

## THE DISAPPEARANCE OF BARN OWL *Tyto alba* AND LITTLE OWL *Athene noctua* OCCURRENCE SITES IN FARMLAND IN EAST POLAND

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### Abstract

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Complexes of buildings belonging to vast farms, distributed in the form of islands over a landscape of monoculture farming constituted important occurrence sites of the barn owl and the little owl. During 1999–2012, the fate of 59 farms inhabited by the studied species was observed. Both species of owls preferred using three categories of buildings: cowsheds, warehouses and blocks of flats. Cases have been reported of the same building being simultaneously occupied by two species of owls. The study showed that the disappearance of sites of the studied owls is caused by factors connected with the decreasing intensity of farming. The most common of these factors turned out to be demolitions of buildings occupied by owls and the abandonment of animal production. Cases of predation by carnivore mammals were also reported. The process of disappearance of owl sites appears to manifest itself more intensely on those farms where residential and industrial infrastructure occupies a smaller area.

**Key words:** barn owl, little owl, farmland, vast farms, agricultural sector.

### Introduction

The farmland in Poland has recently been undergoing sweeping changes. They are a result of clear and long-term politically determined processes of agricultural sector transformation in the economic sense and Polish countryside transformation in the social sense. The source of these processes lies in the collapse of the centrally planned economy system at the beginning of the 1990s. They led, among other things, to a total collapse of the entire segment of state-managed collective farming. That segment was almost entirely based on enterprises comprising large monocultures with small 'islands' of production-related infrastructure and human settlements among them. Such farms also exist in Eastern Poland. The socio-economic processes described have their ecological consequences as well, affecting the condition of farmland and the birds found there.

In the Polish conditions, the species of owls typical of these 'islands' are the barn owl *Tyto alba* and the little owl *Athene noctua*, which found these conditions appropriate for

reproduction and for roosting (Kitowski, 2002; Kitowski, Kisiel, 2003). Given the sedentary lifestyle of both species of owls (Stawarczyk, Tomiałojć, 2003), the changes that these agricultural enterprises undergo may be of crucial importance to their occurrence. Still, in Poland, the population of both species has been decreasing not only in farmland but also in towns, and the causes of this decrease have not been fully discovered. The aim of the study was to analyse the factors responsible for the distribution and permanence of occurrence sites of the studied owls within the 'islands' occupied by production and residential infrastructure of vast farms, state-owned until the early 1990s.

## Methods

This article presents the results of observations carried out during 1999–2000, 2006–2007 and 2001–2012. The study was focused on the area of SE Poland (districts: Tomaszów Lubelski, Hrubieszów, Zamość) (Fig. 1). The methodology was based on Domaszewicz et al.'s (1984) recommendations concerning farmland owls; the experience described in the study by Ramsden (1998) was also used. The surveys consisted mainly in inspections of facilities within the patches of land ('islands') covered by residential and production infrastructure. A total of about 900 facilities were inspected, such as barns, cowsheds, piggeries, granaries, garages, blocks of flats, warehouses, transformers, umbrella roofs, distilleries, mills, forges, administration buildings and other buildings remaining within the islands of farm infrastructure. During inspections, special attention was given to evidence of bird reproduction, such as the presence of living and dead young, as well as all signs of owl presence, such as feathers, pellets or droppings. Each facility was given a status: 0 = absent, no signs of occupation found; 1 = occasionally used, one or more feathers found, fewer than 10 pellets; 2 = roosting, ten or more pellets found; 3 = breeding, one or more eggs or young seen (Ramsden, 1998). If several facilities with different status were found within one farm, our study takes into account the fate of the site with the highest status. The area of the 'islands' occupied by farm infrastructure surrounded by monocultures was measured using the ArcView program (version 3.2) and expressed in hectares (ha) (ArcView, 1996 ).



Fig. 1. Study area where owls were surveyed.

Results

Inspections at the surveyed farms carried out during 1999–2000 revealed the following: 17 sites where only barn owls and 13 sites where only little owls occurred were found, and 29 sites were found where both species occurred simultaneously within one farm (more precisely, within residential or production infrastructure) (Table 1). Out of the total of 63 farms surveyed, the presence of the studied owls was found on 59 farms. During surveys performed in 2006–2007, only 6 farms were reported where little owls were present and barn owls were found to be present in 14 farms. Only on two farms was the simultaneous presence of both species of owls reported. During surveys in 2011–2012, owl sites were found on 16 farms: barn owls occupied 9 farms while the rest were occupied by little owls. There was no case reported of the simultaneous use of a farm by both species of owls (Table 1).

T a b l e 1. Number farms occupied by barn owls *Tyto alba* and little owls *Athene noctua* during study.

Years	<i>Athene noctua</i>	<i>Tyto alba</i>	<i>Athene noctua</i> and <i>Tyto alba</i>
1999–2000	13	17	29
2006–2007	6	14	2
2011–2012	7	9	–

Surveys revealed that cattle sheds, warehouses and blocks of flats were the buildings of fundamental importance for the occurrence of both species of owls. In case of cowsheds, the owls used lofts. In warehouses and barns, the entire space of the facilities was used by the birds. In blocks of flats, the ventilating holes were important for little owls as well as barn owls which they used for nesting or resting during the daytime.

During surveys performed in 1999–2000, no differences in frequency were found between the studied owls with regard to their use of cowsheds ( $\chi^2 = 1.47$ ,  $df = 1$ ,  $p = 0.225$ ), warehouses ( $\chi^2 = 0.06$ ,  $df = 1$ ,  $p = 0.811$ ) or blocks of flats ( $\chi^2 = 0.03$ ,  $df = 1$ ,  $p = 0.854$ ) (Tables 2 and 3). Such differences were clearer for barns, which were inhabited by barn owls three times more often than by little owls (Tables 2 and 3), though these differences turned out to be insignificant (Fisher’s exact test:  $p = 0.102$ ). With time, the role of other facilities occupied by owls diminished; as a result, the most recent inspections revealed that over a half of the buildings used by barn owls and over a half of those used by little owls were barns (Tables 2 and 3).

The percentage of buildings with the highest status for the occurrence of the studied owls increased with time only in the case of cowsheds (3 = breeding, see Methods). This was observed in each of the three study periods, respectively: 4 (28.6%), 3 (33.3%) and 4 (44.4%) of the buildings used for barn owls and 4 (21.1%), 2 (25%) and 2 (28.6%) for little owls.

In 1999–2000, areas covered with production and residential infrastructure within farms ( $n = 30$ ) where either little owls or barn owls occurred exclusively were smaller (mean: 7.14 ha, median: 5.7 ha, range: 1.03–21.75 ha) compared to areas where both species of owls occurred simultaneously ( $n = 29$ ) (mean: 13.51 ha, median: 9.9 ha, range: 1.2–48.9 ha) (Mann–Whitney U test:  $Z = -2.373$ ,  $n_1 = 30$ ,  $n_2 = 29$ ,  $p < 0.018$ ). A comparison was also made during 1999–2000 between the size of areas covered with infrastructure where buildings were occupied exclusively by the little owl and those where buildings were occupied exclusively by the barn owl.

T a b l e 2. Objects occupied by Barn owls *Tyto alba* on the study area. N, number of objects.

Object	1999–2000		2006–2007		2011–2012	
	N	%	N	%	N	%
Cattle shed	14	30.4	6	37.5	6	66.7
Warehouse	10	21.7	2	12.6	-	-
Block of flats	6	13.0	1	6.2	-	-
Barns	7	15.2	1	6.2	1	11.1
Granary	3	6.5	6	37.5	2	22.2
Distillery	1	2.2	-	-	-	-
Garages	1	2.2	-	-	-	-
Transformer	1	2.2	-	-	-	-
Shed	1	2.2	-	-	-	-
Production hall	1	2.2	-	-	-	-
Boiler	1	2.2	-	-	-	-
Total	46	100	16	100	9	100

T a b l e 3. Objects occupied by Little owls *Athene noctua* on the study area. N, number of objects.

Object	1999–2000		2006–2007		2011–2012	
	N	%	N	%	N	%
Cattle shed	19	45.2	3	37.5	4	57.1
Warehouse	11	26.2	1	12.5	2	28.6
Block of flats	4	9.5	1	12.5	-	-
Barns	2	4.7	-	-	1	14.3
Granary	1	2.4	3	37.5	-	-
Distillery	1	2.4	-	-	-	-
Garages	1	2.4	-	-	-	-
Transformer	1	2.4	-	-	-	-
Shed	1	2.4	-	-	-	-
Mill	1	2.4	-	-	-	-
Total	42	100	8	100	7	100

It was observed, for both the barn owl and the little owl, that these birds deserted those farms whose infrastructure covered a smaller area compared to those that still remained occupied in 2011–2012. The figures for the barn owl and for the little owl were as follows: barn owl – (mean: 8.45 ha, median: 9.4 ha, range: 2.75–21.75 ha) vs. (mean: 4.05 ha, median: 4.91 ha, range: 1.97–7.96 ha) (Mann–Whitney U test:  $Z = 1.99$ ,  $n_1 = 9$ ,  $n_2 = 8$ ,  $p < 0.05$ ); little owl – (mean: 3.25 ha, median: 3.72 ha, range: 1.03–4.85 ha) vs. (mean: 10.25 ha, median: 9.5 ha, range: 5.5–15.3 ha) (Mann–Whitney U test:  $Z = 3.0$ ,  $n_1 = 7$ ,  $n_2 = 6$ ,  $p < 0.003$ ).

Table 4 gives the percentage of farms subjected to activities that affected the occurrence of the studied owls. The highest percentage of the inspected farms – as many as 49 of them (79.7%) – experienced the abandonment of pig and cattle production. The latter, naturally, entailed the abandonment of the grazing of cattle on nearby pastures. The abandonment of grazing caused the overgrowing of pastures and resulted in the area being devoted to other purpos-

es, e.g. to sowing, etc. Total abandonment of agriculture production was confirmed only on six (10.2%) of the inspected farms. On as many as 29 farms (49.2%) cases of planned demolition of buildings were reported, motivated by the need to avoid taxation. A vast majority of these concerned cowsheds (Table 4). On at least four farms, buildings (cowsheds and granaries) were pulled down in which both species of the studied owls occurred simultaneously. In the case of cowsheds, the buildings demolished were high ones ( $n = 2$ ), with many entry openings leading to lofts. Birds used their opposite ends, as evidenced by direct observation and considerable amounts of pellets. For granaries ( $n = 2$ ), it was observed that little owls used ground floors or first floors while barn owls used higher floors. On 16 farms, the facilities used by owls were renovated. This was accompanied by a change in the manner of their use, and their access was blocked for birds (Table 4); windows were bricked up or new windowpanes were put in in place of previously broken ones. In the course of these works, residential buildings were renovated (insulated) on four farms, which included the blocking of access to ventilation holes and openings in slab roofs. In the case of five farms, large-scale use of fungicides was detected, and in the case of one farm the use of rodenticides was observed (Table 4).

Poverty forces local inhabitants to look for additional occupations in order to make a living. Three cowsheds that had been used by barn owls for a long time (at least 14 years) were

T a b l e 4. Negative forms of activity within and in the vicinity of buildings occupied by owls. N, the number of farms where a given activity happened.

No.	Activities	N	%
1.	Demolitions of buildings motivated by tax burdens	29	49.2
2.	Abandonment of pig production	24	40.7
3.	Abandonment of cattle production, including pasturing in the vicinity of buildings	23	39.0
4.	Increase in the area of rapeseed fields in the vicinity of buildings	23	39.0
5.	Functional conversions of farm buildings preceded by renovations	16	27.1
6.	Illegal penetrations of buildings	9	15.3
7.	Abandonment of plant production	6	10.2
8.	The use of fungicides on the farm	5	8.5
9.	Renovations of residential buildings	4	6.8
10.	Illegal demolitions aimed at scrap acquisition	4	6.8
11.	Abandonment of agricultural production on the farm	3	5.1
12.	Abandonment of agricultural production and total abandonment of the farm	2	3.4
13.	The use of rodenticides on the farm	1	1.7

deserted when local inhabitants penetrated their lofts, using these places for drying lime blossom or other herbs. Such illegal penetrations of facilities occupied by owls, motivated by various reasons, were reported on a total of nine farms (Table 4). In the case of four farms, local inhabitants searching for scrap caused the demolition of cowsheds made of aluminium, where sympatric nesting and roosting barn owls and little owls had been reported. In the case of three farms agricultural production was abandoned altogether while housing estates continued to function, and in the case of two farms both agricultural production and residential buildings were abandoned. The surroundings of patches covered with infrastructure have also changed; apart from the above-mentioned overgrowing of pastures, (Table 4), trees have been planted in

the vicinity of one of the farms. In the case of as many as 23 farms (39.0%), extensive rapeseed fields have appeared in the immediate proximity of their infrastructure.

During 1999–2012, apart from the local processes largely dependent on the financial condition of farms, other processes related to the occurrence of owls in the studied area took place as well. In the first study period, within the area of 49 out of 63 farms (77.8%) traces of the presence of martens *Martes* spp. were reported (droppings, tracks) and individuals of stone martens *Martes foina* were directly observed. Individuals of polecats *Mustela* spp. were observed on two farms. During 2011–2012, traces of marten presence were found on all of the studied farms. On two farms, abandoned barns were occupied by foxes *Vulpes vulpes*. On six farms, pellets and feathers of tawny owls *Strix aluco* were found and individuals of that species were observed. During surveys, within the area of the inspected farms, remains were found of one adult barn owl, one young barn owl and one young little owl; judging by the kind of injuries, they were killed by carnivore mammals.

## Discussion

The barn owl and the little owl are agricultural landscape species that have been associated with humans for decades (Bunn et al., 1992; Van Nieuwenhuijse et al., 2008; Šálek, Schropfer, 2008; Hindmarch et al., 2012). However, barn and little owls are now experiencing declines across their range (Šálek, Schropfer, 2008; Van Nieuwenhuijse et al., 2008; Hindmarch et al., 2012). Three major factors have been associated with the declines of barn owl populations. First, suitable nesting/roosting sites have been lost due to the conversion of old wooden barns into inaccessible steel barns and the removal of old trees as part of field enlargement programmes (Ramsden, 1998). Second, the loss of moderate-length grassland over the last 50 years has decreased small mammal populations and potential prey availability (Taylor, 1994). Third, the mortality of adult birds may have increased due to the increasing road network density and traffic intensity in farmland (Preston, Powers, 2006; Guinard et al., 2012). Barn owls are known to be sensitive to small-scale habitat change, so the loss of a single occupied site can lead to the desertion of other nearby sites: ‘the knock-on effect’ (Ramsden, 1998).

Different types of grasslands, with a high availability of potential prey, are the most important feeding habitat of the little owl in the Central European farmland. Results of many studies confirm the importance of grassland habitats within the little owl territories. Therefore, the reduction of the area covered by grasslands is recognized as an important factor in the disappearance of the occurrence sites of that species (Loske, 1986; Finck, 1990; Šálek, Schropfer, 2008; Van Nieuwenhuijse et al., 2008). Although the highest densities of prey were found in cornfields, little owls significantly preferred grassland habitats, probably because of the lower vegetation cover (Šálek et al., 2010). Other studies point to mortality on roads and railways as an important factor influencing the population of little owls (Hernandez, 1988; Bauer, Berthold, 1996). In some areas, where little owls nest in tree holes, a factor reducing their population could be cases of felling old trees (Génot et al., 1997; Van Nieuwenhuijse et al., 2008). It should be noted, however, that in Central Europe this factor plays an increasingly less important role due to the decreasing importance of tree holes as nesting sites, both in farmland and in towns (Šálek, Schropfer, 2008; Kitowski, Grzywaczewski, 2010).

Particularly harmful to the owls living there seems to be the practice of demolishing buildings occupied by owls. However, it seems that the problem of the conversion of buildings, less common in Eastern Poland, may appear when agribusiness becomes more profitable in Poland, resulting in larger investments. In the west of Europe, conversion in the use of buildings seems to be a very important factor responsible for population limitation of barn owls (Ramsden, 1998).

Studies on the diet composition of little owls in the area under discussion (Kitowski, Pawlega, 2009) revealed that a significant component in the diet were insects associated with pastures as well as with stored grain. In this situation, decrease in the intensity of animal production in the studied area turns out to be an important factor for the decrease in the population size of the studied owls. Decrease in the number of cows results in a deterioration of the condition of pastures as hunting areas. This deterioration refers especially to factors such as the increase of grass length, due to lower pressure in the form of grazing or treading, which may limit access to potential prey, or to the lack of dung pats, which attract various species of insects (Denholm-Young, 1978). Unused pastures result in the dilapidation of fences, which serve as perching sites for little owl individuals. Their use constitutes a very important element of this owl's hunting strategy (Loske, 1986; Finck, 1990; Šálek, Schropfer, 2008; Tome et al., 2011). Decrease in pig production seems to affect barn owls negatively, since it contributes to a reduction in the number of rats *Rattus* sp., a frequent prey of barn owls in this area, characterized by large biomass (Kitowski, 2000, 2013).

The hunting capacity of the barn owl is also diminished by extensive rapeseed monocultures surrounding human settlements. Even though the barn owl has a larger home range than the little owl, rapeseed fields may – due to their compactness, particularly in the period preceding harvest – very effectively limit the feeding possibilities of this owl, especially with regard to its main prey in this area: voles *Microtus* sp. (Kitowski, 2000).

The decrease in the intensity of farming coincided with the processes of impact of species that can limit the populations of both species of owls which makes their difficult situation even worse. This particularly concerns the influence of martens as well as the tawny owl on the little owl. Earlier observations in the studied area (Kitowski, 2002) show that the tawny owls are capable of killing the young of little owls. Due to the small home range of the little owl, particularly in the incubation and nesting periods (Šálek, Lovy, 2012), any changes within the small patches of environment occupied by production and residential infrastructure of farms as well as in their immediate vicinity are of fundamental importance to the survival of the sites of the this owl in Eastern Poland.

Summing up the results of surveys performed in South-eastern Poland, we observe that the causes of the disappearance of the sites of barn owls and little owls differ from those identified in different areas where these species occur, where population decline was caused by the increase in the intensity of agricultural production as well as by the development of road and production infrastructure. In the studied area of Eastern Poland, it is the stagnation and disappearance of agricultural production that contributes to the disappearance of owl sites.

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