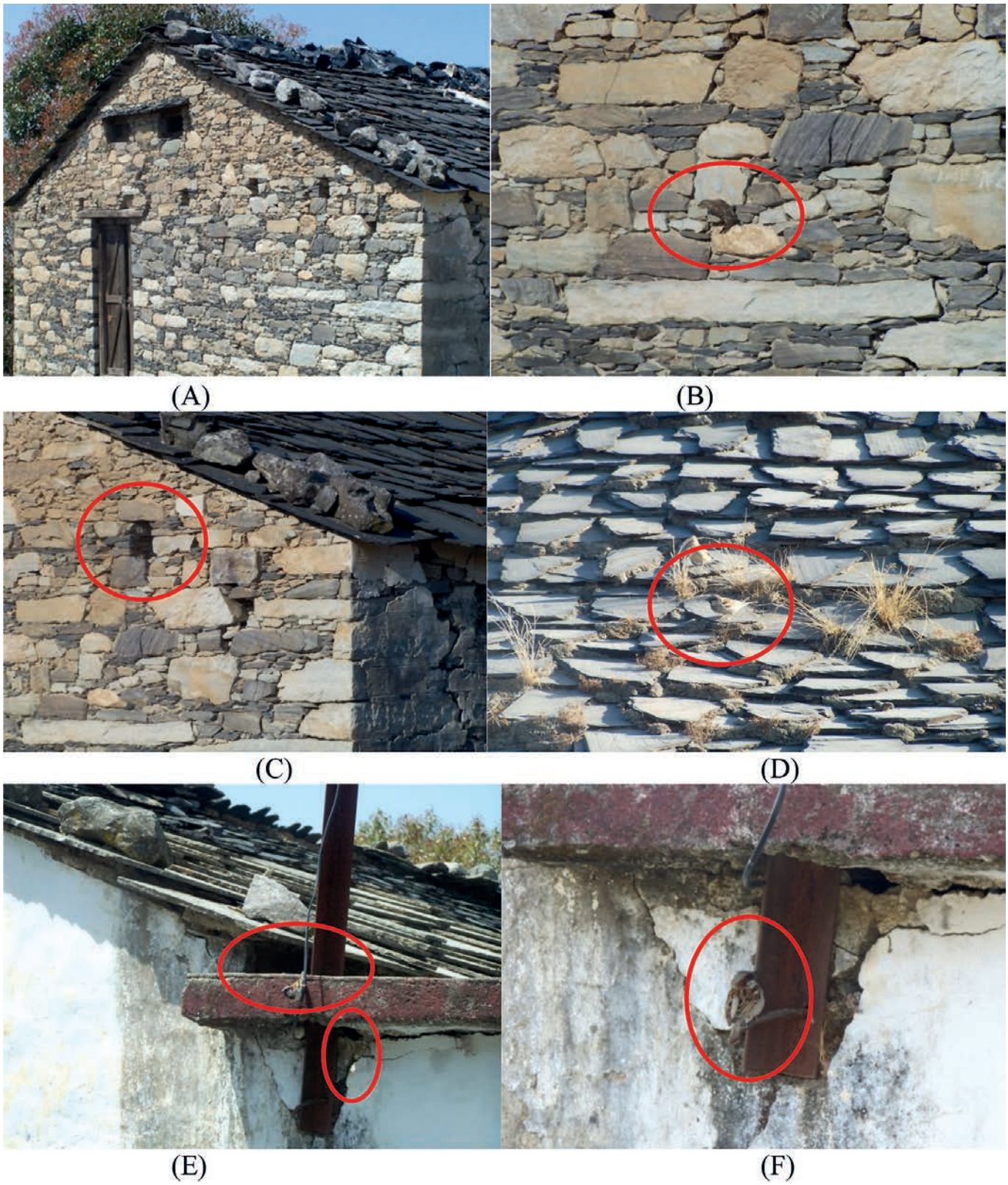

Fig. 2 – A) House sparrow nest in vacant traditional house; B,C) female and male house sparrow in the nest at the wall of same traditional house; D) house sparrow pair using crevices in the slate roof for nesting site; E) house sparrow perched on electric wire near its nest in the roof crevices; F) same male sitting in the iron clip fastener of an electric pole (Photo: Mohan Kukreti). / A) Nido di passero domestico in una casa tradizionale disabitata; B,C) femmina e maschio di passero domestico nel nido presso il muro della stessa casa tradizionale; D) coppia di passero domestico che utilizza le fessure del tetto di ardesia come sito di nidificazione; E) passero domestico appollaiato sul filo elettrico vicino al suo nido nelle fessure del tetto; F) lo stesso maschio seduto nel fermaglio di ferro di un palo elettrico (Foto: Mohan Kukreti).

breeding in the months of March/April to August/ September (Grimmett *et al*., 1998; Ali *et al*., 2002). Therefore, it is possible that the house sparrow will start using the nest before the migrant returns or aggressively defend the nest when the house sparrow starts breeding in early February; the latter is shown by the first observation (on 5 April 2018). Kalinoski (1975) suggested that house sparrows usurp nests for two reasons: either they nest in sites previously occupied by migrant species, and when migrants return, they defend the occupied nest, or they aggressively evict the occupant. This study reports that the house sparrows raise their nestlings in a protective mud nest, which protects them from strong winds, temperature drops, and occasional rain during unfavourable weather conditions and may also provide better insulation and protection from predators. The other reason for usurpation in this case may be the presence of fewer nest sites during the breeding season, which forced the house sparrow to usurp the nest of other birds (Newton, 1998; Yosef *et al*., 2016). According to Lindell (1996), because of their high reproductive success, swallow's mud nests and woodpecker's cavities are more susceptible to usurpation by other species. In another study, Indykiewicz (1991) reported that house sparrows more frequently used nests of common house martin *Delichon urbica* than those of other species, such as the white stork *Ciconia ciconia*, and were also much more common in urban/suburban areas than in rural areas. He also explained that this species has been observed using the nests of up to 14 avian species, indicating its behavioural flexibility.

Additional observations (2, 3, and 4) showed that the house sparrow breeds in different building structures, from fully modern concrete buildings (college building and grocery store) to traditional houses, which are the preferred nesting sources in rural areas. Other studies from Europe (Sziemer & Holzer, 2005) and America (Mason, 2006)

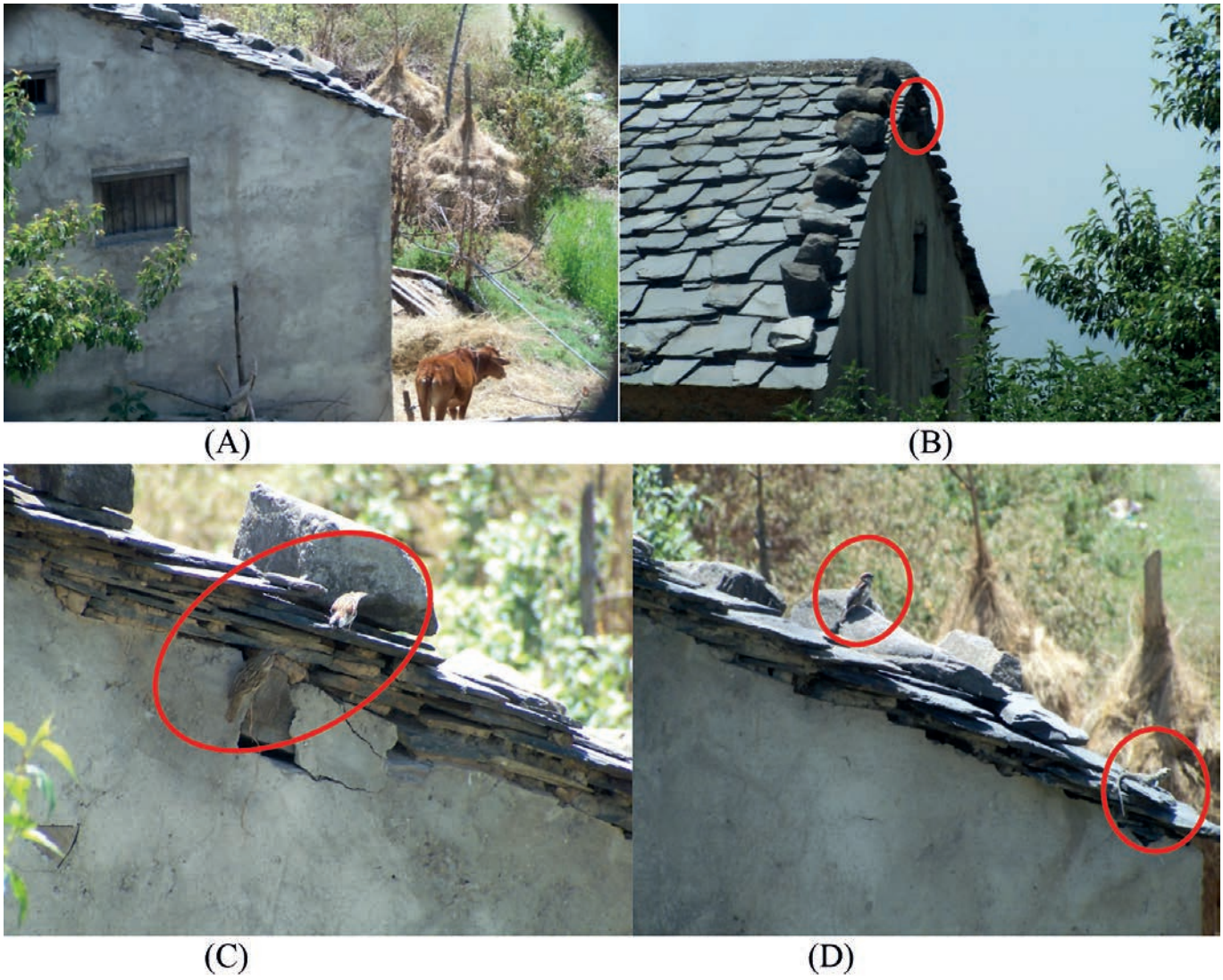

Fig. 3 – A) Showing cowshed architecture; B) house sparrow male sitting on the end of wooden truss; C) house sparrow pair with nesting material on the slate roof; D) male house sparrow defending its nest under the crevices of slate roof from Kashmir Rock Agama *Laudakia tuberculata* (Photo: Mohan Kukreti). / A) Architettura della stalla; B) maschio di passero domestico appollaiato sull'estremità della capriata di legno; C) coppia di passeri domestici con materiale per il nido sul tetto di ardesia; D) maschio di passero domestico che difende il suo nido sotto le fessure del tetto di ardesia della Kashmir Rock Agama *Laudakia tuberculata* (Foto: Mohan Kukreti).

have also shown that the house sparrow prefers damaged and old buildings or post-war houses. In India, near our site, a study by Naithani & Bhatt (2012) argued that traditional houses are responsible for the high density of house sparrows due to the increased availability of possible nest sites. However, another reason for preferring traditional houses and cowsheds for breeding may be the presence of invertebrates in cow dung heaps, which are usually found nearby in adjacent agricultural fields. Home gardens and agricultural fields, as well as stored household grain and kitchen scraps, can also provide a good source of nesting material and year-round food sources (e.g., rice and wheat seeds, fruits, vegetables, and legumes). Peach *et al*. (2018) confirmed that in urban areas, food availability, particularly invertebrates, was a limiting factor in the development and survival of house sparrow's fledglings. These observations indicate that traditional houses are the most suitable and frequently used nesting sites of this species in a rural habitat. These traditional houses should, therefore, be preserved, and new homes/buildings in the rural areas should include both modern and traditional architecture to provide more nest cavities. Shaw *et al*. (2008) argued that modern roofs are likely to provide fewer nest cavities than older poorly maintained ones, which are abundant in regions of low socioeconomic status.

In this study, house sparrows were also found to breed in shoes at a grocery store. This behaviour may be due to the presence of easily accessible foods, such as legumes, grains, and vegetables. Other studies from India similarly showed a positive relationship with grocery stores in nest site selection (Nath *et al*., 2015; Choudhary *et al*., 2020). The unusual nesting in a shoe may be due to the presence of fewer cavity nest sites due to competition or may reflect the behavioural flexibility of house sparrows in anthropogenic environments. Indykiewicz (1990 and 1991) found that this species made excessive use of sheltered sites, most of which are anthropogenic structures or objects such as the casing of streetlamps, neon signs, and sunshades because building a nest in open site required more energy than in protected places. Another possible reason for this behaviour could be environmental factors such as a shoe that provides better crevices to hold the clutch together and cushion the eggs and better insulation of eggs or fledglings from temperature changes. In passerine birds, such as great-tit *Parus major*, clutch size decreases with the shape of the nest cup (Álvarez & Barba, 2008), and nest size, mass, or lining proportion have been found to positively correlate with breeding success (Álvarez & Barba, 2008, 2011; Álvarez *et al*., 2013; Glądalski *et al*., 2016). Hilton *et al*. (2004) and Mainwaring *et al*. (2014) found that the material used in a nest not only controls thermoregulation but also cushions the eggs. In the present case, the outsole, midsole, and insole are made of polyurethane foam and covered with a cotton fabric with Rexine outer coating. This can provide insulation for eggs or fledglings from the cold and windy conditions experienced, particularly at night, in this hilly area. Also, the inner lining of the shoe and the padding of the insoles can provide good cushioning and hold the clutch together. These observations support the findings of Møller & Nielsen (2015) that birds respond locally and globally to ambient temperature by adapting and changing the size and characteristics of their nest.

These observations contribute to our understanding of short-term ecological and behavioural adaptations of house sparrows in nest-site selection in a rural environment with intra- and interspecific competition during a breeding season. Together with the results of other studies (Indykiewicz, 1991; Samson *et al*., 2017; Ieziekel & Yosef, 2020), these observations suggest an ecological preference for this species for mud nests. The present documented flexibility in nest site selection may be due to its established opportunistic secondary cavity-nesting behaviour, whether in an artificial nest box (Jayaraman *et al*., 2017; Maxmellion & Rajendran, 2021) or in or outside of natural cavities

(A) (B)

Fig. 4 – A,B) House sparrow nestlings in a nest located both in a shoe and between the shoe pair (Photo: Mohan Kukreti). / A,B) Nidiacei di passero domestico in un nido situato sia in una scarpa che tra il paio di scarpe (Foto: Mohan Kukreti).

(Pitts, 1991). However, further long-term breeding and associated behavioural studies are needed to understand the adaptive value of this behavioural flexibility in house sparrows. Nonetheless, since all of these observations were made within a distance of 305 m, perhaps reflecting their restricted home range in a rural habitat during a breeding period, further studies (Havlíček, 2021) are carried out to investigate the home range and foraging distance of house sparrows.

In summary, this study describes the diverse nesting strategies of the house sparrow in a rural mosaic and provides valuable insight into the behavioural flexibility of this species. These diverse nesting strategies may be inherently adaptive, but this requires further evaluation. Although observations were only made over one season, they suggest that house sparrows prefer more traditional cavities over modern concrete buildings, and I did not find nests in any type of vegetation, including in surrounding agricultural fields. From a conservation perspective, the traditional house architecture should be preserved and maintained in its natural form in order to conserve the natural nesting sites and cultural heritage of the rural areas.

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