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# LAND-USE CHANGES AT NEST SITES OF THE LITTLE OWL (*ATHENE NOCTUA*) IN THE SOUTH-MORAVIAN REGION OF THE CZECH REPUBLIC

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## ABSTRACT

The Little Owl is currently endangered bird species of agricultural lowland areas in Central Europe. Nesting sites of the Little Owl are often old trees as well as buildings and quarries with suitable nesting cavities. The Little Owl has severely declined in a major part of Europe during the past decades. Information on habitat requirements of the Little Owl and data related to land-use changes at nest sites (covering both the breeding and foraging habitats) are needed for conservation programmes aimed at this bird species. Land-use changes in farmland rank among frequently discussed negative factors causing the population decline of the Little Owl. The aim of this study is to analyse land-use changes at nest sites of the Little Owl in the South-Moravian region (Czech Republic) between the years 1976/1977 and 2014. In both studied periods (1976/1977 and 2014), the most important land-use type within 500 m from the nest sites of the Little Owl was arable land (66.94 % – 62.25 %), followed by built-up areas (19.97 % –22.41 %), while the other land-use types made up less than 5 %. The proportion of the particular land-use type did not change significantly between the years 1976/1977 and 2014. The most important change in comparison with the period 1976/1977 was the decrease in the area of arable land by 4.69 % and that of orchards and gardens by 1.99 %, while the surface of built-up areas increased slightly by 2.45 % and that of meadows and pastures by 1.5 %. The analysis shows that at the known nest sites of the Little Owl in the South-Moravian region (Czech Republic), there were no significant changes in the proportion of the particular land-use types within 500 m from the nests between the years 1976/1977 and 2014. Based on these results, we can conclude that in comparison with the availability of nest sites, which seems to be the important limiting factor for the occurrence and population density of the Little Owl, land-use changes in study area were not very important factor influencing decline of the Little Owl.

**Keywords:** Agricultural land, birds, GIS analyse, land-cover, nest site.

## INTRODUCTION

The Little Owl (*Athene noctua*) is a Turcmenic-Mediterranean faunal element (Vogus, 1962) which uses open habitats such as meadows, grasslands and fields as hunting grounds. Nesting takes place in tree cavities which are also important as raised stands (Framis *et al*., 2011). In Central Europe, open agricultural land is a typical hunting habitat of the Little Owl (Scherzinger, 1981). Nesting sites are often old trees as well as buildings and quarries with suitable cavities (Mebs & Scherzinger, 2000). The Little Owl has severely declined in a major part of Europe during the past decades (Šálek & Schröpfer, 2008; Zmihorski *et al*., 2009). This population trend of the Little Owl is similar as population trends of other owls breeding in agricultural landscapes in Europe. Artificial nest boxes seem to be a simple and effective conservation measure supporting the population restoration of the Little Owl. However, further information on habitat requirements of the Little Owl and data related to land-use changes at nest sites (covering both the breeding and foraging habitats) are needed for conservation programmes aimed at this endangered bird species.

Several decades ago, the Little Owl was one of the most common breeding owl species in the Czech Republic. It was widespread in lowland areas of the country, breeding in almost every settlement there, and its population comprised several thousands of breeding pairs. Since the 1960s the species started to decline gradually (Hudec, 1983) and the decrease became more pronounced in the late 20$^{th}$ century (Hudec & Šťastný, 2005). The breeding population of the Little Owl in the Czech Republic in the year 1990 was estimated at 600–700 pairs (Danko *et al*., 1994). On the other hand, Schröpfer (1996) mentioned 1,000–2,100 pairs for the period 1993–1995, and the same author (Schröpfer, 2000) noted 500–1,000 pairs for the period 1998–1999. According to the results of monitoring of the Little Owl in the Czech Republic, the breeding population did not exceed 100 pairs in the year 2015 and it was approximately 130 pairs in 2016 (Opluštil, 2016).

The causes of the dramatic decline in numbers of the Little Owl in the Czech Republic are not quite clear. Some authors (Hudec *et al*., 2005) suggest climatic factors to influence the Little Owl population (severe winter rich in snow). However, in lowland areas of Central Europe, such winters have been rather exceptional in recent decades. Other potential important causes of the population decrease of the Little Owl mentioned in the literature include road an railway casualties (Hernandez, 1988; Bauer & Berthold, 1996) and mortality due to technical dangers, such as concrete electric poles with a vertical inner cavity where the Little Owls hide but are not able to leave, or molasses tanks in agricultural farms where the Little Owls get drowned (Machar & Poprach, 2012).

The main causes of the dramatic decline in numbers of the Little Owl mentioned in the literature include intensification of agriculture (use of chemicals and rodenticides), increased predation pressure due to high abundance of small carnivores, loss of breeding opportunities related to the elimination of scattered vegetation in the landscape, or climatic factors (Šťastný *et al*., 1987; Martiško, 1994).

Land-use changes in farmland rank are one of important factors among frequently discussed negative factors causing the population decline of the Little Owl (e.g. Cramp, 1985; Génot *et al*., 1997; Šálek & Berec, 2001; Machar, 2012). As pointed out by Kitowski & Stasiak (2013), different types of grassland with high availability of potential prey are the most important feeding habitat within the Little Owl territories in the Central European farmland. The reduction of the area covered by grasslands is recognized as an important factor in the disappearance of the occurrence sites of the Little Owl (Loske, 1986; Finck, 1990). The study by Kitowski & Pawlega (2009) revealed that insects associated with pastures as well as with stored grain is a significant component of the Little Owl diet.

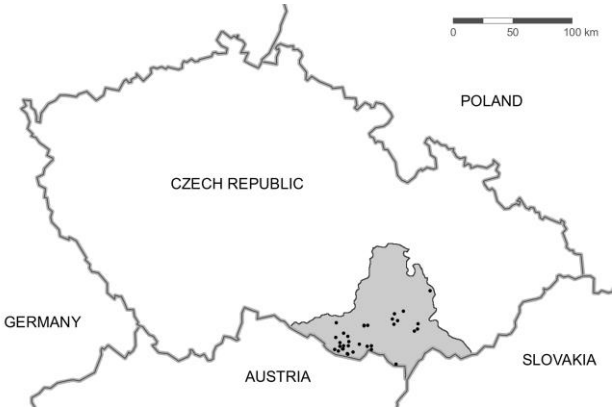
Decreasing numbers of cattle in the farms result in deterioration of the conditions of pastures as hunting areas for the Little Owl. This deterioration refers to factors such as the increase of grass length, due to lower pressure in the form of grazing, which may limit the access to potential prey, or to the lack of dung pats, which attract various species of insects (Denholm-Young, 1978).

Presented study deals with land-use changes in the South-Moravian region (Czech Republic) in the context of changes in abundance of breeding population of the Little Owl. This region has been chosen as the typical landscape with convenient environmental conditions for the Little Owl in Europe based on current knowledge of this species. In the South-Moravian region (the area of the current South-Moravian region together with the districts of Jihlava, Kroměříž, Prostějov, Třebíč, Uherské Hradiště, Zlín and Žďár nad Sázavou), the Little Owl was a regularly and commonly breeding species in the first half of the 20$^{th}$ century, mainly at the altitudes below 450 m a.s.l. At higher elevations (up to 550 m a.s.l.) it was rare or absent. Already after the year 1940, a decline in numbers was recorded, this became more pronounced after 1957. The aim of this study is to analyse land-use changes at nest sites of the Little Owl in the South-Moravian region between the years 1976/1977 and 2014.

## MATERIAL AND METHODS

We analysed the available data on breeding of the Little Owl in the South-Moravian region (1620 km$^2$) from the period 1998-2014. These data are related to altogether 35 nest sites of the Little Owl (Fig. 1). The nest site is defined as a concrete nesting place of the Little Owl; there may be more than one nest site in a settlement (nesting of two pairs). Primary data were processed using the TYTO database application (Poprach, 2011). Within 500 m from each nest site (flying range of the Little Owl during foraging, usually less than 200-300 m from the nest), individual land-use types were recorded from the orthophotomaps coming from the years 1976/1977 and 2014. For each site and aerial image, the following land-use types were distinguished: 1) woodland; 2) meadows and pastures; 3) arable land; 4) hedgerows, windbreaks and parks; 5) orchards and gardens; 6) vineyards; 7) water bodies; 8) built-up area. The area of the individual land-use type was measured using GIS application of Esri products (Arc-Info v.9) and the results for the particular nest site and aerial images from the years 1976/1977 and 2014 were compared.

**Fig. 1: Distribution of the studied breeding sites of the Little Owl (*Athene noctua*) in the South-Moravian region (Czech Republic) in the period 1998–2014**



## RESULTS

In the period 1998–2014, we localised altogether 35 nest sites of the Little Owl in the South-Moravian region. Of them, 33 were situated in farms, 1 in an attic of a castle and 1 in a dwelling house. Altogether 15 nest sites were „natural" (Little Owls used the existing nesting opportunities) and 20 sites were in nest boxes (designed for the Little Owl or the Barn Owl, respectively) installed in farming facilities. In the study period, we recorded altogether 69 nesting attempts at the 35 nest sites. At most of the sites, breeding occurred for 1–3 years, however, continuous nesting of the Little Owl at the same site for six years was recorded at two nest sites in the Břeclav district. In a large part of the nest sites (51 %, n = 18), we registered nesting in one year only. In the recent period 2012–2014, nesting of the Little Owl was recorded at 8 nest sites (23 % of the 35 nest sites). The decline in the nesting sites has been caused by reduced density in mostly the same area (Fig. 1.).

In both studied periods (1976/1977 and 2014), the most abundant land-use type found within 500 m from the nest sites of the Little Owl was arable land (66.94 % – 62.25 %), followed by built-up areas (19.97–22.41 %), while the other land-use types made up less than 5 %. The proportion of the particular land-use type did not change significantly between the years 1976/1977 and 2014 (Tables 1–2). The most important change in comparison with the period 1976/1977 is the decrease in the area of arable land by 4.69 % and that of orchards and gardens by 1.99 %, while the surface of built-up areas increased slightly by 2.45 % and that of meadows and pastures by 1.5 %.

## DISCUSSION AND CONCLUSION

During the mapping of breeding distribution of birds in the Czech Republic in the period 1973–1977, the occurrence of the Little Owl in the breeding season was recorded in 72 % of the mapping squares (n = 607) and breeding of the species was confirmed in 39 % of the squares (n = 331) (Šťastný *et al*., 1987). During the subsequent mapping in the period 1985–1989, the occurrence of the Little Owl in the breeding season was reported from 68 % of the squares (n = 428) and confirmed breeding from 30 % of the squares (n = 189) (Šťastný *et al*., 1996). The breeding distribution of the Little Owl thus did not change much between the two atlas mapping periods. A sharp decline in numbers of the Little Owl in the Czech Republic is apparent first from the results of bird mapping in the period 2001–2003, when the occurrence of the species in the breeding season was recorded in 27 % of the squares only (n = 168) and confirmed breeding in 6 % of the squares (Šťastný *et al*., 2006). This population decline has continued until today (Šálek, 2014). The question arises whether there indeed was a 50 % decline of the Little Owl population between the periods 1993–1995 and 1998–1999 (e.g. due to the severe winter of 1995/1996) or whether the data on numbers for the period 1993–1995 were overestimated. The estimate of the number of pairs was based on mean population densities of the Little Owl: 0.33 and 0.17 pairs/10 km$^2$, respectively, in the years 1993–1995, and 0.12 pairs/10 km$^2$ in the period 1998–1999. The values of mean densities were extrapolated to the whole area of the Czech Republic (78,870 km$^2$), i.e. including areas not inhabited by, and unsuitable for, the Little Owl, such as mountainous areas and forest complexes. As a certain compensation of the estimate and possible overestimation, the in the period 1998–1999 the monitoring methods were not observed strictly in some areas and the local populations of the Little Owl thus could have been underestimated.

During the first mapping of birds of the Czech Republic in 1973–1977, the breeding distribution of the Little Owl in the South-Moravian region was still more or less the same,

but a marked decline in numbers was apparent. In the early 1980s, the Little Owl was still quite abundant in some areas, e.g. in the Břeclav district (mapping square no. 7267) there were 6–7 breeding pairs. After the year 1985, a further population decrease and disappearance of the species from a number of sites, regularly occupied as late as in the early 1980s, was recorded. In the early 1990s, the breeding population in the region was estimated at less than 50 pairs (Martiško, 1994). Danko *et al*. (1994) estimated the population size in the then South-Moravian region at 30 breeding pairs by the year 1990, which was probably an undervalued estimate.

The Little Owl prefers sheltered roost sites such as tree cavities with multiple entrances. This important habitat is often negatively affected by human activities in the landscape (Bock *et al*., 2013). In some areas, where Little Owls nest in tree holes, a factor reducing their population could be felling of old trees (Génot *et al*., 1997). However, in Central Europe, this factor plays a rather insignificant role due to the decreasing importance of tree holes as nesting sites, both in agricultural landscape and in towns (Kitowski & Grzywaczewski, 2010).

In eastern Poland, Kitowski & Stasiak (2013) showed that the disappearance of nest sites of the Little Owl is caused by factors connected with the changes in farming practices, especially demolitions of buildings motivated by tax burdens, abandonment of pig and cattle production, including pasturing in the vicinity of farm buildings and increase in the area of rapeseed fields in farms.

Habel *et al*. (2015) analysed the effects of land-use changes on the Little Owl in 2001–2010 across Western Luxembourg. They found out a large-scale transformation of pastures with single trees into arable land during the past 10 years. Despite this agricultural intensification, the presence of the Little Owl increased, most likely as a result of the installation of nest boxes. Their results indicate that land-use parameters such as the presence of arable land, forests, pastures and pastures with trees had only a negligible impact on the occurrence of the Little Owl.

The results of our study indicate a similar interpretation. The analysis shows that at the known nest sites of the Little Owl in the South-Moravian region (Czech Republic), there were no significant changes in the proportion of the particular land-use types within 500 m from the nests between the years 1976/1977 and 2014. We believe the composition of the land-uses within 500 m of the total landscape is sufficiently representative based on the knowledge of maximum size of foraging range of the Little Owl. However, the proportion of the particular land-use types is not directly connected with the farming practices applied at these sites. Even though the proportion of crops is similar in both studied periods, the Little Owl may react e.g. on the way and frequency of mowing of meadows and pastures, loss of food due to the use of chemicals in agriculture, increased predation pressure as well as the other above mentioned negative factors.

We can conclude that in comparison with the availability of nest sites, which seems to be the limiting factor for the occurrence and population density of the Little Owl, land-use parameters play a rather negligible role. This conclusion is in line with other studies focussing on the habitat requirements of the Little Owl, indicating a positive correlation with open land (Dalbeck *et al*., 1999; Kasprzykowski & Golawski, 2006; Loske, 2007) and the presence of pastures (Mebs & Scherzinger, 2000). The high relevance of open land might be connected with the hunting behaviour of the Little Owl – the bird typically feeds where crops have been recently harvested or replanted or where meadows have been cut (Tomé *et al*., 2011). These conditions simplify visual recognition of prey and hunting (Schönn *et al*., 1991). In contrast to meadows and pastures, arable land is only suitable as long as the crop is still short, but becomes unsuitable if high standing crops make visual recognition of prey

difficult (van Nieuwenhuyse *et al.*, 2008). This explanation is further supported by the negative correlation between the increase of arable land and the population density of the Little Owl recorded in some areas in Europe.

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## APPENDIX

**Table 1: Absolute area of the particular land-use types within 500 m from the nest sites of the Little Owl (*Athene noctua*) in the South-Moravian region, Czech Republic, in the years 1976/1977 and 2014 (n = 35)**

| Number of the nest in TYTO database | Land-use type | Orthophoto 1976/1977 (m2) | Orthophoto 2014 (m2) | Land-use changes between 1976/1977 and 2014 (m2) |
|---|---|---|---|---|
| 582 | meadows and pastures | 0 | 34328,8 | -34328,8 |
| | arable land | 651278,1 | 620556,6 | 30721,5 |
| | hedgerows, windbreaks and parks | 4794,889 | 10330,23 | -5535,341 |
| | built-up areas | 129325,6 | 120182,5 | 9143,1 |
| | ∑ | **785398,589** | **785398,13** | 0,459 |
| | | | | |
| 253 | meadows and pastures | 6236,776 | 21334,95 | -15098,174 |
| | arable land | 609397,2 | 587828,1 | 21569,1 |
| | hedgerows, windbreaks and parks | 9232,36 | 26123,32 | -16890,96 |
| | orchards and gardens | 18340,99 | 11285,01 | 7055,98 |
| | built-up areas | 142190,8 | 138826,9 | 3363,9 |
| | ∑ | **785398,126** | **785398,28** | -0,154 |
| | | | | |
| 583 | meadows and pastures | 20839,52 | 18723,92 | 2115,6 |
| | arable land | 616279,4 | 582018 | 34261,4 |
| | hedgerows, windbreaks and parks | 14036,87 | 17503,58 | -3466,71 |
| | orchards and gardens | 32270,95 | 13466,33 | 18804,62 |
| | built-up areas | 101971,5 | 153686,3 | -51714,8 |
| | ∑ | **785398,24** | **785398,13** | 0,11 |
| | | | | |
| 584 | arable land | 582484,6 | 697969,2 | -115484,6 |
| | hedgerows, windbreaks and parks | 21054,32 | 23154,53 | -2100,21 |
| | orchards and gardens | 146659,2 | 25464,07 | 121195,13 |
| | built-up areas | 35200,05 | 38810,26 | -3610,21 |
| | ∑ | **785398,17** | **785398,06** | 0,11 |
| | | | | |
| 585 | meadows and pastures | 0 | 2848,659 | -2848,659 |
| | arable land | 666945,7 | 668378,5 | -1432,8 |
| | hedgerows, windbreaks and parks | 42058,18 | 12691,59 | 29366,59 |

| | | | | |
|---|---|---|---|---|
| | orchards and gardens | 0 | 31592,26 | -31592,26 |
| | water bodies | 3853,707 | 6259,45 | -2405,743 |
| | built-up areas | 72540,61 | 63627,96 | 8912,65 |
| | ∑ | **785398,197** | **785398,419** | -0,222 |
| | | | | |
| 574 | woodland | 59372,02 | 78636,58 | -19264,56 |
| | meadows and pastures | 20009,8 | 31426,53 | -11416,73 |
| | arable land | 578353,6 | 347723,6 | 230630 |
| | vineyards | 4352,655 | 161974,4 | -157621,745 |
| | built-up areas | 123310 | 165637 | -42327 |
| | ∑ | **785398,075** | **785398,11** | -0,035 |
| | | | | |
| 575 | woodland | 105798,9 | 109682,2 | -3883,3 |
| | meadows and pastures | 9979,992 | 79749,69 | -69769,698 |
| | arable land | 572904,1 | 417436,3 | 155467,8 |
| | hedgerows, windbreaks and parks | 2283,955 | 116178,5 | -113894,545 |
| | vineyards | 41119,6 | 0 | 41119,6 |
| | built-up areas | 53311,51 | 62426,38 | -9114,87 |
| | ∑ | **785398,057** | **785473,07** | -75,013 |
| | | | | |
| 576 | woodland | 14095,54 | 14221,46 | -125,92 |
| | arable land | 700100,2 | 709581,2 | -9481 |
| | hedgerows, windbreaks and parks | 1444,507 | 1572,802 | -128,295 |
| | built-up areas | 69758,21 | 60023,06 | 9735,15 |
| | ∑ | **785398,457** | **785398,522** | -0,065 |
| | | | | |
| 573 | meadows and pastures | 21146,68 | 10109,36 | 11037,32 |
| | arable land | 621696,1 | 630639,6 | -8943,5 |
| | hedgerows, windbreaks and parks | 0 | 1571,404 | -1571,404 |
| | orchards and gardens | 8233,189 | 0 | 8233,189 |
| | vineyards | 0 | 15646,57 | -15646,57 |
| | built-up areas | 134322,2 | 127431,1 | 6891,1 |
| | ∑ | **785398,169** | **785398,034** | 0,135 |
| | | | | |
| 77 | meadows and pastures | 0 | 8460,033 | -8460,033 |
| | arable land | 311016,1 | 288605,2 | 22410,9 |

| | | | | |
|---|---|---|---|---|
| | hedgerows, windbreaks and parks | 0 | 20654,93 | -20654,93 |
| | orchards and gardens | 123516,5 | 124041 | -524,5 |
| | built-up areas | 350865,1 | 343636,8 | 7228,3 |
| | ∑ | **785397,7** | **785397,963** | -0,263 |
| | | | | |
| 923 | meadows and pastures | 0 | 3200,654 | -3200,654 |
| | arable land | 706568,5 | 700804,9 | 5763,6 |
| | hedgerows, windbreaks and parks | 19675,8 | 26145,38 | -6469,58 |
| | orchards and gardens | 12309,81 | 0 | 12309,81 |
| | built-up areas | 46843,92 | 55247,24 | -8403,32 |
| | ∑ | **785398,03** | **785398,174** | -0,144 |
| | | | | |
| 316 | meadows and pastures | 6392,9 | 60826,37 | -54433,47 |
| | arable land | 487805,5 | 479348,9 | 8456,6 |
| | hedgerows, windbreaks and parks | 0 | 28278,83 | -28278,83 |
| | orchards and gardens | 153968,8 | 84442,76 | 69526,04 |
| | built-up areas | 137230,7 | 132501,2 | 4729,5 |
| | ∑ | **785397,9** | **785398,06** | -0,16 |
| | | | | |
| 254 | meadows and pastures | 0 | 3465,435 | -3465,435 |
| | arable land | 626345,3 | 613748,5 | 12596,8 |
| | hedgerows, windbreaks and parks | 0 | 9925,352 | -9925,352 |
| | built-up areas | 159052,8 | 158259 | 793,8 |
| | ∑ | **785398,1** | **785398,287** | -0,187 |
| | | | | |
| 315 | meadows and pastures | 0 | 36685,85 | -36685,85 |
| | arable land | 669828,2 | 564397,6 | 105430,6 |
| | hedgerows, windbreaks and parks | 19196,33 | 63955,9 | -44759,57 |
| | orchards and gardens | 1190,424 | 0 | 1190,424 |
| | water bodies | 8135,585 | 5004,11 | 3131,475 |
| | built-up areas | 87047,7 | 115354,8 | -28307,1 |
| | ∑ | **785398,239** | **785398,26** | -0,021 |
| | | | | |
| 149 | woodland | 122882 | 128846,8 | -5964,8 |
| | meadows and pastures | 86046,82 | 102014,6 | -15967,78 |
| | arable land | 434669,6 | 415131,1 | 19538,5 |

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|---|---|---|---|---|
| | hedgerows, windbreaks and parks | 3618,978 | 5535,885 | -1916,907 |
| | built-up areas | 138180,7 | 133869,8 | 4310,9 |
| | ∑ | **785398,098** | **785398,185** | -0,087 |
| | | | | |
| 249 | meadows and pastures | 778,1456 | 4928,67 | -4150,5244 |
| | arable land | 574050,3 | 563514,7 | 10535,6 |
| | hedgerows, windbreaks and parks | 50345,64 | 73655,95 | -23310,31 |
| | vineyards | 6883,973 | 0 | 6883,973 |
| | built-up areas | 153340,1 | 143299 | 10041,1 |
| | ∑ | **785398,1586** | **785398,32** | -0,1614 |
| | | | | |
| 142 | woodland | 78973,41 | 84437,87 | -5464,46 |
| | meadows and pastures | 5201,198 | 47114,22 | -41913,022 |
| | arable land | 483145 | 411600,1 | 71544,9 |
| | hedgerows, windbreaks and parks | 12669,39 | 28374,57 | -15705,18 |
| | orchards and gardens | 55028,06 | 14263,1 | 40764,96 |
| | built-up areas | 150380,6 | 199608,3 | -49227,7 |
| | ∑ | **785397,658** | **785398,16** | -0,502 |
| | | | | |
| 4247 | meadows and pastures | 0 | 15979,62 | -15979,62 |
| | arable land | 518631,9 | 483764 | 34867,9 |
| | hedgerows, windbreaks and parks | 11721,22 | 15298,61 | -3577,39 |
| | built-up areas | 255045 | 270356 | -15311 |
| | ∑ | **785398,12** | **785398,23** | -0,11 |
| | | | | |
| 161 | meadows and pastures | 0 | 15979,62 | -15979,62 |
| | arable land | 519464,2 | 484380,1 | 35084,1 |
| | hedgerows, windbreaks and parks | 11242,78 | 14858,49 | -3615,71 |
| | built-up areas | 254691,2 | 270179,9 | -15488,7 |
| | ∑ | **785398,18** | **785398,11** | 0,07 |
| | | | | |
| 183 | woodland | 0 | 18217 | -18217 |
| | meadows and pastures | 7881,945 | 20713,13 | -12831,185 |
| | arable land | 548511,4 | 486187 | 62324,4 |
| | hedgerows, windbreaks and parks | 0 | 1016,626 | -1016,626 |
| | orchards and gardens | 51236,66 | 33968,34 | 17268,32 |

| | | | | |
|---|---|---|---|---|
| | built-up areas | 177768,1 | 225296,2 | -47528,1 |
| | ∑ | **785398,105** | **785398,296** | -0,191 |
| | | | | |
| 4214 | meadows and pastures | 12263,52 | 25962,12 | -13698,6 |
| | arable land | 599458,5 | 567240,7 | 32217,8 |
| | hedgerows, windbreaks and parks | 4287,967 | 6044,855 | -1756,888 |
| | built-up areas | 169388,1 | 186150,5 | -16762,4 |
| | ∑ | **785398,087** | **785398,175** | -0,088 |
| | | | | |
| 180 | meadows and pastures | 12210,05 | 24655,9 | -12445,85 |
| | arable land | 602078,6 | 570846,7 | 31231,9 |
| | hedgerows, windbreaks and parks | 4211,31 | 5972,716 | -1761,406 |
| | built-up areas | 166898,2 | 183923 | -17024,8 |
| | ∑ | **785398,16** | **785398,316** | -0,156 |
| | | | | |
| 579 | woodland | 102145 | 128280,2 | -26135,2 |
| | meadows and pastures | 49565,95 | 36543,71 | 13022,24 |
| | arable land | 75641,37 | 57149,76 | 18491,61 |
| | hedgerows, windbreaks and parks | 7599,428 | 11624,72 | -4025,292 |
| | orchards and gardens | 33071,84 | 0 | 33071,84 |
| | vineyards | 23512,05 | 21208,09 | 2303,96 |
| | water bodies | 94999,63 | 97278,92 | -2279,29 |
| | built-up areas | 398862,9 | 433312,8 | -34449,9 |
| | ∑ | **785398,168** | **785398,2** | -0,032 |
| | | | | |
| 577 | woodland | 223703,9 | 243431,5 | -19727,6 |
| | meadows and pastures | 18355,77 | 15607,02 | 2748,75 |
| | arable land | 367427,7 | 315214,9 | 52212,8 |
| | hedgerows, windbreaks and parks | 2134,736 | 2661,987 | -527,251 |
| | orchards and gardens | 62831,69 | 0 | 62831,69 |
| | vineyards | 57389,85 | 134244 | -76854,15 |
| | built-up areas | 53554,57 | 74239 | -20684,43 |
| | ∑ | **785398,216** | **785398,407** | -0,191 |
| | | | | |
| 4284 | meadows and pastures | 3335,005 | 36305,07 | -32970,065 |
| | arable land | 377241,7 | 402341 | -25099,3 |

| | | | | |
|---|---|---|---|---|
| | hedgerows, windbreaks and parks | 6297,001 | 15926,27 | -9629,269 |
| | orchards and gardens | 69504,39 | 72133,93 | -2629,54 |
| | vineyards | 95324,53 | 0 | 95324,53 |
| | built-up areas | 233695,5 | 258692 | -24996,5 |
| | ∑ | **785398,126** | **785398,27** | -0,144 |
| | | | | |
| 205 | meadows and pastures | 0 | 24658,14 | -24658,14 |
| | arable land | 540361 | 540801,7 | -440,7 |
| | hedgerows, windbreaks and parks | 0 | 2379,115 | -2379,115 |
| | orchards and gardens | 20070,2 | 10686,42 | 9383,78 |
| | built-up areas | 224965,4 | 206877,2 | 18088,2 |
| | ∑ | **785396,6** | **785402,575** | -5,975 |
| | | | | |
| 157 | arable land | 402455,1 | 327147,3 | 75307,8 |
| | hedgerows, windbreaks and parks | 7278,842 | 34587,78 | -27308,938 |
| | orchards and gardens | 10424,32 | 0 | 10424,32 |
| | built-up areas | 365239,8 | 423663 | -58423,2 |
| | ∑ | **785398,062** | **785398,08** | -0,018 |
| | | | | |
| 251 | arable land | 538662,5 | 481642,2 | 57020,3 |
| | hedgerows, windbreaks and parks | 11546,78 | 38223,47 | -26676,69 |
| | orchards and gardens | 10424,32 | 0 | 10424,32 |
| | built-up areas | 224764,5 | 265532,4 | -40767,9 |
| | ∑ | **785398,1** | **785398,07** | 0,03 |
| | | | | |
| 167 | meadows and pastures | 35241,22 | 34314,02 | 927,2 |
| | arable land | 554925,6 | 478909,8 | 76015,8 |
| | hedgerows, windbreaks and parks | 23241,32 | 19037,24 | 4204,08 |
| | orchards and gardens | 6816,622 | 1897,017 | 4919,605 |
| | water bodies | 4425,313 | 13442,67 | -9017,357 |
| | built-up areas | 160748 | 237797,4 | -77049,4 |
| | ∑ | **785398,075** | **785398,147** | -0,072 |
| | | | | |
| 169 | meadows and pastures | 10306,31 | 4716,516 | 5589,794 |
| | arable land | 658191,5 | 597700,9 | 60490,6 |
| | hedgerows, windbreaks and parks | 0 | 2417,782 | -2417,782 |

| | | | | |
|---|---|---|---|---|
| | orchards and gardens | 6485,241 | 0 | 6485,241 |
| | built-up areas | 110415,1 | 180563 | -70147,9 |
| | ∑ | **785398,151** | **785398,198** | -0,047 |
| | | | | |
| 4217 | woodland | 39273 | 41798,48 | -2525,48 |
| | meadows and pastures | 17557,39 | 0 | 17557,39 |
| | arable land | 373818,8 | 443590,6 | -69771,8 |
| | hedgerows, windbreaks and parks | 2284,629 | 4901,668 | -2617,039 |
| | orchards and gardens | 99720,27 | 0 | 99720,27 |
| | vineyards | 8199,142 | 0 | 8199,142 |
| | built-up areas | 244544,1 | 295133,3 | -50589,2 |
| | ∑ | **785397,331** | **785424,048** | -26,717 |
| | | | | |
| 252 | woodland | 80151,2 | 89364,03 | -9212,83 |
| | meadows and pastures | 23331,1 | 23885,84 | -554,74 |
| | arable land | 297599,4 | 293904,3 | 3695,1 |
| | hedgerows, windbreaks and parks | 5924,124 | 20685,11 | -14760,986 |
| | orchards and gardens | 54145,29 | 0 | 54145,29 |
| | vineyards | 266673,5 | 288272,7 | -21599,2 |
| | built-up areas | 57572,97 | 69285,71 | -11712,74 |
| | ∑ | **785397,584** | **785397,69** | -0,106 |
| | | | | |
| 215 | meadows and pastures | 3120,558 | 11285,18 | -8164,622 |
| | arable land | 624526,7 | 590300 | 34226,7 |
| | hedgerows, windbreaks and parks | 0 | 4400,489 | -4400,489 |
| | orchards and gardens | 2157,589 | 0 | 2157,589 |
| | built-up areas | 155593,3 | 179412,4 | -23819,1 |
| | ∑ | **785398,147** | **785398,069** | 0,078 |
| | | | | |
| 581 | woodland | 2879,407 | 6556,433 | -3677,026 |
| | meadows and pastures | 27605,51 | 17186,4 | 10419,11 |
| | arable land | 349180,5 | 384815,8 | -35635,3 |
| | hedgerows, windbreaks and parks | 7976,901 | 41390,02 | -33413,119 |
| | vineyards | 297890,8 | 194855,2 | 103035,6 |
| | built-up areas | 99865,07 | 140594,1 | -40729,03 |
| | ∑ | **785398,188** | **785397,953** | 0,235 |

| | | | | |
|---|---|---|---|---|
| 580 | woodland | 0 | 6137,046 | -6137,046 |
| | meadows and pastures | 7601,349 | 43187,85 | -35586,501 |
| | arable land | 559958,3 | 307539,2 | 252419,1 |
| | hedgerows, windbreaks and parks | 8967,741 | 20871,77 | -11904,029 |
| | orchards and gardens | 52721,27 | 60109,34 | -7388,07 |
| | vineyards | 106366,6 | 300491,7 | -194125,1 |
| | built-up areas | 49782,84 | 47061,28 | 2721,56 |
| | ∑ | **785398,1** | **785398,186** | -0,086 |
| | | | | |

**Table 2: Land-use within 500 m from the nest sites of the Little Owl (*Athene noctua*) in the South-Moravian region, Czech Republic, in the years 1976/1977 and 2014 (n = 35)**

| **Land-use type** | **1976/1977** | | **2014** | | **Differences in land-use between 1976/1977 and 2014** |
|---|---|---|---|---|---|
| | **n (m2)** | **%** | **n (m2)** | **%** | **%** |
| woodland | 829274,377 | 3,02% | 949609,599 | 3,45% | 0,44% |
| meadows and pastures | 405007,509 | 1,47% | 816197,877 | 2,97% | 1,50% |
| arable land | 18401002,3 | 66,94% | 17112758,06 | 62,25% | -4,69% |
| hedgerows, windbreaks and parks | 315125,998 | 1,15% | 727951,471 | 2,23% | 1,08% |
| orchards and gardens | 1031127,63 | 3,75% | 483349,577 | 1,76% | -1,99% |
| vineyards | 907712,7 | 3,30% | 1116692,66 | 4,48% | 1,18% |
| water bodies | 111414,235 | 0,41% | 121985,15 | 0,44% | 0,04% |
| built-up areas | 5488266,75 | 19,97% | 6160496,79 | 22,41% | 2,45% |
| **Total** | **27488931,5** | **100,00%** | **27489041,18** | **100,00%** | |