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SHORT COMMUNICATION

House sparrows benefit from the conservation of white storks

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Abstract As with many farmland bird species, the house sparrow *Passer domesticus* is declining in Europe, mainly due to intensification of agriculture reducing nest sites and food supplies. During 2002–2005, we studied the population size and nest site characteristics of house sparrows breeding within white stork *Ciconia ciconia* nests in a large area of agricultural landscape within western Poland. To explain sparrow density within stork nests, we examined characteristics of white stork nests (position, age, productivity) and the farm type around the nest. House sparrow density was greatest in the longest established (and hence larger) white stork nests located on traditionally managed farms. Two recent changes appear to have adverse effects on house sparrows. The first is the intensification of farming and the second is active management of white stork nests on electric poles to reduce nest size and thus avoid both disruption to the electrical supply and electrocution of white storks. Because the white stork has such a high profile in Poland, there are numerous schemes to conserve and enhance this species. In conclusion, we clearly show that protecting one species can have valuable, although unplanned, benefits to another species of conservation interest, the house sparrow.

Keywords House sparrow · White stork · Conservation

Introduction

The house sparrow is very flexible in its choice of nest sites. It may build nests in the crowns of trees, in nest boxes and may evict other bird species from their nests (Summers-Smith 1963; Kulczycki and Mazur-Gierasińska 1968; Saumel 1969; Indykiewicz 1991; Tryjanowski and Kuczyński 1999). However, the majority of nests are established on or within buildings. Recent changes in farm structure, including increased farmyard cleanliness, a reduction in animals housed outdoors and renovations of farm buildings, have negatively affected the house sparrow population. In general, modern farm cleanliness has had a negative influence on food resources, and changes in building design have reduced nesting opportunities for house sparrows. In consequence, house sparrow populations have declined throughout Europe over the last two to three decades (Mitschke et al. 2000; Hole et al. 2002; Summers-Smith 2003; Robinson et al. 2005).

Potential house sparrow nest sites outside of buildings have therefore become more important. Among these are white stork nests, which are used relatively often for nesting by house sparrows (Kulczycki and Mazur-Gierasińska 1968; Indykiewicz 1998; Bocheński 2005). White storks build large nests, which are repaired and extended each year. They can reach considerable dimensions with time (e.g. up to 2 m in height and 1.5 m in diameter, Indykiewicz 1998; Tryjanowski et al. 2005), and house sparrows can nest mutually in the sides of the white stork nest. White storks are

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an emblematic species in Poland and receive considerable attention to preserve and enhance their population; Poland is thought to support 25% of the world population of this species (Schulz 1998).

In this paper we focus on the factors affecting the number of house sparrows nesting within white stork nests. We particularly take into account the age of the white stork nest, as we predict that older, and therefore bigger, nests should support a greater number of sparrows. In addition, we examined whether site productivity (measured as stork chick production), the surrounding farm practice (traditional or intensive) and the structure of the nest (on electricity pole, roof or tall chimney) influenced number of house sparrows in white stork nests.

Materials and methods

The study was conducted during 2002–2005, in the agricultural landscape of western Poland, near Leszno (51°51′N, 16°35′E). In this area of 810 km^2, arable fields are interspersed with meadows, pasture, human settlements and small woods (for details, see Kuźniak 1994). The white stork builds nests mainly on roofs of buildings, chimneys, trees and electricity poles. During recent years, the number of nests located on poles has increased rapidly (Kuźniak 1994).

Each white stork nest in the study area was visited four times between late March and mid July in each breeding season, 2002–2005, to record breeding house sparrows. Because the maximum number of house sparrows occurred between late April and mid-May, we used data from that period to estimate the number of breeding pairs of house sparrow in each white stork nest.

A total of 48 white stork nests were under observation. During the study, other bird species were also occasionally recorded nesting in white stork nests (1–4 breeding pairs per year in total). These were tree sparrow *Passer montanus*, pied wagtail *Motacilla alba*, wood pigeon *Columba palumbus* and starling *Sturnus vulgaris*. However, number of these species was too small for analysis.

White stork nests were recorded on three types of structures (electricity pole 34 nests, roof 3 nests or tall chimney 11 nests). Information on the age of white stork nests (in years) was obtained from S. Kuźniak who has studied the local white stork population since 1973 (Kuźniak 1994). Because direct access to measure white stork nests is sometimes problematical, due to their height and dangerous location, it is not always possible to measure nest dimensions. Therefore, we used nest age as proxy of nest size (see also Tryjanowski et al. 2005), which we found were strongly positively correlated (r=0.742, p=0.002, n=16 nests measured in 2004 and 2005; nest size expressed as diameter × height; nest age expressed in years). The number of white stork chicks produced by each nest in each year was noted.

Farms were coded to two different types of management, intensive (a modern farm with very clean farmyards, mainly covered by concrete or asphalt, with no poultry or other animals foraging in the yards) or traditional (with smaller yards, open ground often with short vegetation cover, with animals [mainly poultry, goats, occasionally pigs] foraging in the yard).

Because nests recorded in different years cannot be considered to be independent, we have taken averages across the four study years before analysis using an ANOVA incorporating categorical and continuous variables. As not all nests were recorded in each year, we have used the number of years each nest was recorded (mean 3.3, SE 0.1) as a weighting factor, thus giving more influence to the nests recorded in all 4 years. For the 48 white stork nests, we have analysed the mean number of house sparrow pairs in relation to the mean age of the nest, the mean number of white stork chicks produced, the farm type (as a categorical variable) and the structure on which the nest was built (also as a categorical variable). Effects were eliminated in a backwards elimination model until all remaining terms were statistically significant (p<0.05). Residuals from the final model were checked for normality. All statistical analyses were applied according to the recommendations of Sokal and Rohlf (1995) and were conducted using Minitab v.13.

Results

Frequency of occupation of white stork nests

In the study years, between 71 and 90% of white stork nests were occupied by house sparrows, and the proportion of occupied nests did not differ significantly between years (G-test, $G_{(3)}$=1.71, p=0.2).

Factors affecting number of house sparrows

The number of breeding pairs of house sparrow in white stork nests ranged between 0 and 12 (mean 1.9, SE 0.2). The backwards elimination model left just two factors influencing the number of house sparrow pairs. These were the age of the white stork nest ($F_{1,45}$=10.92, p=0.002; Fig. 1) and the type of farm ($F_{1,45}$=15.76, p<0.001; Fig. 2). On expansion of this model to include an interaction term, the increase in number of house sparrow pairs with increasing stork nest age was significantly greater on traditional farms ($F_{1,44}$=4.24, p=0.045; Fig. 1). White stork nests on intensive farms supported an average of 1.3±

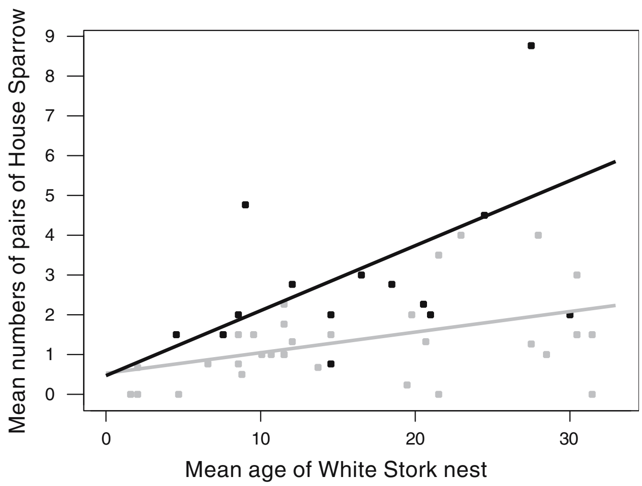

Fig. 1 Relationship between the mean age (in years) of white stork nests and the mean number of pairs of house sparrows. *Grey regression line and symbols* represent intensive farms, *black regression line and symbols* represent traditional farms. Weighted regression equations intensive farms: $y = 0.55 + 0.052(\pm 0.018)x$, $p=0.008$; traditional farms: $y = 0.48 + 0.162(\pm 0.070)x$, $p=0.040$

0.2 pairs of house sparrows, whereas those on traditional farms supported an average of 2.9±0.5 pairs. Mean white stork chick number was not influenced by farm type (intensive farm 1.5±0.2, traditional farm 1.5±0.3, two sample *t*-test $t_{46}=0.14$, $p=0.89$) or correlated with numbers of house sparrow pairs ($r_{47}=0.06$, $p=0.69$).

Discussion

In this study, we found that white stork nests are often (average 82%) used for nesting by house sparrows. This is higher than the proportion mentioned in earlier studies

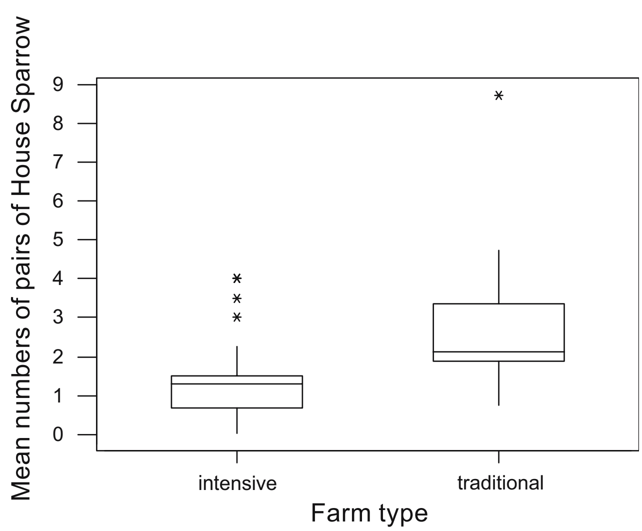

Fig. 2 *Box and whisker plot* showing differences in mean numbers of breeding pairs of house sparrow in relation to the farm type where the white stork nest was located

focussing on this subject (40 and 51%, respectively, in Bocheński 2005 and Indykiewicz 1998). One reason for the lower occupancy stated by these earlier authors is that they counted sparrows just once, in April and July, respectively, whereas we counted house sparrows over the whole season, including the peak of their breeding activity.

House sparrows choose white stork nests for nesting because they offer a good nest substrate, insulated from environmental conditions (Tortosa and Villafuerte 1999), and because, with the exception of nests on roofs, they are probably very safe from nest predators, especially on electricity poles (Profus 1986; Bocheński 2005). We did not find a statistically significant difference in house sparrow numbers between poles, tall chimneys and roofs (where predators such as domestic cat *Felis catus* and stone marten *Martes foina* have easier access) possibly due to the small sample sizes (numbers) of nests located on roofs.

The number of house sparrows in Poland is unknown, but white stork nests probably support <10% of the population. However, in the face of declining house sparrow numbers, the increasing white stork population is likely to become increasingly more important to their survival. The value of white stork nests as a nesting site is also confirmed by the result that the number of house sparrow pairs increased with the age (and hence size) of the nest. The potential size of a house sparrow colony in a white stork nest is probably limited by social factors of the house sparrow population, such as optimization of the colony size (Vaclav and Hoi 2002). Recently, in many countries, including Poland (Muzinic and Cvitan 2001), white stork nests on electricity poles have been deliberately reduced in size and transferred to a special platform to reduce problems with disrupted electricity supply and white stork electrocution. Such deliberate nest size reduction would adversely affect house sparrows, reducing nest sites for them.

Interestingly, we show that the farm type around the host nest strongly influences the number of house sparrows; Pair density on traditional farms is more than twice that on modern farms, and the relationship with increasing stork nest age is greater on traditional farms. This, probably, is a consequence of the great differences in food resources of the two different farm types. On traditional farms, house sparrows can easily find food by foraging among vegetation and via grain offered to poultry and other domestic animals, in contrast to intensive farms with yards covered by concrete or asphalt. This difference in access to food resources may strongly affect nestling development and survival (Pinowski et al. 1994; Vincent 2005), fledgling survival to maturity (Ringsby et al. 1998; Vincent 2005) and, in consequence, the overall population, shown to be recently declining (Hole et al. 2002; Robinson et al. 2005).

The white stork receives very active protection in Poland and is held in high regard by the human population. In conservation management projects where the white stork is chosen as a keystone species to protect (e.g. Watzold and Schwerdtner 2005), we have shown that there are also proven benefits to another species of conservation importance, the house sparrow, which mutually inhabits white stork nests, although recent programs to shift storks away from traditional nest sites may be detrimental to this.

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