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Short research contribution

Piotr SKÓRKA<sup>1\*</sup>, Magdalena LENDA<sup>2</sup>, Janusz SKÓRKA<sup>3</sup>

<sup>1</sup> Institute of Nature Conservation, Polish Academy of Sciences, Mickiewicza 33, 31-120 Kraków, Poland, \*e-mail: skorka@iop.krakow.pl (corresponding author)

<sup>2</sup> Institute of Environmental Sciences, Jagiellonian University, Gronostajowa 7, 30-387 Kraków, Poland, e-mail: lenda.m@vp.pl

<sup>3</sup>33-150 Wola Rzędzińska 530, Poland

## SUPERMARKETS – A WINTERING HABITAT FOR HOUSE SPARROW *PASSER DOMESTICUS* L.

**ABSTRACT:** Animals often co-exist with humans inside buildings, however in birds such cases are only sporadically noted. In this paper we describe the occurrence of House Sparrows in supermarket interiors. The probability of House Sparrows presence was higher in larger markets and during winter period. The abundance and density of birds were positively and negatively related to the size of the supermarket, respectively. The birds were active at night. They foraged mainly along market shelves on bakery products, vegetables and cereals. We did not observe nesting inside market halls. The supermarkets seem to be hospitable wintering place for this species, however they may also be ecological traps imprisoning the birds once they find their way in. Moreover, House Sparrows may contaminate food, thus, the presence of such species inside supermarkets should be controlled.

**KEY WORDS:** Passerines, pest, wintering, feeding behaviour

Many organisms occur alongside people and utilize human resources and products. Most such instances are known for insects (Ross 1994, Arbogast *et al.* 2000). Also vertebrates, primarily small mammals may occur with humans in their buildings. In birds, many species inhabit man-made habitats.

The best-known examples of bird species which are closely associated with humans are the Feral Pigeon *Columba livia*, House Martin *Delichon urbica*, Barn Swallow *Hirundo rustica*, House Sparrows *Passer domesticus* and other species inhabiting urban areas (e.g. Tryjanowski and Kuczyński 1999, Hetmański 2007, Zieliński 2006, Riegert *et al.* 2007). However, the occurrence of these birds inside buildings is very rare.

In this study we describe the inhabiting of the interior of supermarkets by House Sparrows. This species is one of the most common passerine occurring in urban areas. The House Sparrow nests in crevices in buildings, nest boxes or nests of other species. Recently, the decline of this species in many European towns has been noted (Summers-Smith 2000, Siriwardena *et al.* 2002, Böhner *et al.* 2003). We were interested in factors affecting the presence, abundance and density of this species inside the halls of supermarkets, the resource use and behaviour of this species in such an unusual habitat.

We made observations in winter 2005/2006 (from the beginning of December 2005 to the end January 2006) and spring/summer 2006 (from the beginning of April to the end of June 2006). We chose a total of 28

various supermarkets (Table 1) in two towns in southern Poland: Kraków (756 000 inhabitants) and Tarnów (117 000 inhabitants). We performed five visits in winter as well as five visits in spring/summer in each supermarket. Each visit lasted 30 minutes. At least one visit was after dark (at least 1 hour after sunset). We noted the presence of birds, their number and behaviour.

Only parts of the supermarkets available for customers were controlled as we did not have permission to conduct the observations in other parts of the shops. Two persons took part in the bird surveys and observations of the bird behaviour. One observer counted birds and recorded the behaviour, the second noted down the observations in the protocol. The observers slowly moved in zig-zag way through the market hall during the surveys. The birds occupied certain parts of the supermarket and spent most of time there, thus we believe that we did not count the same individuals twice. Moreover, we suppose that some birds could not be noticed as they spent most of time among air ducts in the upper parts of the market hall that made the counting difficult. Also, the noise in the market prevented detection the birds aurally sometimes. Therefore, the bird numbers presented in this paper are probably lowered.

The behaviour of birds was also noted during occasional visits beside those spared for noting the presence of birds. We selected randomly individuals and observed them as long as possible (observation time: mean value  $307 \pm 19$  s, range: 134–492 s,  $n = 35$  birds). We noted the number of calls in time unit and food types eaten by birds as well as other behaviours like copulations, aggressive interactions etc. (the latter were rarely observed thus we did not consider them in the analyses).

We tested if the area of the supermarket, number of doorways and percentage of the area in 1-km radius from the shop covered by built up areas affected the probability of House Sparrow presence (when at least one

bird was noted), abundance (mean number of birds in the given supermarket per visit) and density (mean number of birds in the given supermarket per unit area). The percentage cover of built up areas within 1-km radius from the supermarket was received by digitalizing aerial photographs in the AutoCad software. Generalized linear mixed model with logit link function (GLMM) was used to test the effects of the explanatory variables on the probability of bird presence in the supermarkets during winter and spring/summer periods. All independent variables in the model had the tolerance values higher than 0.8, thus there was no problem with multicollinearity.

The effects of the explanatory variables on the abundance and density of birds per visit were tested with the correlation analysis due to small sample size. This analysis was done only to the winter period due to the small number of supermarkets with birds during the breeding period. General linear model (GLM) was used to test if the vocal activity of birds differ between day and night, winter and spring/summer. Three parts of the day were established: morning (from sunrise until noon), afternoon (from noon until sunset) and night (between sunset and sunrise). The variable “city” was assigned as a random effect in every models and the variable “supermarket ID” was assigned as an additional random factor in the GLM. We used the  $\chi^2$  test to check if the proportion of supermarkets occupied by birds differ between winter and spring/summer.

The proportion of occupied supermarkets was higher in winter than in summer ( $\chi^2 = 4.46$ ,  $P = 0.04$ , Fig. 1A). Moreover, the probability of House Sparrow occurrence was higher in larger shops during the winter (Table 2). Number of indoors and percentage of built up areas in the 1-km radius from the supermarket did not influence the presence of birds in supermarkets during winter (Table 2). None of the explanatory variables

Table 1. Characteristics of the studied supermarkets.

Characteristic	Mean (SD)	Range
Area (ha)	0.86 (0.84)	0.04–2.86
Number of indoors	4.1 (1.4)	2–8
% of built up areas in 1-km radius from the shop	87 (12)	51–100

affected significantly the presence of birds during spring/summer period in supermarkets (the effect of patch area was marginally insignificant, Table 2). The mean ( $\pm$  SE) number of birds per visit within the supermarket was 2.7 ( $\pm$  0.4), range: 0.4–5.0 ( $n = 11$ ) and was positively correlated with its area during winter (Table 3; Fig. 1B) but not affected by the number of doorways and the percentage of area within 1-km radius from the colony covered by the built up areas (Table 3). The mean  $\pm$  S.E. density of birds (number of individuals per 1 ha of supermarket) during winter was  $2.3 \pm 0.5$ , range: 0.6–6.7 ( $n = 11$ ). The density was negatively correlated with area of the supermarkets (Fig. 1C) but was not correlated with other variables (Table 3). In spring/summer we noted birds only in four supermarkets, thus such analyses was prevented.

House Sparrows were usually present in upper parts of the market hall (90 % of observations,  $n = 132$  observations). Birds gathered mostly in places where food was on display (82% of observations,  $n = 132$ ). Foraging behaviour was rarely observed ( $n = 43$  observations). Birds flew down, captured food items and returned back to the upper parts of market hall. Restaurants were the other places where birds foraged within the market hall. Birds foraged mainly on baked goods, vegetables and cereals (Fig. 2). Interestingly, birds were active all night and often foraged then.

Vocal activity was the highest in the morning (GLM  $F_{2, 27.9} = 4.23$ ,  $P = 0.02$ ; Fig. 3). During the night and afternoon the vocal activity was similar (Fig. 3). Surprisingly, we did not find significant differences in vocal activity between winter and spring/summer (GLM  $F_{1, 12.9} = 0.21$ , n.s.). In two cases we also observed copulation but we never recorded nesting within the market hall.

We noted the regular occurrence of House Sparrows inside supermarket halls, mostly during winter. Sparrows occurred most often in large shopping centers. Sparrows were also more abundant there. This is probably linked with a larger food supply and probably with the greater amount of shelter. Moreover, large supermarkets are often open round-the-clock and birds have the opportunity to forage with little human disturbance. However, the density of birds was lower in larger shops. Large supermarkets are probably more heterogeneous as habitats because there are many parts without resources for birds (e.g. parts with household equipment or clothes), whereas small supermarkets contain mostly foodstuffs. It is also possible, that negative relationship between supermarket area and bird density is an artifact resulting from difficulties in counting all birds in large shops.

It is unknown how birds get inside the building. They could fly indoors through the main entrance of the supermarkets as well as

Table 2. Factors affecting presence of House Sparrows in the supermarkets during winter and spring/summer. Results of the GLMM ( $n = 28$  supermarkets).

Variable	beta (SE)	df	F	P
Winter				
Area (ha)	1.60 (0.72)	1, 23.0	6.21	0.02
Number of indoors	-0.65 (0.58)	1, 24.0	2.20	0.15
% of built up areas in 1-km radius from the shop	-0.08 (0.06)	1, 23.3	2.67	0.12
Spring/summer				
Area (ha)	0.89 (0.48)	1, 24.0	3.91	0.06
Number of indoors	-0.06 (0.51)	1, 24.0	1.01	0.33
% of built up areas in 1-km radius from the shop	-0.08 (0.09)	1, 24.0	2.77	0.11

Table 3. Pearson correlation coefficients between the characteristics of the supermarkets and abundance as well as density of the House Sparrows during winter ( $n = 11$  supermarkets).

Variable	Abundance		Density (ind. ha <sup>-1</sup> )	
	r	P	r	P
Area (ha)	0.67	0.02	-0.69	0.02
Number of indoors	0.49	0.13	-0.05	0.12
% of built up areas in 1-km radius from the shop	0.10	0.76	0.35	0.30

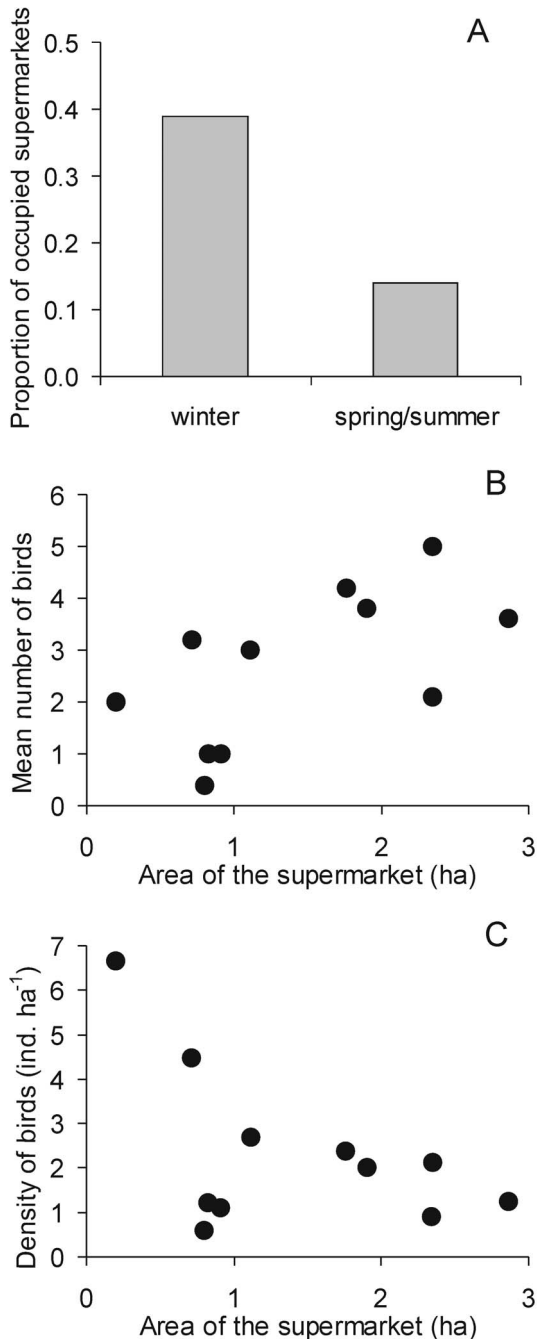


Fig. 1. Proportion of occupied supermarkets during winter and summer (A); relationship between supermarkets' area and mean abundance (B) and density (C) of the House Sparrow during winter ( $N = 11$  supermarkets).

through doorways where products are delivered to the store-room. Both entrances are frequently opened and birds often forage in front of them. Birds could also get inside the

market hall through the air ducts. The probability of presence, abundance and density of birds inside the supermarket did not depend on proportion of built up areas in the vicinity of the shops that suggests the habitat type surrounding the supermarkets is of lower importance. However, supermarkets are built usually in the vicinity of human settlements, thus the variability in the cover of built up areas around the shops was rather low.

The empirical and theoretical study clearly indicate that that colonization of potential habitat patches is often density-dependent (e.g. Hanski 1999, Doligez *et al.* 2004, Hambäck and Englund 2005). Thus, one may expect that density of bird in the areas around the supermarkets may be the key factor influencing the occurrence of House Sparrow inside the buildings. Although we did not examine this factor, the published data (Walasz and Mielczarek 1992, Walasz 2000) and our unpublished observations indicate that density of House Sparrow in built up areas is much higher than inside the supermarkets. For example, during winter mean  $\pm$  S.E. densities of House Sparrow were  $10.1 \pm 1.2$  birds per 1 ha ( $n = 7$  plots) while in spring were  $15.6 \pm 1.6$  per 1 ha ( $n = 5$ ). Our anecdotic observations also indicate that House Sparrow occurred in high number within the vicinity of all the studied supermarkets. The above hypothesis should be tested in the future study.

Surprisingly, birds were active at night, which was behaviour never observed outside the building at the same time. It is an interesting change of diurnal rhythm and indicates high behavioural plasticity in this species. Other studies showed that changes in diurnal rhythm activity of urban birds is influenced mostly by human disturbance (Ditchkoff *et al.* 2006) and most of species (mainly predators) shift into nocturnal activity (Ditchkoff *et al.* 2006, Riley *et al.* 2003, Rejt 2004). Also, the urban environment may influence evolutionary changes in singing activity and other components of bird behaviour (Rejt 2004, Slabbekoorn and Boer-Visser 2006, Liker *et al.* 2008). The increased activity of House Sparrows in supermarkets during night hours results probably from artificial lighting and lower human disturbance at this time. During the night

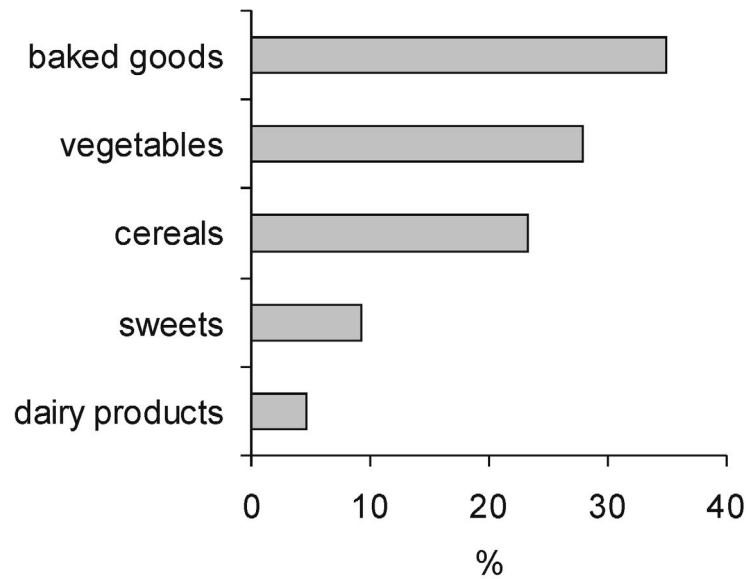


Fig. 2. Food composition of the House Sparrows occurring inside the supermarkets (N = 43 observations).

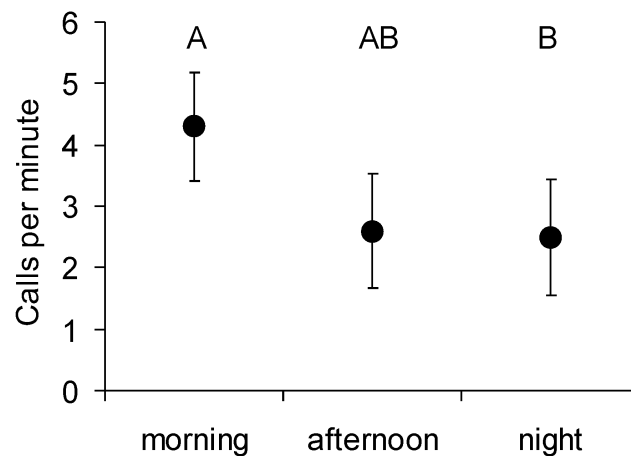


Fig. 3. Effect of part of a day on vocalization activity in the House Sparrow inside supermarkets. Means with 95% confidence intervals are shown. Levels not connected by same letter are significantly different (as indicated by Tukey's post-hoc test at  $\alpha = 0.05$ ). Sample sizes were 13, 11 and 11 birds for morning, afternoon and night, respectively.

hours food resources are also easily accessible for House Sparrows due to lower number of people in supermarkets.

Supermarkets seem to be hospitable wintering places for Sparrows. They provide calm shelter on cold winter days, and also protect them against predators, besides providing a considerably food supply. However, supermarkets may also acts as ecological traps. Birds probably get inside market

halls accidentally, and it is possible they have difficulty in getting back outside the supermarket. On the other hand, the proportion of occupied supermarkets decreased during summer indicating that Sparrows manage to get outside during the breeding period. Anyway, it is surprising that such a hospitable habitat during winter is utilized by birds during summer in a lesser degree. We did not observe nesting in the market hall, but birds

often nest in crevices in outside walls of the supermarkets and forage on green areas or gather food at open-air fast-food facilities. It is probable, that during breeding season birds change their diet, e.g. the Sparrows may frequently hunt insects during spring/summer and this resource may be in low supply inside the market hall. The lack of nesting material may cause the birds to leave the buildings as well. Finally, it is also possible the owners of the supermarkets try to remove birds that get indoor during winter, and in a result their number and presence are lower during nesting period.

House Sparrows damage food in supermarkets and plants by pecking seeds, vegetables, fruits and flowers. They consume water and contaminate or deface buildings, facilities with their droppings. They can also transmit many diseases and parasites to humans (Box 1981, Morishita *et al.* 1999, Haag-Wackernagel and Spiewak 2004). This requires control of this species in such places. Several methods may be applied including repelling, lethal control (used occasionally in some countries), or trapping. We believe the best practice is to prevent possibilities of the birds getting inside the buildings by placing nets in roof ventilations. If birds get inside the market hall, the best way should be trapping them in nets baited with food, and then releasing them outside the building. In only two out of 28 studied markets was that solution to the problem noted.

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