Polish J. of Environ. Stud. Vol. 19, No. 5 (2010), 1039-1043

Original Research

The Role of Forest Age, Habitat Quality, Food Resources and Weather Conditions for Tawny Owl *Strix aluco* Populations

Jarosław Wiącek[1]*, Marcin Polak[1], Grzegorz Grzywaczewski[2]

[1]Department of Nature Conservation, Maria Curie-Skłodowska University,
Akademicka 19, 20-033 Lublin, Poland,
[2]Department of Zoology, University of Life Sciences in Lublin,
Akademicka 13, 20-950 Lublin, Poland

Received: 27 November 2009
Accepted: 12 April 2010

Abstract

The main goal of this study was to determine the reason for the significant increase of the tawny owl *Strix aluco* population in Kozłówka Forest near Lubartów (51°30' N, 22°35' E) in eastern Poland. Since 1990, this forest complex has been part of Kozłowiecki Landscape Park. Our research was conducted using standard playback method on a sample plot covering 50 km^2. Each year in March and April 1990-91 and 2007-09, three counts with vocal stimulation were performed on the study plot. Between 1991 and 2009, a significant increase in the density of the tawny owl population was observed from 2.4 pairs/10 km^2 to 4.6 pairs/10 km^2. We discuss how habitat quality, food availability, and weather conditions can explain this phenomenon.

Keywords: tawny owl, *Strix aluco*, population trends, owl conservation

Introduction

Unsuitable forest management is a widespread and common threat facing many forest bird species. Forestry practices modify the original structure of most European forests and promote changes in tree age and species composition [1, 2]. The changes in vegetation structure and resource availability have a major impact on wildlife populations [3]. The present forestry reduces the availability of old trees, dead wood and tree cavities [4]. Owls breeding in woodlands are especially vulnerable because of their low numbers and specific habitat requirements. Recently in Poland, the introduction of reduced impact logging in forest management systems was proposed in some areas. This system is based on retention of cavity-bearing trees and selective harvest in forestry practice. The implementation of this programme led to management more suitable for hole-nesting forest birds, because it focused on the conservation of old trees with nest-holes and provisioning of nest boxes (also for owls). Unfortunately, in most of cases this practice can be unsatisfactory in owl protection, because most owl species need larger holes in natural areas with good habitat conditions.

We analyzed tree age composition changes and observed that the proportion of stands over 80 years old increased during the study period. Therefore, we may expect that the above-described changes can significantly improve habitat conditions for the tawny owl in the study area. In this analysis, we also control the impact of winter conditions and potential food resources on the population in our study area.

Tawny owls breed throughout most of Europe [5-6]. This species is the most common owl in Poland [7], but there has been a lack of long-term studies on changes in the

*e-mail: wiacek@hektor.umcs.lublin.pl

abundance of this species [8]. The breeding density of tawny owl populations has been studied in different habitats in Poland [9]. It is common mostly in deciduous and mixed old forests, reaching densities of 10-20 pairs/10 km^2. In coniferous forests and agricultural landscapes its density is 1-10 pairs/10 km^2. Its total number in Poland is estimated to be 65,000-75,000 pairs [10]. Despite this, knowledge about the number and distribution of this species in Poland is not sufficient, especially in respect to long-term changes in numbers.

The aim of this study was to determine reasons for the increased number of the tawny owl population in Kozłówka Forest and to understand how the tawny owl responded to the aging of forests and improving quality of habitats, including weather conditions during the time of study.

Fig. 1. A comparison of age forest classes between 1981-90 and 1991-2000 in Kozłówka Forest.

Experimental Procedures

Study Area and Forest Management Changes

We examined the effects of aging forests, rodent cycle stages (based on *Quercus* sp. seeds productivity), habitat quality and weather conditions (temperature from December to February and days with snow fall) on the entire number of tawny owls in Kozłówka Forest near Lubartów (51°30' N; 22°35' E) in eastern Poland. This forest complex was part of the Zamojscy estate. The surface of the study area was 41 km^2 in 1990 and 50 km^2 in the following study seasons (1991 and 2007-09). The data from 1990 were excluded from further analyses because they had a preliminary character and were obtained from a smaller plot. The dominant form was pine (78%) and oak (13%) stands. Habitats of the study area consisted of pine forest (70%), hornbeam (20%) and alder (10%) [11]. Generally, this proportion did not change between the 1991 and 2007-09 seasons. We used information based on the number of breeding territories gathered in 1991 and 2007-09. In the last three seasons the studies were conducted based on the high vole and mice number conditions (unpublished data from State Forest Inspectorates Lubartów). Between these two periods, the forest and owls conservation procedures changed significantly. In order to preserve this forest complex, the Kozłowiecki Landscape Park was established in 1990. During the last two decades, the age structure of the forest changed. The share of the old-growth stands (81-120 years old) in the study plot increased from about 24% to 35% (Fig. 1). In 2001, twelve nest boxes for tawny owls were placed on the study area by forest managers. All nest boxes were checked once in April 2007 to find signs of use by owls such as pellets, feathers, and prey remains, with adult owls or eggs.

Sampling Methods

The sampling methods were the same in 1991 and 2007-09. We visited the entire sample plot three times during one breeding season (February, March, and April) using a nocturnal vocal stimulation with standard playback technique [12, 13]. During each visit, one to five groups of observers were present in the field. Playback sessions of the male "hoot" calls lasted 6 minutes (3 minutes of broadcasting and 3 minutes of listening). Playback stations were located at approximately 200 m intervals along the transect routes. During all seasons, the same kind of male territorial call was used. All observations were noted on official forestry planning maps at 1:25,000 scale. Observations were conducted in stable weather without strong winds and rainfall. Meteorological conditions were obtained from www.tutiempo.net/en/ from Radawiec Meteorological Station (N 51°13'; E 22°23') located 20 km from our study area. The preference of owls for stands in six age classes (Fig. 1) was tested using the chi-square test. We analyzed the role of forest age when comparing the potential habitats and the nesting places.

Results and Discussion

Between 1991 and 2009 a significant increase of density in the tawny owl population was observed from 2.4 pairs/10 km^2 to 4.6 pairs/10 km^2 (Table 1). In 1991 there were 12 pairs on the study plot. The highest number of pairs during the study period was recorded in 2009 – totaling 23 pairs (Table 1). Changes in the number and distribution of breeding pairs between 1991 and 2007 is presented in Fig. 2. Among the 12 boxes placed in the study area in 2000, 7 boxes (58.3%) were already used by tawny owls before 2007. However, in the 2007 breeding season only one nest

Table 1. The number and density of tawny owls in Kozłówka Forest in 1991 and 2007-09.

Year	Study area (km^2)	Number of pairs	Density (pairs/10 km^2)
1991	50	12	2.4
2007	50	22	4.4
2008	50	19	3.8
2009	50	23	4.6

Table 2. The comparison of the habitat selection between 1991 and 2007 in Kozłówka Forest.

Habitat	% habitat stands	Number of territories in 1991 (%)	Number of territories in 2007 (%)
Pine forest	70	6 (50)	16 (72)
Hornbeam	20	6 (50)	5 (23)
Alder	10	0	1 (5)

box was used for breeding. In the following two seasons none of the boxes were used. The analysis of preferences to different age forest classes has shown a significant preference of this species for older stands (χ^2=105.3, *df*=5, P<0.0001). In both study periods (1991 and 2007) most territories were located in the oldest stands (>100 years) - 45%, following 27.5% for 81-100 years old and then 27.5%. for 61-80 years old. Changes of habitat selection during the study period is presented in Table 2. In the mature oak stands, the number of territories was stable during the study period. However, we observed significant colonization of pine forests by tawny owls. The weather data shows that in both study periods of 1991 and 2007-09, weather conditions were similar. In both season, the snowfalls were less intensive than during other winters (Fig. 3). In these seasons, temperatures were higher in comparison with typical Polish winter conditions (Fig. 4). These weather traits were probably optimal for breeding owls.

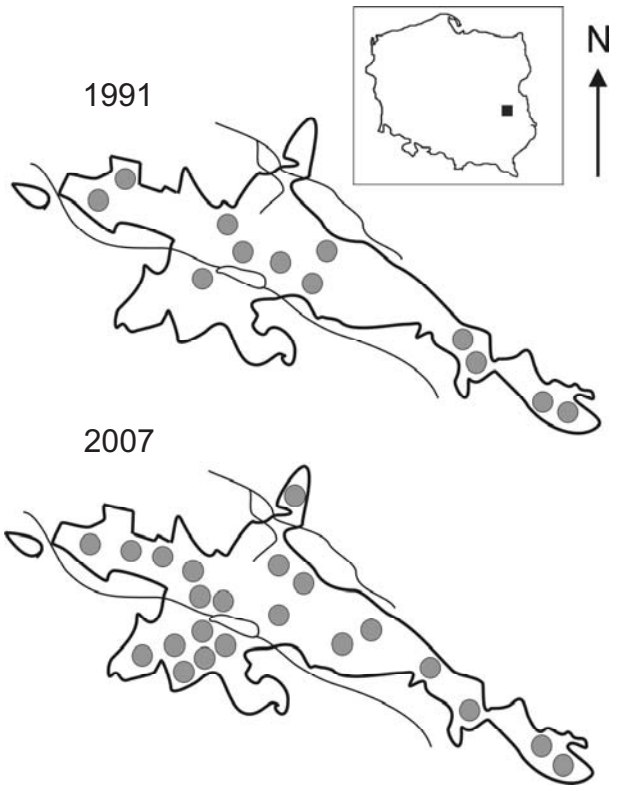

Fig. 2. Number and distribution of tawny owl territories in 1991 and 2007 in Kozłówka Forest.

A few seasons before the first study year, 1991, were poor in oak seeds, while years prior to the second study period, 2007-09, were rich (Fig. 5). Seeds of oaks are the main food for forest mice species such as *Apodemus sylvaticus* and *A. flavicollis*, the main prey for the tawny in the study area [31]. Oak masts are the main food of forest species of mice *Apodemus* sp. and voles *Microtus* sp. Breeding density of the tawny depends strongly on the density of small rodents [17]. This data suggests that the first survey (1991) was made in poor provisioning conditions for rodents, while the following surveys (2007-09) were made during good food conditions. Therefore, at the beginning of the 1990s, food availability for owls might have been limited, while in the last seasons (2007-09) availability of prey was rather high.

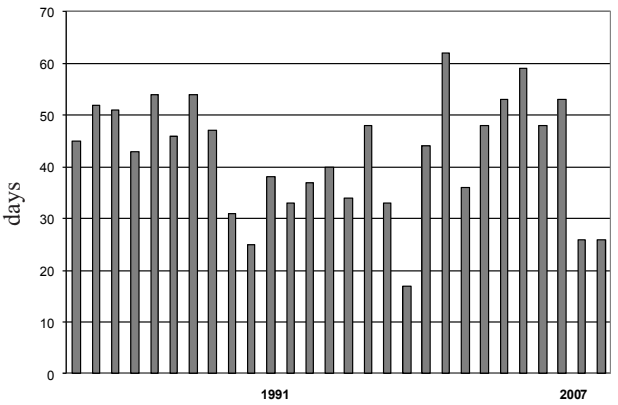

Fig. 3. Days with snowfall as cumulated index for December, January, and February (1981-2008).

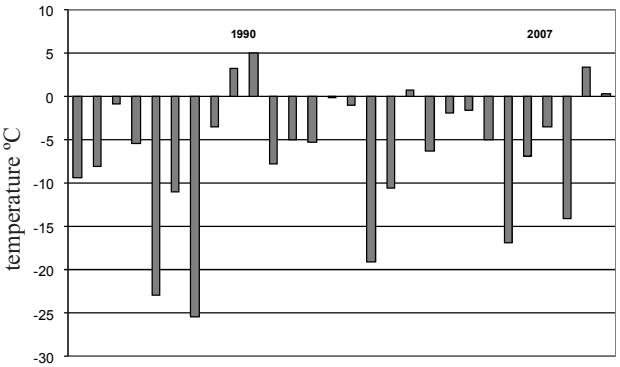

Fig. 4. Mean temperature as cumulated index for December, January, and February (1981-2008).

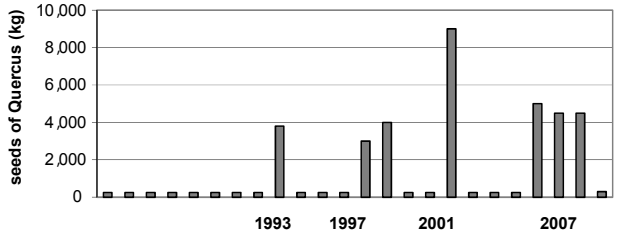

Fig. 5. The seasons with high seed production (*Quercus* sp.) in Kozłówka Forest.

The main result of this study was to verify the significant increase in the tawny owl population. The Polish population of this species increased in cities since the 1960s [14]. The following data gathered in the 1970s and 1980s confirmed the stability of this trend in the density of the tawny in large towns [15, 16]. Lack of data from forest territories in Polish literature from recent years makes the estimation of trends in the forest habitat problematic. The only data for comparative analyses of changes or trends in the breeding density of the tawny in this habitat comes from our study. Significant increase of the number of tawny owls in the forests of Central Europe was reported by Hagemeijer and Blair [7]. Much data from France, Belgium, Luxembourg, Netherlands, Germany, and Finland indicates an increase in the number of breeding pairs [17]. Some rudimentary information about changes in breeding density of this owl in eastern Poland can affirm that the tawny population significantly increased [18, 19].

The density of the tawny as compared to other raptors depends on food abundance and cycles in populations of their prey. Many authors have reported strong correlation between the breeding density of the Tawny and the numbers of their prey [6, 17]. Fluctuations between the number of breeding pairs in the following years increased by 30% as a consequence of prey availability [20], but the increase recorded in our population was much higher than this value and cannot be explained only by small mammals' regular cycles. Polish ornithological data confirm that the year 1991 was good for other raptors such as the short-eared owl *Asio flammeus* and other predators feeding on small mammals like mice or voles [21, 20], similar to 2007-09, when our research in Kozłówka Forest was repeated (forest inspectorate data).

The breeding density of the tawny owls from Kozłówka Forest in 1991 was 2.4 pairs/10 km^2. This data is situated as a mean value for pine forests in Poland where breeding densities in the 1980s changed from 2 pairs/10 km^2 [22] to 5 pairs/10 km^2 [23]. However, data from 2009, when the breeding density was 4.6 pairs/10 km^2, showed that nesting conditions for this owl improved significantly. The age of forest stands is important for the nesting of the tawny in Kozłówka (Fig. 1). This positive change in the environment caused an increase in the density this species of owl in the study area. Most published data underline a strong relation between breeding density and the age of forest stands in the tawny owl habitat [5, 6, 17, 23, 24]. Additionally, providing nest-boxes can help with strong colonization, in young, suboptimal pine habitats in the study area. Such a situation was described by Gramsz et al. [8]. Nest boxes placed in comparatively young forest stands can make possible nesting of the tawny owl. Unfortunately, nearly half of the nest boxes in the study area were unsettled because they were located near optimal habitats with natural holes. Natural holes are probably more attractive for birds, therefore most boxes near occupied territories were empty. The strong territoriality of the tawny made it impossible to colonize these boxes by other birds. Changing their location to far from occupied territories makes possible settling by new pairs. On the other hand, some authors underlined that too great a number of nest boxes for the tawny owl increase their negative impact on other rare species of owl, such as the pygmy owl *Glaucidium passerinum*, the little owl *Athene noctua* or Tengmalm's owl *Aegolius funereus* [8]. Some data confirmed that the Tawny is increasing its density, displacing the barn owl *Tyto alba* in the agricultural landscape of eastern Poland [19].

In 1991 and 2007-09, a quick increase in the number of territories in the pine forest was recorded. But the number of the hornbeam territories was stable. In the situation of low (1991) and high (2007-09) densities in the following seasons, all available hornbeam territories were occupied (5-6). New pairs came to settle only in pine or alder wood. Therefore, strong growth in the numbers of territories was only observed in the pine forest. This preference in order of settlement in a different habitat was described in literature. Tawny owls nest in different habitats but prefer old, broadleafed forest [25]. Therefore, breeding densities recorded in hornbeam habitats (usually above 5 pairs/10 km^2) were significantly higher in comparison with habitats in pine woods [11, 26-30].

The age of tree stands in the study area significantly changed between the 1991 and 2007-09 seasons. But a strong increase in the number of pairs probably had an effect on other factors too. Many authors underlined that weather conditions can influence the breeding density in many owl species [6]. Data from Poland (Białowieski National Park) suggest that mild winters with small snowfall can help with the survival of small mammals and their detection by raptors [20]. During the time of our study in Kozłówka Forest, the tawny population was monitored in the comparatively mild winters in comparison to, in general, harsh Polish winter conditions. Additionally, a small number of days with snow fall was observed in the study seasons. These factors can help with high hunting success and high density breeding in both study seasons. However, a much lower breeding density observed in the 1991 season was the effect of strong winter conditions in former years (1985-87) when the tawny population probably decreased strongly (Figs. 3 and 4). This phenomenon was compared with tawny counts in Kozłówka forest in 2010, when after a harsh, snowy and long winter we recorded their decline in a number of territories (our unpublished data).

The present forest management in Poland is based on protection of old trees with natural holes. Theoretically, this system can favour highly territorial and sedentary species such as the tawny. A few old trees with holes remaining in the clearing areas can provide a safe nesting place for this owl. In practice, the reduced impact of logging was probably not a main reason for the strong increase of pair numbers.

Conclusions

In summary, the number of breeding pairs of the tawny owl in the study area significantly increased since the 1990s. The main reasons for this increase were the aging of the forest, connected with improvement of habitat quality. The number of breeding pairs depended on good weather

conditions and food abundance. The presence of nest-boxes and the reduced impact of logging in forest practices cannot significantly help in density increase of the tawny owl in the study area. We need data from the plots located in other regions of Poland to determine the true trend in Tawny Owl population changes throughout the country.

Acknowledgements

We are grateful to Beata Niedźwiedź, Diana Płudowska, Kalina Łapińska, Paweł Łapiński, Małgorzata Patyniak, Waldemar Gustaw, Piotr Karpiński, Magdalena Małkowska, and other students from Maria Curie-Skłodowska University and the University of Life Sciences in Lublin and State Forest Inspectorates Lubartów for their help during the fieldwork.

References

1. HANSSON L. Traditional management of forests: plant and bird community responses to alternative restoration of oak-hazel woodland in Sweden. Biodiveristy and Conservation **10**, 1865, **2001**.
2. LAIOLO P., CAPRIO E., ROLANDO A. Effects of logging and non-native tree proliferation on the birds overwintering in the upland forests of north-western Italy. Forest Ecology and Management **179**, 441, **2004**.
3. ROSENVALD R., LOHMUS A. Nesting of the black stork (*Ciconia nigra*) and white-tailed eagle (*Haliaetus albicilla*) in relation to forest management. Forest Ecology and Management **185**, 217, **2003**.
4. SACCI R., GALEOTTI P., BOCCOLA S., BACCALINI F. Occupancy rate and habitat variables influencing nest-box use by tawny owls *Strix aluco*. Avocetta **28**, 25, **2004**.
5. CRAMP S., SIMMONS K. E. L. The Birds of Western Palearctic. Vol. **IV**. Oxford University Press.Oxford, **1980**.
6. MIKKOLA H. Owls of Europe. London, T&D Poyser, **1983**.
7. HAGEMEIJER W.J.M., BLAIR M.J. The EBCC Atlas of European Breeding Birds. Their distribution and abundance. T& AD Poyser. London, **1997**.
8. GRAMSZ B., KOŚCIÓW R., ŻEGLIŃSKI G. Tawny Owl *Strix aluco*. In: Mikusek R. (Ed.). 2005. The Owls Methods of Research and Conservation. FWIE. Kraków, **2005** [In Polish].
9. TOMIAŁOJĆ L., STAWARCZYK T. The avifauna of Poland, distribution, numbers and trends. Vol. **II**. PTTP "Pro Natura" Wrocław, **2003** [In Polish].
10. Bird Life International. Birds in Europe: population estimates, trends and conservation status. BirdLife International, Cambridge, **2004**.
11. WIĄCEK J. Breeding density of the Tawny Owl *Strix aluco* in the Kozłówka Forest. Remiz, **2**, 62, **1993** [In Polish].
12. SALVATI L., MANGANARO A., RANAZZI L. Wood quality and the Tawny Owl *Strix aluco* in different forest types of central Italy. Ornis Svecica, **12**, 47, **2002**.
13. MIKUSEK R. The Owls Methods of Research and Conservation. FWIE. Kraków. **2005** [In Polish].
14. LUNIAK M., KALBARCZYK W., PAWŁOWSKI W. Birds of Warsaw. Acta Orn., **8**, 175, **1964**.
15. TOMIAŁOJĆ L. Birds of Poland. PWN, Warszawa. **1972** [In Polish].
16. JABŁOŃSKI P. Distribution of Tawny Owl *Strix aluco* in Warsaw. Acta Orn., **26**, 31, **1991** [In Polish].
17. GALEOTTI P. *Strix aluco* Tawny Owl, BWP Update, **3**, (1), 43, **2001**.
18. RZĘPAŁA M., MITRUS C. An attempt at analyzing the numbers of the avifauna breeding in the Kryńszczak forest complex near Łuków, Siedlce Province. Not. Orn., **36**, 273, **1995** [In Polish].
19. GRZYWACZEWSKI G., CZOCHRA K., FRĄCZEK T., GUSTAW W., KITOWSKI I., PISKORSKI M., POTAKIEWICZ G., SZEWCZYK P., URBAN M. Barn Owl population Tyto alba and some Vertebrates in sacral buildings of Lublin region at the beginning of the XXI century. Kulon, **10**, 21, **2005** [In Polish].
20. JĘDRZEJEWSKA B., JĘDRZEJEWSKI W. Predation in Vertebrate Communities. The Białowieża Primeval Forest as a case study. Berlin, Springer Verlag., **1998**.
21. BUCZEK T. Breeding records of Long-eared Owl *Asio flammeus* on the calcareous marshes near Chełm. Not. Orn., **33**, 141, **1992** [In Polish].
22. FRONCZAK J., DOMBROWSKI A. Owls *Strigiformes* in an agricultural and forest landscape of South Podlasie Lowland. Acta Orn., **26**, 55, **1991** [In Polish].
23. KOWALSKI M., LIPPOMAN T., OGLĘCKI P. Census of owls *Strigiformes* in the Eastern part of Kampinos National Park. Acta Orn. **26**, 23, **1991** [In Polish].
24. GLUTZ VON BLOTZHEIM U. N., BAUER K. M. Handbook of the Birds of the Middle Europe, Vol. **9**. Aula-Verlag. Wiesbaden, **1980**.
25. SOUTHERN H. N. The natural control of a population of Tawny Owls. J. Zool. Lond., **162**, 197, **1970**.
26. BOLDREGHINI P., CASINI L., SANTOLINI R. The population of the Tawny Owl *Strix aluco* in the Mesola Great Wood. Suppl. Ric.Biol. Selvaggina, **XII**, 37, **1987**.
27. SARA M. Preliminary data on Tawny Owl *Strix aluco* density in Sicily. Suppl. Ric. Biol. Selvaggina **XII**, 207, **1987**.
28. GRAMSZ B. Tawny Owl *Strix aluco* diet in oak hornbeam forest near Oława. Acta Orn., **26**, 3, **1991**.
29. SZMAL A., JERMACZEK A., NAWROCKI P., SZWAGRZAK A., WINIECKI A. Numbers, distribution and territorial behaviour of the Tawny Owl *Strix aluco* in Wielkopolski National Park (Western Poland). Acta Orn., **26**, 15, **1991**.
30. REDPATH S. Habitat fragmentation and the and the individual: Tawny Owl *Strix aluco* in woodland patches. J. Anim. Ecol., **64**, 652, **1995**.
31. WIĄCEK J., POLAK M., NIEDŹWIEDŹ M. The diet composition of the Tawny Owl *Strix aluco* in the Kozłówka Forest, in eastern Poland. Annales UMCS, **2**, **2009** [In press].