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Cooperative defence of colonial breeding house martins (*Delichon urbicum*) against nest-usurping house sparrows (*Passer domesticus*)

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Abstract. The usurpation of house martin nests by house sparrows has previously been reported. However, our study demonstrates how neighbouring house martins cooperatively defended against nest-usurping attempts by house sparrows. House martins collectively helped a conspecific pair build their nest at a much faster pace than would be possible for the breeding pair alone, within several hours as compared to a couple of days, in order to overcome the continued attempts of house sparrows to usurp the partially built nest. In our study, between the two breeding seasons of 2018 and 2019, the number of breeding house martins at the study site decreased by almost 63% while in contrast the number of house sparrow breeding pairs increased almost six-fold. The number of usurped nests by house sparrows was comparatively higher in 2019 as compared to 2018.

Key words: Cyprus, colonial defence, nest construction

Introduction

Resource defence is essential to ensure the persistence of any given organism. Critical resources differ among species and their specific requirements. Nest sites can often be a limiting factor (cf. Newton 1998, Yosef et al. 2016). In some species nest defence may be limited to the breeding pair (e.g. *Passer domesticus*, Reyer et al. 1998), or it can be colonial whereby neighbouring individuals participate in defending against an intruder (e.g. *Circus pygargus*, Arroyo et al. 2001), or it can be regional and encompassing whole neighbourhoods and the nests of neighbouring conspecifics (e.g. *Corvus splendens*, Yosef R., pers. observ.).

The house martin (*Delichon urbicum*) is a common breeding species with a breeding distribution across Eurasia and Africa (Birdlife International 2012). Although it breeds on cliff faces, rocky clefts and other high places, it now largely uses human-built structures such as bridges and buildings (Turner & Rose 1989). The nest is a closed cup fixed below a suitable overhang, with a narrow opening at the top (McNeil & Clark 1977). Both parents participate in nest construction using mud pellets that they collect in their beaks from fresh-water sources (Hansell 1984). The nest is lined with soft materials like grasses, hair or feathers (but see McNeil & Clark 1977).

House sparrows occasionally use house martin nests for breeding/roosting in winter (e.g. Lind

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1962, Balát 1973, Menzel 1984, Müller 1987). The entrance of completed house martin nests is too narrow for the more robust house sparrows (Turner & Rose 1989). However, house sparrow have learnt that if they disrupt the building of a nest by house martins when the cup has been completed, but before it is closed off completely, they can nest in it (McNeil & Clark 1977). This outcome can be achieved by attacking and driving away a house martin pair when they are in the advanced stages of building their nest (Rendell 1945, Lind 1962, Balát 1973).

In March 2018 we observed on two separate occasions in Panagia Village, Cyprus, house sparrows that attempted to usurp the nests of house martins while the latter were building their nest. However, the ensuing response of the house martin pair and other conspecifics in the area appeared to be a form of communal defence that involved completion of building of the nest in just an hour. These observations were unusual in that previous studies have shown that house martins may take between 12-14 days to complete nest building (cf. McNeil & Clark 1977).

Material and Methods

Both observations occurred at the 2nd-floor office of SI in the building of the Panagia Forest Station (34.921820° N, 32.632123° E) in March 2018. Colonies of house martins nest regularly outside these windows and under the eaves of the office building. We observed a pair of house sparrow attempting to prevent the continued building of a nest by one of the house martin pairs and the almost immediate reaction of the conspecifics of the colony.

Fig. 1. Male house sparrow (*Passer domesticus*) attempting to usurp the partly-constructed nest of a house martin (*Delichon urbicum*). Note the wet mud on which the sparrow is perched. The colour of the mud at the base of the nest suggests that it is from a previous season.

Fig. 2. A colony of house martins in which house sparrows have succeeded in appropriating nests at the 'cup' stage and successfully laid their own eggs in them (arrows). Completed and occupied house martin nests are evident around these usurped nests.

Upon continued attempts by the house sparrows to take over the partially built nest (Fig. 1), we observed a shift in the behaviour of the house martins. Observations were recorded on a cellular phone as photos and short video-clips.

Results

We observed two instances wherein a pair of house martins brought mud to the nest in their beaks and intermittently one of them sat inside, we assume, shaping it while still wet. However, when the nest was half built and in the shape of an open cup, a pair of house sparrows tried to usurp the partially built nest by attacking the house martin pair and entering the nest (Fig. 1).

Within a few minutes of harassment by sparrows, the neighbouring conspecifics, who were also building nests in the vicinity of the attacked pair, were observed to help complete the nest in a cooperative manner, in a short time (less than an hour). In addition, the nest structure was also physically guarded from the inside. However, since we were unable to determine the identity of the breeding pair from that of the conspecifics, we are uncertain as to which individuals performed guarding from inside the nest. Usually when a pair is building the nest, one of them infrequently sits inside to shape and contour the wet material using their body. When attempts were made by sparrows to usurp the partially built cup, we observed both individuals present in the nest thereby preventing the sparrows from entering it. They would only change places with conspecifics. At the same site, we observed the attempts of undisturbed pairs (N = 13) and noted that it would take up to two days to complete nest building to a similar stage. In comparison, in the two instances on which we observed, and partially filmed, these interactions, the nests were completed within 40 minutes. Although the observed birds were not ringed for individual identification, we succeeded in identifying that in addition to the breeding pair, seven and nine conspecifics participated in the events in which the sparrows were repelled and nest building quickly completed. In comparison, McNeil & Clark (1977) reported that it took 12-14 days for a house martin pair to complete the building of their nest.

Subsequently we looked at other colonies in Panagia on four buildings (Forest Station, church, Community Office, coffee shop), and were able to discern the house martin nests in a colony and those that were usurped by sparrows for breeding (Fig. 2). Although unable to identify old from new nests in these other colonies, we found that out of a total of 1637 house martin nests in three separate colonies, there were a total of 22 (1.3%) house sparrow usurped nests that had the characteristic open cup (Fig. 2). In a survey conducted in spring 2019 in the same colonies, we found 601 occupied nests. Of these, 478 were by house martins that successfully fledged young, however, the number of nests destroyed or occupied by house sparrows had increased to 123 (20.5%).

Discussion

Most reproductive studies evaluate breeding success based on either clutch size or fledging success (e.g. Halfwerk et al. 2011). However, few studies show how detrimental the initial stages of nest building can be to a colony if another species learns to usurp the nests thereby dissuading or preventing the host species from nesting (cf. Yosef et al. 2016). This effect is especially critical at the nest-building stage when the breeding pair has the option to move to an alternate site. Although this alternative may have a lower energetic cost in comparison to the later stages of the breeding cycle, the breeding pair incurs a temporal cost in the form of loss of time invested up to that stage of the breeding season. Nest usurpation also disrupts the species-coherence of a colony, which could be of importance in a gregarious species. House martins have also been shown to be sensitive to human attention (Wojciechowski & Yosef 2011).

In our study, between the two breeding seasons of 2018 and 2019, the number of breeding house martins at the four study sites decreased by almost 63%. Over the same period the number of house sparrow breeding pairs increased almost six-fold. This finding corresponds with Lind (1962) who claimed that house sparrows caused the majority of nest losses by house martins in Finland. Further, Schuster et al. (1983) reported that 5.7% of house martin nests were typically occupied by house sparrows, but in 1975 this increased to ca. 13% following a bad year for hirundine species. Müller (1987) and Piskorska (1992) reported that as many as 40% of house martin nests were taken over by house sparrows. Additional studies have also shown sparrows usurping house martins in order to breed in an otherwise inaccessible habitat (Indykiewicz 1991), and is reported from several countries (cf. Czech Republic – Balát 1973, Bulgaria – Nankinov 1984, Turkey – Sahin 1996, Poland – Ptaszyk 2001). Our results are similar to those of Yosef et al. (2016) who demonstrated how the invasive rose-ringed parakeet (*Psittacula krameri*) negatively affected the breeding of indigenous Eurasian hoopoe (*Upupa epops*) by temporal and physical challenges. The parakeets started breeding before the hoopoe population, such that all cavities from previous years were occupied by parakeets, or by parakeets evicting breeding pairs of hoopoes from cavities. Unfortunately, no previous studies of house martins losing nests to house sparrows reported the rate of usurpation or nest occupation by house sparrows in subsequent years. These data would allow us to infer the longer-term effects of this behaviour on house martin colonies. It has been observed that this phenomenon of nest-usurpation by house sparrows has forced house martins to change the location of their nests from external to internal walls of human habitations (Balát 1973, Tryjanowski & Kuczynski 1999); which was attributed to an evolving synanthropy between the two species. The same has also been reported by Weber (1973) and Maréchal (1986).

Also of note is the change in nest building behaviour by house martins in response to an attempted nest appropriation by house sparrows. McNeil & Clark (1977) found that the shape of each mouthful of mud resembled an oblate spheroid with an average volume of about 210 mm^3. They further established that the wall of the nest varied from four mouthfuls thick at the base, to two mouthfuls at the top and was estimated to contain 540,000 mm^3 of mud, representing approximately 2575 mouthfuls. However, in cases where sparrows displaced house martins, eliminating their eggs and young, the house martins constructed a thin-walled replacement nest, built in about one day. In our study this appears to have developed into a colonial strategy wherein while the breeding pair fends off the sparrows, they are assisted by neighbouring conspecifics. These conspecifics complete a nest that is thin-walled but has an entrance that is too small for house sparrows to enter. McNeil & Clark (1977) found that replacement nests were only one mouthful thick and the volume of mud used only about half that in a normal nest. It will be of interest in future studies to measure nest wall thickness, and its consequences, to further understand the cost to house martins of rapid nest completion in response to house sparrows. Hansell (1984) described house martin nest building in detail, from the collection of mud to applying it at the nest. He found that house martins first collect mud from the edges of the pond, and then scoop softer mud onto the top of the beak. At the nest the bird presses the mud onto the nest rim and agitates it with a vibrating movement such that the soft mud comes into contact with the nest rim first and forms a weld between the nest and the newly added dry mud. Hansell (1984) believed that the rapid vibration takes advantage of the thixotropic properties of the mud which results in it becoming temporarily liquid on agitation.

The apparently altruistic behaviour of neighbouring house martins to conspecifics facing the threat of nest usurpation requires explanation. The adaptive value of this behaviour is not evident, but we assume that it represents a form of evolved communal defensive behaviour in house martins. For colonies to remain cohesive, it may be adaptive for the entire colony to prevent invaders from successfully establishing. Future studies should clarify genetic relatedness among neighbouring conspecifics to establish whether co-operating individuals are closely related. The situation wherein avian young of previous broods or seasons help their parents in subsequent breeding attempts is well recognised (Fry 1977). Turner & Rose (1989) showed that male house martins display greater levels of nest and location fidelity than females.

The phenomenon described in this study was reported by Konstantinou (2015) for Cyprus, who noted that house sparrows frequently attempt to take over house martin nests during construction, with house martins rebuilding elsewhere if sparrows were successful. Our study is the first to demonstrate how neighbouring house martins can cooperatively defend against house sparrows by assisting conspecific pairs in building their nest at a faster rate than would be possible for the breeding pair alone. Future studies should focus on social inter- and intra-specific interactions, specifically (1) how colonial defence has evolved in this population of house martins; (2) whether this behaviour occurs in other colonies of house martins; (3) whether house martins express site-specific strategies to overcome nest usurpers; (4) whether house martin breeding success is affected by rapidly-built thin-walled nests; (5) whether ‘altruistic’ conspecifics are related to the affected pair.

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