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Abundance and distribution of owls *Strigiformes* in the Pieniny Mountains National Park (southern Poland) – the pattern of changes in the protected area after 10 years

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Abstract: This paper presents the results of the owl survey conducted in 2012 in the Pieniny National Park (southern Poland) and compares them with the results from 2002. The survey was carried out using the mapping method and playback. Six species of owls have been recorded, of which Tawny Owl *Strix aluco* (density 7.7–9.5 pairs/10 km^2) was the most common. The densities of the other species were lower: Eagle Owl *Bubo bubo* 2.6 pairs/10 km^2, Pygmy Owl *Glaucidium passerinum* 2.2 pairs/10 km^2, Tengmalm's Owl *Aegolius funereus* 0.9–2.2 pairs/10 km^2, Ural Owl *Strix uralensis* 0.9–1.7 pairs/10 km^2 and Long-eared Owl *Asio otus* 0.4–1.7 pairs/10 km^2. The total density of the breeding owl community in 2012 was 14.6–19.8 pairs/10 km^2, and it had increased compared to 2002 levels (12.9–16.3 pairs/10 km^2). During the ten-year period the densities of the Tawny Owl, Pygmy Owl, Tengmalm's Owl and Ural Owl continued to rise, but no changes in the Eagle Owl and Long-eared Owl numbers were noted. The species richness and high density of the breeding owl community highlights the great importance of the Pieniny Mts. for these birds at the national scale. Potential factors favouring such a pattern are a strict conservation regime in the area, the high quality of various breeding habitats and abundant food resources. In addition, the mild climate of the region is of crucial importance for sedentary species.

Key words: owls, *Strigiformes*, Pieniny Mts., density of owls

Liczebność i rozmieszczenie sów *Strigiformes* w Pienińskim Parku Narodowym – obraz zmian na obszarze chronionym po 10 latach. Abstrakt: Praca przedstawia wyniki inwentaryzacji sów prowadzonej w 2012 roku w Pienińskim Parku Narodowym i porównuje je z danymi z 2002 roku. Cenzus powadzono przy użyciu metody kartograficznej połączonej ze stymulacją głosową. Stwierdzono sześć gatunków sów, wśród których najliczniejszy był puszczyk *Strix aluco*, występujący w zagęszczeniu 7,7–9,5 pary/10 km^2. Zagęszczenie pozostałych gatunków było niższe: puchacz *Bubo bubo* 2,6 pary/10 km^2, sóweczka *Glaucidium passerinum* 2,2 pary/10 km^2, włochatka *Aegolius funereus* 0,9–2,2 pary/10 km^2, puszczyk uralski *Strix uralensis* 0,9–1,7 pary/10 km^2 i uszatka *Asio otus* 0,4–1,7 pary/10 km^2. Ogólne zagęszczenie zespołu lęgowych sów w 2012 r. wynosiło 14,6–19,8 pary/10 km^2 i wzrosło na przestrzeni minionej dekady (12,9–16,3 par/10 km^2 w 2002). W porównaniu z 2002 rokiem wykazano wzrost zagęszczenia puszczyka, sóweczki, włochatki i puszczyka uralskiego. U puchacza i uszatki nie odnotowano zmian liczebności. Na tle innych części kraju, Pieniny wyróżniają się bogactwem gatunkowym oraz wysokim zagęszczeniem całego zespołu sów. Przypuszczalnie przyczyną tego jest wysoki reżim ochronny, dobry stan zachowania

zróżnicowanych siedlisk lęgowych oraz dostępność bazy pokarmowej, a także łagodny klimat, co jest szczególnie istotne dla gatunków osiadłych.

Słowa kluczowe: sowy, *Strigiformes*, Pieniny, zagęszczenia sów

Regular qualitative and quantitative surveys of fauna in a given environment permit an assessment of changes that have taken place there (Thompson et al. 1988). They also set up a foundation for the planning of conservation measures, the rational management of natural resources and efficacy assessments of earlier implemented conservation action (Burgman 2005, Nichols & Williams 2006). Species with high position in trophic pyramids, sensitive to changes taking place at lower levels, such as raptors *Accipitriformes* and owls *Strigiformes*, can be a useful indicator group for assessing the changes in the environment.

The numbers and distribution of owls are affected *inter alia* by the availability of food, the quality and structure of the habitat and by the weather conditions. The population dynamics of rodents, which depends on the harvest of seeds, especially of European beech *Fagus sylvatica* and oaks *Quercus* spp. (Lithner & Johnson 2002), can lead to changes in the numbers and breeding success of owls. Species with a narrow feeding spectrum reduce their own numbers in response to changes in numbers and availability of prey (Korpimäki 1984, Korpimäki & Nordahl 1989, Jędrzejewska & Jędrzejewski 2001). On the other hand, species with a broad feeding spectrum can exhibit a functional response, i.e. the one that invokes dietary changes depending on the availability of different types of prey. Reduced breeding success among owls, and consequently lower numbers of these birds can also ensue from altered habitat conditions (Hakkarainen et al. 2003), such as landscape transformations or changes to forest and farmland management practices. Finally, low temperatures and thick snow cover can increase mortality among owls (Sitkiewicz & Anderwald 2010).

The owl assemblage in the Pieniny Mountains has been relatively well studied. A series of historical papers have presented data on the species composition and sometimes on the numbers of owls in this region (Sitowski 1916, 1923, Bocheński 1960a, 1960b, 1966, Ferens 1953, Strojny 1965). Fragmentary information can also be found in papers covering the whole Poland or larger regions of the country (Ruprecht & Szwagrzak 1988, Tomiałojć 1990, Głowaciński 1992, Walasz & Mielczarek 1992, Głowaciński 2001, Tomiałojć & Stawarczyk 2003). However, most of the older data was not gathered in a methodical manner or using the now-standard techniques of detecting owls. Comprehensive data on the distribution and numbers of owls in the Pieniny National Park (PNP) was gathered in 2001–2002 (Ciach 2005). In consequence, we have information on the changes in numbers of Eagle Owl that have taken place over the past 100 years, while for the other species the data collected in 2001–2002 (Ciach 2005) provide a starting point for a survey of the entire assemblage.

This work presents the current species composition, distribution and numbers of owls in the Pieniny National Park, and tracks the changes that have occurred in this assemblage during the past ten years.

Study area

The present study was carried out within the boundaries of the Pieniny National Park (PNP), a total area of 2346 ha (Fig. 1). The Pieniny range is 35 km long and up to 5 km wide. The two gorges of the River Dunajec divide them into three parts: the Spisz Pieniny (highest peak: Żar – 879 m asl.), the Pieniny Proper (Trzy Korony – 982 m asl.) and the

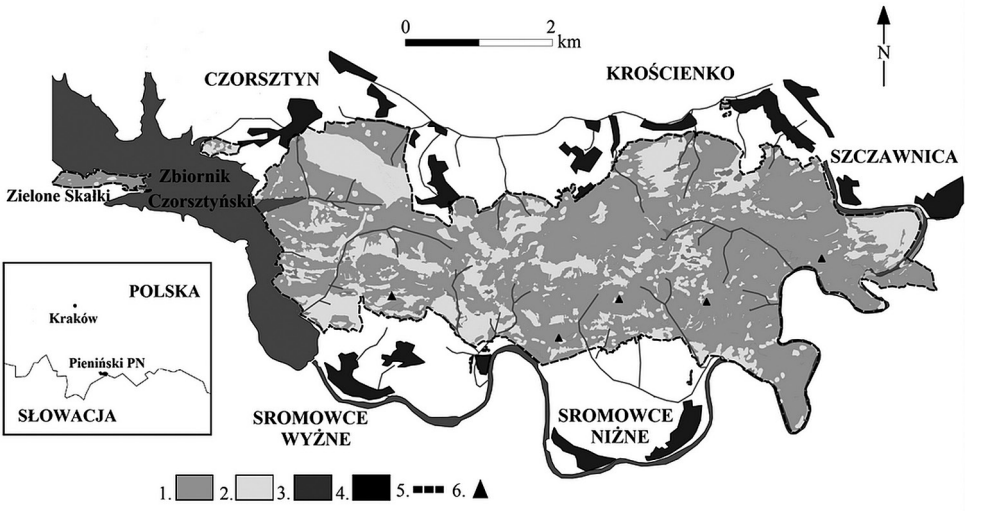

Fig. 1. Map of the Pieniny Mts. National Park. 1 – woodlands, 2 – open areas, 3 – water bodies, 4 – urban areas, 5 – border of the Pieniny National Park, 6 – peaks
Rys. 1. *Mapa Pienińskiego Parku Narodowego. 1 – tereny leśne, 2 – tereny otwarte, 3 – zbiorniki wodne, 4 – zabudowa, 5 – granica Pienińskiego Parku Narodowego, 6 – szczyty*

Little Pieniny (Wysoka – 1052 m asl.) (Nyka 1997). Established in 1932, the Pieniny National Park is one of the oldest and also the smallest in Poland. The core of the PPN lies in the Pieniny Proper, with small areas extending on to the adjacent parts of the range. The highest peak in the PPN is the Trzy Korony ('Three Crowns'), and the lowest point (alt. 420 m asl.) is in the Dunajec valley near Krościenko.

The Pieniny Mountains lie within two vertical climatic zones – moderately warm and moderately cold (Hess 1965). They enjoy a warmer climate compared to neighbouring mountain ranges: the annual precipitation is lower and air temperatures – higher, snow cover season is shorter, and the insolation – stronger. The growing season, beginning in late March and ending in late October, lasts for an average of 223 days at the bottom of the Dunajec valley, and with increasing altitude, falls to 197 days at the highest peaks (Perzanowska 2004). The dominant rocks in the PPN are calcareous, particularly limestones and marls. Rendzinas and pararendzinas make up 60% of the soil in the PNP, and a further 30% consists of brown earths (Adamczyk et al. 1982, Niemyska-Łukaszuk et al. 2002). The southern slopes are characterised by frequent rocky precipices, which make up one side of the Dunajec gorge. In contrast, the northern slopes slope gently down to the Krośnica valley. The slopes are crossed by numerous, deep stream valleys. The Dunajec valley marks the eastern and to some extent the southern boundary of the PNP.

The plant communities in the PNP are dominated by woodland and scrub, which cover 78% of the park area. The most frequently occurring associations are *Dentario glandulosae – Fagetum typicum* (covering 15% of the PNP), *Dentario glandulosae – Fagetum abietetosum* (12%) and *Carici albae – Fagetum abietetosum* (11%). Among the non-woodland communities (22% of the park area), the most common are meadows with *Campanula patula* and *Trisetum flavescens,* and the *Lolio-Cynosuretum* association (Chećko 2004).

The eastern part of the PNP is dominated by multispecies tree stands of a highly diverse age and structure. Silver fir *Abies alba*, European beech *Fagus sylvatica* and Norway

spruce *Picea abies* dominate there. The tree stands of the western part are less varied: they are dominated by Norway spruce plantations. The landscape around the edge of the PNP is mostly agricultural, consisting mainly of pastures, meadows and arable lands with numerous villages. Well-known for its diversity of fauna and flora, the PNP has been included in the Natura 2000 network as Special Area of Conservation PLH 120013 (habitats) and Special Protection Area PLB 120008 (birds).

Methods

A total of twelve field surveys were carried out. They covered either the whole or part of the study area using the mapping method (Tomiałojć 1980) adapted for owl surveys (Domaszewicz et al. 1984). Fieldwork was done from 3 March to 27 June 2012. The field work was tailored to the weather conditions – preferably during anticyclonic weather and at nights around full moon. If possible, periods of low air pressure were avoided, as they usually coincide with rainfall, strong winds, cloudiness and fog; under such conditions, owls are the least likely to call. In order to maximise the area monitored during one night, from one to three groups of observers explored the area. For reasons of safety, each group consisted of 2–3 persons.

The routes were walked in such a way that the whole area could be monitored by ear. They followed ridges and valleys, and in some places every part of the area could be penetrated. As the PNP boasts quite a dense network of hiking trails, paths and forest roads, a single group was able to cover up to 8 km per night. Playback consisting of calls of the various owl species was used every 200–300 m along a route. The playback lasted for about 1 minute, after which 5–10 minutes were allowed to elapse in anticipation of a reaction. The playback started with calls of the smallest species and ended with those of the largest ones (Domaszewicz et al. 1984). No playback was used in the case of the Eagle Owl *Bubo bubo*.

In addition, twelve surveys were carried out in the daytime in order to search for potential nesting sites of the various species. Sought after were trees with suitable nesting holes, raptor nests, fledglings, and also signs of the presence of owls like pellets, feathers, remains of prey items and faeces-whitened rocks. Since the Pygmy Owl *Glaucidium passerinum* is active by day, its calls were also played back. For conservation reasons, approaches to the potential Eagle Owl nesting sites were kept to a minimum, and rock faces and sills were scanned with a spotting scope. All signs of the activity and presence of owls were marked on a 1:25 000 map.

Data processing

The survey covered the whole area of the PNP except for enclaves of an agricultural or historical nature, a total of 20 ha. The reference area for which owl densities were calculated was 2325 ha. A territory was considered occupied if a species was found in a locality at least twice. A probable territory was defined when a territorial male was recorded once, or a species was found on two occasions but an incursion from a neighbouring territory could not be ruled out.

To illustrate the distribution of the particular owl species, territories were assumed to be circular (Ciach 2005) with the following radii (after Domaszewicz et al. 1984): the Tawny Owl *Strix aluco* – 35 ha (radius ~330 m), Ural Owl *S. uralensis* – 80 ha (~500 m), Tengmalm's Owl *Aegolius funereus* and Long-eared Owl *Asio otus* – 10 ha (~180 m),

Pygmy Owl – 100 ha (~560 m). The Eagle Owl territory was assumed to have a radius of 1000 m, and hence an area of ~315 ha (after Ciach 2005).

The results relating to the owl assemblage of the PNP were compared with those from woodland sampling plots elsewhere in Poland. Only the results that covered the whole assemblage were taken into consideration, excluding those describing the numbers and distribution of selected species only. In view of possible changes in the species composition and numbers of owls in woodland assemblages, only recent data, i.e. published after the year 2000, were used for comparison.

Results

In 2012 six species of owls were found to inhabit the PNP: the Tawny Owl, Ural Owl, Eagle Owl, Tengmalm's Owl, Pygmy Owl and Long-eared Owl (Table 1). In total, 34 breeding territories and 12 probable territories were found in the area of 23.25 km^2. The overall density was 14.6 territories/10 km^2, or 19.8 territories/10 km^2 if probable territories are included.

The Tawny Owl was the most numerous owl species in the PNP with 18 breeding territories and four probable ones (Table 1, Fig. 2). Its density was 7.7 pairs/10 km^2, or 9.5 pairs/10 km^2 if probable breeders are taken into account. The Tawny Owl had the greatest densities in the eastern part of the park, where it inhabited coniferous, deciduous and mixed woodlands. The territories were situated in stream valleys and on steep slopes, mostly in the vicinity of open terrain.

The six Eagle Owl territories were found in the PNP (Table 1, Fig. 3). All the localities were situated in the southern part of the park, in places where precipitous rocky outcrops adjoined extensive areas of farmland. The density was 2.6 pairs/10 km^2, but quite a large part of these territories extended beyond the confines of the PNP. The average distance between the centres of neighbouring territories was 2400 m (SD = 901 m, range 1200–3400 m).

Table 1. Number of breeding territories, density (pairs/10 km^2) and dominance (%) of owls in the Pieniny Mts. National Park in 2002 and 2012 (the maximum numbers of breeding territories were used to calculate the dominance of each species)

Tabela 1. *Liczba terytoriów lęgowych, zagęszczenie (par/10 km^2) i dominacja (%) sów w Pienińskim Parku Narodowym w latach 2002 i 2012 (dla obliczenia dominacji przyjęto maksymalną liczbę terytoriów). (1) – gatunek, (2) – liczba terytoriów, (3) – zagęszczenie, (4) – dominacja, (5) – razem*

Species (1)	Number of territories (2)		Density (3)		Dominance (4)	
	2002	2012	2002	2012	2002	2012
Strix aluco	16–17	18–22	6.9–7.3	7.7–9.5	44.8	47.8
Bubo bubo	6	6	2.6	2.6	15.8	13.0
Glaucidium passerinum	3	5	1.3	2.2	7.9	10.9
Aegolius funereus	2–4	2–5	0.9–1.7	0.9–2.2	10.5	10.9
Asio otus	0–4	1–4	0–1.7	0.4–1.7	10.5	8.7
Strix uralensis	2–3	2–4	0.9–1.3	0.9–1.7	7.9	8.7
Athene noctua	1	+	+	+	2.6	+
Tyto alba	–	+	–	+	–	+
Total (5)	30–38	34–46	12.9–16.3	14.6–19.8	100.0	100.0

Fig. 2. Distribution of the Tawny Owl *Strix aluco* breeding territories in the Pieniny Mts. National Park. 1 – breeding territory, 2 – border of the national park, 3 – probable territory
Rys. 2. *Rozmieszczenie terytoriów lęgowych puszczyka w Pienińskim Parku Narodowym. 1 – terytorium lęgowe, 2 – granice parku narodowego, 3 – terytorium prawdopodobne*

Fig. 3. Distribution of the Eagle Owl *Bubo bubo* breeding territories in the Pieniny Mts. National Park. 1 – breeding territory, 2 – border of the national park
Rys. 3. *Rozmieszczenie terytoriów lęgowych puchacza w Pienińskim Parku Narodowym. 1 – terytorium lęgowe, 2 – granice parku narodowego*

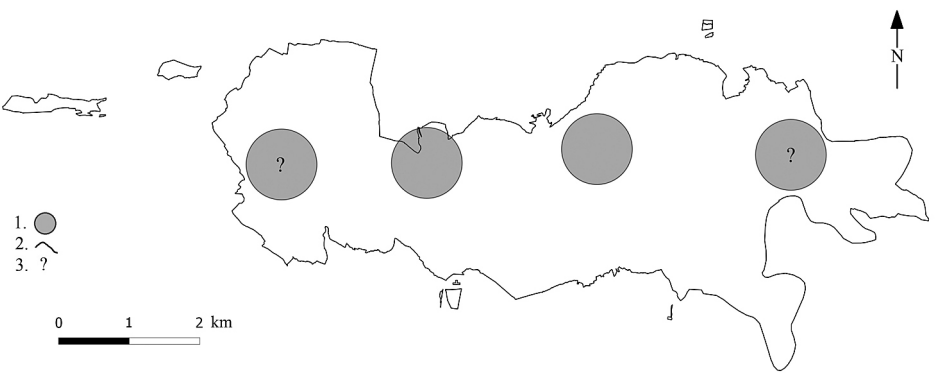

Fig. 4. Distribution of the Ural Owl *Strix uralensis* breeding territories in the Pieniny Mts. National Park (symbols as in Fig. 2.)
Rys. 4. *Rozmieszczenie terytoriów lęgowych puszczyka uralskiego w Pienińskim Parku Narodowym (oznaczenia jak na rys. 2).*

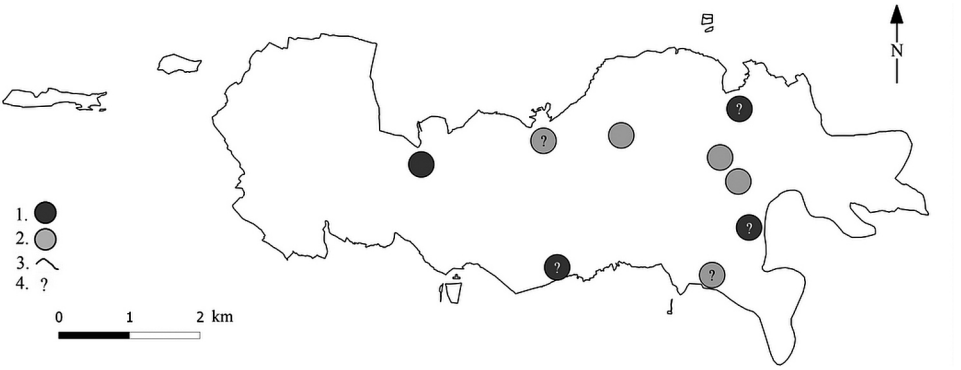

Fig. 5. Distribution of the Long-eared Owl *Asio otus* (1) and Tengmalm's Owl *Aegolius funereus* (2) breeding territories in the Pieniny Mts. National Park. 3 – border of the national park, 4 – probable territory
Rys. 5. *Rozmieszczenie terytoriów lęgowych uszatki (1) i włochatki (2) w Pienińskim Parku Narodowym. 3 – granice parku narodowego, 4 – terytorium prawdopodobne*

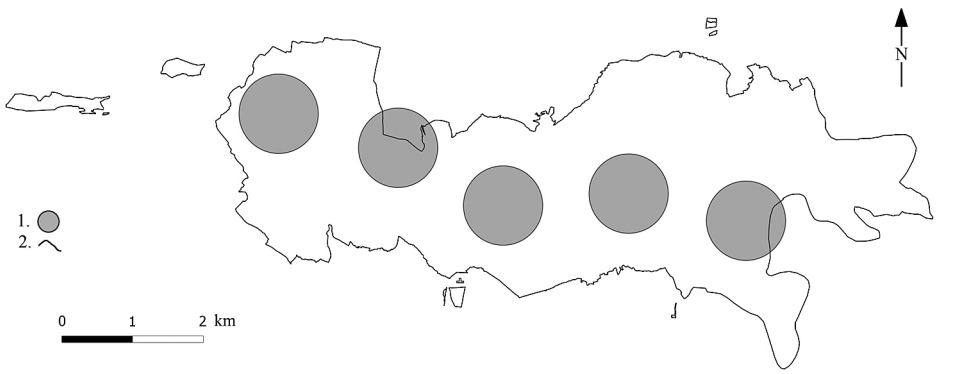

Fig. 6. Distribution of the Pygmy Owl *Glaucidium passerinum* breeding territories in the Pieniny Mts. National Park (symbols as on Fig. 2)
Rys. 6. *Rozmieszczenie terytoriów lęgowych sóweczki w Pienińskim Parku Narodowym (oznaczenia jak na rys. 2)*

Four territories of both Ural and Long-eared Owls were found in the PNP. The density of Ural Owls, whose territories laid exclusively in the northern part of the park, mostly in the vicinity of extensive glades and the upper parts of stream valleys (Fig. 4), was 0.9–1.7 pairs/10 km^2 (Table 1). In contrast, the density of Long-eared Owls, whose territories were situated around the edges of the PNP, in most cases in woodland margins near fields and meadows (Fig. 5), was 0.4–1.7 pairs/10 km^2 (Table 1).

We have found five territories of both the Tengmalm's Owl and the Pygmy Owl. The density of the former species was 0.9–2.2 pairs/10 km^2, and its territories were situated mainly among the silver fir trees in the eastern part of the park (Fig. 5). In contrast, the territories of Pygmy Owl were equally spaced among the silver firs and Norway spruces on the northern slopes of the PNP (Fig. 6); its density was 2.2 pairs/10 km^2 (Table 1).

In addition, in the surroundings of the PNP, a calling male of the Little Owl *Athene noctua* was heard on 4 March 2012 near the village of Sromowce Średnie (altitude ca 500 m asl.). On 17 March 2012, a male Barn Owl *Tyto alba* was heard as it was flying from Sromowce Wyżne towards Sromowce Niżne.

Discussion

The comparison of the data from this work with the results from 2001–2002 (Ciach 2005) indicates that the assemblage of breeding owls in the PNP has not changed significantly (χ^2=10.59, P=0.16). In 2012, however, some species were found to have a larger number of territories (Table 1), the consequence of which was a general increase in density from 12.9–16.3 pairs/10 km^2 to 14.6–19.8 pairs/10 km^2.

The Tawny Owl was the most numerous species in both 2002 and 2012, making up nearly half the owl assemblage in the PNP. During these ten years the numbers of the species increased (Table 1). In both periods densities of this owl were the highest in the eastern part of the PNP; and their values, fluctuating around a level of 10 pairs/10 km^2, are among the highest recorded in Poland (Table 2). The numbers of Tawny Owl in a given year depend mainly on the numbers of wood rodents and the thickness of the snow cover during the preceding winter (Jędrzejewska & Jędrzejewski 2001). In the mild climate of the Pieniny Mountains, the snow cover appears later and is thinner than in neighbouring ranges. The high abundance of these owls could also result from the mosaic-like environment of forests and glades, the diverse species composition and high seed productivity of woodland species (Ciach 2005).

The Ural Owl inhabits mainly south-eastern Poland and the Świętokrzyskie Mountains (Tomiałojć & Stawarczyk 2003); its population in the country is estimated at 750–1000 pairs (Chylarecki & Sikora 2007). This species achieves its greatest densities in the Beskid Niski and the Bieszczady Mountains, while it is less numerous in the western Carpathians (Table 2). Its westernmost localities are currently to be found in the Beskid Śląski and Beskid Żywiecki Mountains (Ciach 2010, Jagiełko & Wiśniewski 2012). In the eastern Carpathians the Ural Owl is the dominant species in the breeding owl assemblage (Ćwikowski 1996, Naturski 2001, Bylicka 2011), with densities exceeding 5 pairs/10 km^2 (Table 2). This owl displays a preference for old, open-canopy tree stands, mainly of European beech and silver fir, with a poorly developed shrub layer (Głowaciński & Stój 2007, Bylicka 2011). The territories of this species in the PNP recorded in 2012 coincided with those found back in 2002, but its density was far lower than in other parts of the Carpathians (Table 2).

The number and location of the Eagle Owl territories in the PNP in both periods was rather constant. The only exception was the location of the territory near the Trzy Korony and Podskalna Góra mountains (Ciach 2005), which had probably been abandoned; but a new locality appeared near Długa Grapa and Cisowiec. In Poland the Eagle Owl occupies mainly habitats of heterogenous structure, situated near open terrain, such as old, open-canopy tree stands with single rocks or clusters of rocks, or steep slopes. The Polish population of the Eagle Owl is estimated at 250–280 pairs, including 40 in the Carpathians (Tomiałojć & Stawarczyk 2003, Chylarecki & Sikora 2007). The density of the species in the PNP is the highest in Poland, and one of the highest recorded for this species elsewhere. High densities were also recorded in the Biebrza Basin (Pugacewicz 1995) and the Góry Stołowe (Stołowe Mts.) (Mikusek 1996). Numerous rock sills and faces of the Pieniny providing suitable nesting habitat for this owl species and extensive foraging grounds around these mountains are the factors explaining its high density there. Even though the calculated density may have been overestimated (as parts of some territories lie beyond the boundaries of the PNP), the distances between the centres of adjacent territories are among the shortest known over the entire range of the species (Mikkola 1983, Cramp 1985). The Eagle Owl is a relatively rare species in Poland (Table 2). Its low recorded densities may, to some degree, reflect the difficulties in the species

Table 2. Breeding assemblages of owls in selected woodland habitats of Poland (density expressed as the number of territories per 10 km²). SXA – Tawny Owl, SXU – Ural Owl, BB – Eagle Owl, GP – Pygmy Owl, AFU – Tengmalm's Owl, AO – Long-eared Owl, AN – Little Owl

Tabela 2. *Skład gatunkowy i zagęszczenie (terytoriów/10 km²) sów w wybranych środowiskach leśnych Polski. (1) – teren badań, (2) – powierzchnia, (3) – oznaczenia gatunków (SXA – puszczyk, SXU – puszczyk uralski, BB – puchacz, GP – sóweczka, AFU – włochatka, AO – uszatka, AN – pójdźka), (4) – łącznie zagęszczenie, (5) – źródło, (6) – niniejsza praca, (7) – mediana zagęszczeń, (8) – średnie zagęszczenie*

Study area (1)	Sample plot size (km²) (2)	SXA (3)	SXU	BB	GP	AFU	AO	AN	Total density (4)	Source (5)
Pieniński Park Narodowy	23.3	7.7–9.5	0.9–1.7	2.6	2.2	0.9–2.2	0.4–1.7		14.6–19.8	present study (6)
Pieniński Park Narodowy	23.3	6.9–7.3	0.9–1.3	2.6	1.3	0.9–1.7	0–1.7	+	12.9–16.3	Ciach (2005)
Magurski Park Narodowy	43.2	0.7	5.8		0.2	0.2	0.2		7.1	Naturski (2001 msc)
Gorczański Park Narodowy	9.2	1.1	3.3		1.1	2.2			7.7	Sobol (2002 msc)
Babiogórski Park Narodowy	10.6	2.8	0.9		6.5	4.7			14.9	Łanocha (2001 msc)
Pogórze Strzyżowskie – Czudec	19.8	8.1	1.5				1.5		11.1	Pitucha & Wojton (2012)
Pogórze Strzyżowskie – Kamienica	19.9	7.5	3.5			1.5	1.5		14.0	Pitucha & Wojton (2012)
Lasy Radłowsko-Wierzchosławickie	78.0	4.5–9.9	1.9–3.8				1.9–2.2		8.3–15.9	Martyka et al. (2002)
Bory Jastrzębsko-Żdżarskie	33.8	8.6	2.4				1.2		12.2	Martyka et al. (2002)
Kampinoski Park Narodowy	89.0	4.4–5.1					0.1–1.4		4.5–6.5	Olszewski et al. (2010)
Pogórze Przemyskie – Dąbrówka	25.0	2.8	5.2		0.4	0.8			9.2	Bylicka (2011)
Pogórze Przemyskie – Janicze	22.0	4.1	7.3		0.5	0.9	1.8	0.9	15.5	Bylicka (2011)
Puszcza Romincka (lasy)	30.0	6.0–6.7					0.3–1.3		6.3–8.0	Osojca (2004)
Puszcza Romincka (bory)	30.0	2.0–2.7				1.3–3.3	0–0.3		3.3–6.3	Osojca (2004)
Beskid Wyspowy	38.0	1.4–2.2	1.7–2.2	0.6	1.4–2.0	1.4–2.0			6.5–9.0	Kajtoch (2006)
Jedlnia-Letnisko	13.5	11.1							11.1	Słupek et al. (2007)
Świętokrzyski Park Narodowy	76.0	9.4–10.5	0.4						9.8–10.9	Kus & Szczepaniak (2003)
Median (7)		6.7	1.7	0	0	0.8	1.2	0	11.1	
Mean (8)		5.9	2.3	0.3	0.8	1.1	0.9	0.1	11.5	

detection, but on the other hand, may provide evidence for its low prevalence. The Eagle Owl population in the PNP, along with the other birds occurring in the Little Pieniny (the Homole, Biała Woda, Zaskalskie-Bodnarówka and Wysokie Skałki reserves) is one of the most important in Poland.

The Long-eared Owl occurs in the farming and forest landscapes over the whole country, nesting in clumps of trees among fields, forest margins and in urban woodland (Tomiałojć & Stawarczyk 2003). The number of Long-eared Owl territories in the PNP did not change over the past decade, although their locations did so. This owl avoids closed canopy woodlands. Its presence in the PNP is facilitated by the mosaic of woodlands and glades, which are its hunting grounds. The density of the species in the PNP lies within the range recorded for Poland (Table 2).

The Pygmy Owl inhabits the Carpathian and Sudetens Mountains, as well as extensive forest complexes, mainly in northern and north-eastern Poland (Tomiałojć & Stawarczyk 2003). It is associated with coniferous forests of diverse structure and age (Mikkola 1983, Cramp 1985). In the Białowieża Forest it prefers a mosaic of mixed and coniferous forests with old trees (Domaszewicz 1997). In the Sudetens it occurs in mixed coniferous woodland and in Norway spruce forests (Mikusek 2004), whereas in the Bieszczady Mts. territories have been found in Norway spruce forests and in European beech-silver fir woodland (Ćwikowski 1996). In Poland the densities of this species can reach 2 pairs/10 km^2 (the high density in the Babia Góra National Park is probably an artifact resulting from calculations per a small area of a montane coniferous forest) (Table 2). However, the densities based on dedicated studies of this species, combined with daytime monitoring and nest-hole searches, suggest that they are even higher, in excess of 5 pairs/10 km^2 (Mikusek 2001). This may indicate that not all individuals can be detected during usual night-time surveys typically performed in owl studies. The Pygmy Owl population of Poland was estimated at 400–500 breeding pairs (Chylarecki & Sikora 2007), although recent data suggest that as many as 1000–1500 pairs occur in the country (L. Kuczyński et al., in preparation). The present estimate may be the result of an actual increase in the population in recent years; the results of this work corroborate this view. In the last ten years the number of Pygmy Owl in the PNP has increased, and the territories discovered in 2012 coincided in part with those found in 2002.

The Tengmalm's Owl is a bird of coniferous forests (Mikkola 1983, Cramp 1985). Its mountain population in Poland occupies forests of Norway spruce and silver fir (Domaszewicz et al. 2007). In the PNP its territories were found in silver fir-European beech and silver fir-Norway spruce stands. The large proportion of deciduous and mixed forests in the PNP does not favour the more frequent occurrence of this owl species (Ciach 2005). Densities of the Tengmalm's Owl in Poland are quite variable (Table 2), which is probably due to the diverse species composition of the woodlands. Moreover, the numbers of this species fluctuate strongly in response to the varying numbers of rodents, which constitute its main source of food (Mikkola 1983, Cramp 1985). Nonetheless, there has been a noticeable increase in the numbers of the Tengmalm's Owl, and also of the Pygmy Owl in other parts of Poland (Mikusek 2004, Stachyra et al. 2005, Tchórzewski et al. 2006).

The Little Owl was found in the Pieniny Mts. in both periods. In 2002 a territory located partly in the PNP was found near the village of Sromowce Wyżne. In 2012, however, this species was detected in the village of Sromowce Niżne, outside the PNP. In Poland this species is the most numerous in the eastern part of the country. At the start of the 21st century numbers were estimated at 1000–1500 breeding pairs, but in recent years

this number has fallen sharply (Grzywaczewski 2006). The Little Owl inhabits mainly agricultural areas, especially those with a mosaic of fields, meadows and pastures, where it nests in old orchards, groves and roadside trees, and ever more commonly in buildings (Kopij & Kowalski 2007).

A new species for the immediate surroundings of the Pieniny Mts. is the Barn Owl, found in 2012. This species occurs throughout Poland except for high mountains and large forest complexes (Tomiałojć & Stawarczyk 2003). It has been exceptionally recorded in urbanized habitats of the Pieniny (Bocheński 1960b).

The species composition of owls in the PNP is much the same as in other mountain areas of Poland. The fact that six owl species were found to be breeding in the park and two other in its immediate neighbourhood provides evidence for the outstanding natural value of the PNP, especially in view of its relatively small area. What makes the Pieniny Mts. to stand out in comparison to other areas is the high density of its entire owl assemblage. The most important factors supporting owl populations within the park are the most likely: the park's strict conservation regime, good condition of habitats providing suitable breeding sites and the availability of food resources, and mild climate, which is particularly important for sedentary owl species The conservation of this area in the form of a national park provides the opportunity to track the changes in the owl assemblage, which is not directly affected by human activities.

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