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Notes on the reproduction, breeding biology and ethology of the Eurasian pygmy owl (*Glaucidium passerinum*) in Slovakia

Poznámky k hniezdeniu, hniezdnej biológii a etológii kuvička vrabčieho (*Glaucidium passerinum*) na Slovensku

Samuel PAČENOVSKÝ & Karol ŠOTNÁR

Abstract: Accessible data on 78 breeding occurrences of the Eurasian pygmy owl (*Glaucidium passerinum*) in Slovakia are evaluated. Data from the oldest known breeding in 1846 up to 2010 were used. The breeding of this species has been proved in 24 orographic units, at altitudes from 450 (400) to 1450 m. Distribution of the species in Slovakia closely follows the distribution of fir (*Abies alba*) and spruce (*Picea abies*) and breeding has also been recorded in forest habitats with an abundance of scots pine (*Pinus silvestris*) and black pine (*Pinus nigra*). From the point of view of natural and secondary origin of these forest habitats, the species breeds in both 'natural' habitats such as montane spruce forests and Euro-Siberian coniferous forests, forests with beech and fir, oak-hornbeam forests with lime and fir, as well as in secondary forest spruce plantations. From 22 evaluated Slovakian nests as many as 17 (70.8%) were situated no farther than 200 m from water. A high number of nests (72.5%) were situated at altitudes between 600–1100 m, with 13% above this range and 14.5% below. As many as 25 nest holes were located in spruce, both living and dead, and in snags, ten in fir (with a significant number of dead stumps), six in beech, four in oak and four in aspen. Nests were also found on one occasion each in larch, maple and black pine. On one occasion breeding took place in a nest-box. On several occasions the same nest hole was used repeatedly, with the highest number of such occasions being four times in the same tree in an eight year period. On three occasions a shift of nest location of ca. 200–350 m within the same territory occurred and two neighbouring pairs, and nests, were once found at the same time just 400 m from each other. Nest holes excavated by the *Dendrocopos major* and *Picoides tridactylus* are often used. On four occasions breeding took place in natural cavities (2× beech, 1× larch, 1× maple). The lowest situated nest was placed lower than one m above ground level and the highest 13 m above the ground. From 44 evaluated nest holes the highest number (26) were situated between 4–7 m. The production of young was evaluated in 57 cases, 34 of which were successful (69.7%). Young were found on 27 occasions, from which 80 fledged: an average of 2.96 per nest. This average is slightly lower than that calculated in Austria and Germany. In the colder than usual years of 2009 and 2010, which were poorer in food availability and characterized by high precipitation, the numbers of fledglings was even lower: on average only 2.3 and 2.0 fledglings per nest respectively. The average number of fledglings per nest from 8 Slovakian nests in three consecutive years (1989 to 1991) was 3.75 fledglings per nest but the same parameter from nine Slovakian nests in six years (2005 to 2010) dropped to 2.88. This indicates a diminishing trend in nest productivity. On one occasion the movements of fledglings in the territory after their fledging were observed for 27 days. On other occasions disturbance due to human activity (tree felling) was recorded as the reason for an abandoned breeding attempt. Such disturbance can be extreme, for example, in the Kysuce Region in the Javorníky Mts and Turzovská vrchovina Mts, two breeding sites with nests in 1999 and 2003 were later destroyed because of complete removal of those forest tracts attacked by bark-beetles. In 2009 in the Strážovské vrchy Mts, a curious case was observed where, during the period of parent care of nestlings, the male disappeared but the female continued to feed her two nestlings alone until they fledged. Just after fledging these fledglings were predated, probably by a *Pernis apivorus* or an *Accipiter nisus*, both of which bred nearby. The authors made several remarkable ethological observations in the life of Eurasian pygmy owls. In the Strážovské vrchy Mts the 'nest-showing' of more than one cavity in its territory by the male to the female was observed. Copulation was observed a total of eleven times during the months February – May in the years 1989–2010, with the following frequency: February 1×, March 3×, first half of April 5×, second half of April 1×, beginning of May 1×. Interactions of the Eurasian pygmy owls with diurnal raptors, other owl species and other cavity-breeders were also documented. In the Strážovské vrchy Mts the breeding of an Eurasian pygmy owl pair at a relatively close distance to the nests of various diurnal raptors were as follows (species/distance from nest of the raptor from nest of the Eurasian pygmy owl): *Pernis apivorus* 7 m, *Accipiter nisus* 230 m, *Buteo buteo* 250 m, *Aquila pomarina* 500 m, *Accipiter gentilis* 700 m. In the Volovské vrchy Mts a pair of Eurasian pygmy owls successfully bred at a distance of 600 m from two nests of *Strix uralensis*, and another pair bred at a distance of 500 m from a nest of *Strix aluco*. The breeding of another pair of *Strix aluco* just 30 m from a cavity used by a pair of Eurasian pygmy owl led to unsuccessful breeding/abandoned nest by this pair. Competitive behaviour was observed between the Eurasian pygmy owl and other cavity-breeders such as *Sitta europaea* and *Dendrocopos major*, and an occasion of the predatory killing of an owl fledgling by *Strix uralensis* was suspected. An attack by *Aegolius funereus* on a Eurasian pygmy owl was also observed.

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Abstrakt: V príspevku sú vyhodnotené dostupné výsledky o priebehu 78 hniezdení kuvičkov vrabčích (*Glaucidium passerinum*) zo Slovenska od najstaršieho známeho údaja o hniezdení druhu z roku 1846 až do roku 2010. Hniezdenie kuvička vrabčieho bolo zistené v 24 orografických celkoch Slovenska, v nadmorských výškach 450(400)–1450 m n. m. Rozšírenie kuvička vrabčieho sleduje na Slovensku rozšírenie jedle a smreka. Hniezdenie bolo zistené aj v biotopoch s výrazným zastúpením borovice lesnej a čiernej. Z hľadiska pôvodnosti biotopov sme zistili kuvička vrabčieho ako hniezdiaci druh aj v lesných biotopoch prírode blízkeho typu (horské smrečiny a eurosibírske ihličnaté lesy, jedľové smrečiny, bukové a jedľové kvetnaté lesy, dubovohrabové lesy lipové s výskytom jedle), ako aj v kultúrach smreka obyčajného. Z 22 hodnotených slovenských hniezd kuvičkov vrabčích až 17 (70,8 %) sa nachádzalo do 200 m od vody. Výrazná prevaha (72,5 %) hniezd sa nachádza vo výškach 600–1100 m n. m., 13 % nad a 14,5 % pod týmto rozmedzím. Až 25 dutín sa nachádzalo v smrekoch, pričom boli zistené živé aj odumreté a zlomené smreky, 10 bolo v jedliach (s výraznou prevahou odumretých), 6 hniezdení prebehlo v dutinách bukov, 4 v duboch, 4 v osikách, z iných drevín boli zistené hniezdne dutiny po jednom prípade v smrekovci, jaseni, v suchom javore, v borovici čiernej a jedno hniezdenie prebehlo v búdke. Vo viacerých prípadoch bolo zistené opakované obsadenie tej istej dutiny. Najviac prípadov opakovaného hniezdenia v tom istom hniezdnom strome bolo zistených až 4× v rozmedzí 8 rokov, v troch prípadoch bol zistený posun lokalizácie hniezda v rámci toho istého teritória o 200–350 m a boli nájdené aj súčasne obsadené dutiny v susediacich teritóriách len 400 m od seba. Nájdené hniezdne dutiny boli vytesané ďatľom veľkým (*Dendrocopos major*) a ďubníkom trojprstým (*Picoides tridactylus*). V štyroch prípadoch bolo zistené hniezdenie v prirodzenej dutine (2× buk, 1× smrekovec a 1× čiastočne vyschnutý javor). Najnižšie vytvorená hniezdna dutina bola zistená vo výške menej ako 1 m nad zemou a najvyššie vo výške 13 m. Zo 44 hodnotených dutín bolo najviac (26) vo výške 4–7 m. Produktivita hniezdenia bola hodnotená u 57 hniezdení. Z nich 34 bolo úspešných, čo predstavuje 69,7 %. Presný počet mláďat bol zistený u 27 hniezdení, z ktorých vyletelo 80 mláďat. Priemer bol 2,96 mláďat na hniezdo, čo je o málo menej, ako bolo zistené v Rakúsku či Nemecku. V chladnejších, na potravu zrejme chudobnejších a silnými zrážkami sa vyznačujúcich rokoch 2009 a 2010 boli počty vyvedených mláďat nižšie, v priemere iba 2,3, resp. 2,0 mláďat/hniezdo. Priemerný počet vyvedených mláďat na hniezdo z 8 slovenských hniezd v troch po sebe nasledujúcich rokoch 1989–1991 bol 3,75 juv. / hniezdo. Tento ukazovateľ z 9 slovenských hniezd poklesol v šiestich po sebe nasledujúcich rokoch 2005–2010 na 2,88 juv./hniezdo, čo naznačuje výrazne sa znižujúci trend produktivity hniezdenia. V jednom prípade bol pohyb vyletených mláďat po teritóriu sledovaný až 27 dní. Vo viacerých prípadoch bola identifikovaná antropogénna rušivá aktivita – ťažba ako príčina neúspešného hniezdenia kuvičkov. Dve známe hniezdiská kuvičkov, kde boli v rokoch 1999 a 2003 dohľadané hniezda na Kysuciach v Javorníkoch a v Turzovskej vrchovine, neskôr úplne zanikli pre vyťaženie porastov napadnutých kôrovcom. V Strážovských vrchoch bol v roku 2009 pozorovaný prípad, kedy počas výchovy mláďat zmizol z lokality samec a samica vychovávala dve mláďatá sama. Hneď po vyletení boli mláďatá ulovené pravdepodobne včelárom alebo jastrabom krahulcom, ktorí hniezdili v blízkosti kuvičkov. Autori získali viacero pozoruhodných etologických pozorovaní zo života kuvičkov. V Strážovských vrchoch bolo pozorované ukazovanie viacerých dutín, ktoré samec predvádzal vyvolenej samici v svojom teritóriu. Celkove bolo párenie kuvičkov v rokoch 1989–2010 zistené počas mesiacov február – máj s nasledovnou frekvenciou: február 1×, marec 3×, 1. polovica apríla 5×, 2. polovica apríla 1× a začiatok mája 1×. Boli sledované interakcie kuvičkov vrabčích s dennými dravcami, sovami a inými dutinovými hniezdičmi. V Strážovských vrchoch bolo zistené hniezdenie páru kuvičkov v pomerne tesnej blízkosti viacerých druhov denných dravcov, konkrétne (druh/vzdialenosť hniezda dravca od hniezda kuvičkov): *Pernis apivorus* 7 m, *Accipiter nisus* 230 m, *Buteo buteo* 250 m, *Aquila pomarina* 500 m, *Accipiter gentilis* 700 m. Vo Volovských vrchoch bolo pozorované úspešné vyhniezdenie páru kuvičkov vo vzdialenosti 600 m od dvoch hniezd *Strix uralensis* a iného páru kuvičkov vo vzdialenosti 500 m od hniezda *Strix aluco*, ale hniezdenie páru *Strix aluco* 30 m od dutiny, ktorú využíval pár kuvičkov, viedlo k neúspešnému hniezdeniu (zanechanie dutiny). Konkurenčné správanie bolo pozorované medzi kuvičkom vrabčím a inými dutinovými hniezdičmi, brhlíkom a ďatľom veľkým. Zaznamenaný bol aj pravdepodobný prípad predácie vyleteného mláďaťa kuvička sovou dlhochvostou a útok pôtika kapcavého na kuvička.

Key words: habitat, vertical distribution, breeding season, productivity of young, eco-ethology, competition, nest tree, nest characteristics

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Introduction

The distribution of the Eurasian pygmy owl (*Glaucidium passerinum*) in Slovakia covers most of the northern part of central Slovakia and large areas of the eastern part of the country (Danko et al. 2002, Pačenovský 2005). Its distribution area comprises an almost uninterrupted zone of forested mountains with stretches of coniferous and mixed forests and ranges from its lowest known occurrence in a spruce forest mixed with larch, hornbeam and oak at an altitude as low as about 300 m in the northern part of the Tribeč Mts (Šotnár, unpubl.) through several habitats with varying representation of fir and spruce up to the highest forest limit in the Veľká Fatra, Malá Fatra, Vysoké Tatry and Nízke Tatry Mts at altitudes of 1400–1650 m (Bališ 1972, Danko et al. 2002, Pačenovský & Shurulinkov 2008). This owl usually avoids coherent deciduous forests, but this seems not to be a strict rule (Danko et al. 2002). It has been found in deciduous forests with just islets of young coniferous trees or only with forest nurseries of coniferous trees, or conifers mixed into stretches of deciduous forests at rates lower than 30%. It has also been found in deciduous forest with only a few conifers. Thus it breeds in various habitats and at considerably different altitudes. There are several available data on distribution of the population based on observations from spring mating (March – April) and autumn mating (August – October), but not as many data from the breeding season (April – July). There is a lack of direct finds of breeding cavities, because locating nest sites is particulary difficult due to the secretive way of life of the species in this season of the year. Our knowledge based on a few dozen nests found is not adequate, and this is also due to the low number of ornithologists specializing in research of this owl species, which clearly does not correspond with the massive altitudinal distribution of the species across several vegetation zones.

Older literary data on breeding from Slovakia was sumerized by Matoušek (1962) and Ferianc (1979), and A. Mošanský (1979) elaborated primarily the museum-based data from eastern Slovakia. The book „Fauna of the ČSSR“ (Hudec et al. 1983) states in connection with the Eurasian pygmy owl population that its distribution in Slovakia at that time was much less known than in the Czech Republic. Regarding Slovakia only general information is mentioned on breeding at higher positions in forested mountains. These data were taken over from earlier sources and specific data on breeding were not mentioned. An overview of published data on the Eurasian pygmy owl from the eastern Slovakia from the earliest known data from the 19th century until 1988 was summarized by Danko (1988). This is an overview of literary data complemented by personal observations and more up-to-date information collected from local ornithologists, and it mentions five cases of breeding (Belianske Tatry Mts, Levočské vrchy Mts, Šarišská vrchovina Mts, Volovské vrchy Mts and Slovenský raj Mts). But prior to 1988 only very little specific data on nests in Slovakia is available. Probably the oldest known nest record from our territory is a note on a clutch from 1846 from the surroundings of Banská Bystrica (J. S. Petényi in Matoušek 1962). Further find of a nest in Slovakia was described by Klaus et al. (1982) in the Belianske Tatry Mts.

Research into distribution of the species after 1989 has been dealt with particularly by S. Pačenovský and A. Kürthy in eastern Slovakia in co-operation with further ornithologists, and by K. Šotnár in central Slovakia. Their results have been published in a number of works dealing with distribution of the species (Pačenovský & Kürthy 1991, Pačenovský 1992, Pačenovský & Matis 1997, Uhrin & Pačenovský 1997), ethology and feeding ecology of the species (Pačenovský 1990, 1993), evaluation of the autumn mating of the species (Pačenovský & Kürthy 1992) and interactions with other forest owls (Pačenovský 1995).

The work of Mikusek et al. (2001) discusses the food of the Eurasian pygmy owl in central Europe, including Slovakia. Some of these works also mention specific data on breeding and nests. Actual accessible data on spatial and altitudinal distribution of the species in Slovakia, preferred types of habitats and densities was summarised in the comprehensive work on the birds of Slovakia by Danko et al. (2002). Several newer findings on the breeding biology and ethology of the species have been published by Šotnár (1998, 2004, 2009, 2010). Findings on densities of the species from a number of Slovakian mountain ranges at altitudes between 800–1650 m were compared with densities in Bulgarian mountains by Pačenovský & Shurulinkov (2008).

The objectives of this contribution are to summarize and evaluate data on known cases of confirmed breeding of the Eurasian pygmy owl found so far in Slovakia, and to evaluate the knowledge on its reproduction behaviour, ethology and competitition with other species. The present work is partially based on already published data, but its substantial part is composed of new and as yet unpublished data. This work aims to fill in the gaps in knowledge about the eco-ethology of breeding of the Eurasian pygmy owl in Slovak ornithological literature, and to compare the findings with other data from the distribution range of the species in Europe.

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Material and methods

Territories of Eurasian pygmy owls were searched in the autumn and spring seasons. Breeding territories were located on the basis of knowledge on calling spots of males in the spring season. Presence of Eurasian pygmy owls is possible to ascertain easily at the site during spring or autumn mating in the months March – April and August – October respectively. Recording of its acoustic displays is probably the only effective method of establishing the presence of *Glaucidium passerinum* (Scherzinger 1970, Kloubec 1992). In surveys of known territories of Eurasian pygmy owls emphasis has been given especially to ascertaining the presence of the female in breeding territories. Eco-ethology of the species has been processed on the basis of observations on ascertained breeding sites in individual phases of the breeding cycle: in periods of mating, incubation, care for nestlings and care for fledglings after they leave the nest.

In the survey of Eurasian pygmy owl territories the first of the authors used especially twilight peaks of activity of the species (morning twilight and evening dusk), and in the breeding season the eco-ethology of the species was also observed during daylight. The second author used a similar method with a difference in the preferred period of the day, because even breeding territories of Eurasian pygmy owls could be located during daylight periods, and almost every nest was found during daylight.

The basic material for evaluation of results came from the authors' field observations and notes from 22 breedings of the Eurasian pygmy owls (some nests were used for breeding repeatedly in more than one season) during the 1989–2010 (Tab. 1), and notes on eight fledged families of Eurasian pygmy owls in the period 1990–2010 (Tab. 2) from eight orographic units: Volovské vrchy Mts, Čierna hora Mts, Slovenský kras Mts, Revúcka vrchovina Mts, Slovenský raj Mts, Vtáčnik Mts, Žiar Mts and Strážovské vrchy Mts (Figs 1, 2; Tabs 1, 2).

In their preparation of results the authors of the contribution also used their knowledge and the as yet unpublished data of a number of other ornithologists who intentionally or accidentally found nests and fledglings of Eurasian pygmy owls. The analysis of nests thus included six nests from the Veľká Fatra and Starohorské vrchy Mts in 1990–2007 found by M. Saniga, six nests from the surroundings of Rejdová in 2000–2009 found by Z. Petrovics, three nests from the Poľana Mts found in 1991–1999 by A. Krištín and associates, three nests and a fledged family found in the Nízke Tatry Mts and in the Liptovská kotlina Basin in 1993–1994 by P. Vrlík and associates, three nests found in the Žiar Mts in 1983, 1989 and 2007 by L. Bohačík, two nests from the Turzovská vrchovina Mts and Javorníky Mts in 1991 found by J. Korňan and associates, and fledged families found in 1994 in the Oravská vrchovina Mts and Oravská Magura Mts in 2005 by D. Karaska. We also used data on a further nine nests and two fledged families, collected from other ornithologists (Tabs 1, 2).

The set of results was completed with data on the breeding of European pygmy owls (one clutch, two nests, four fledged families) from the period 1846–1984, already published earlier by other authors (Tabs 1, 2).

The habitat surroundings of the nests of Eurasian pygmy owls was characterized in a catalogue of habitats in Slovakia (Eliáš et al., 1991), and the comparative abundance of individual tree species in these habitats was estimated. In the case of data on nests taken over from other ornithologists, we had to rely on their decriptions of habitats and further details connected with the location of these nests.

Eurasian pygmy owls breed in smaller nest cavities, so we encountered a methodological problem in checking their nests. A substantial part of the species' reproduction cycle is hidden from the eyes of observers as these cavities are inaccessible or only hardly accessible, and so it is not simple to obtain unambiguous information on numbers of fledged young birds. In the cases of lower-positioned nest cavities they were checked visually with the help of a small mirror. Older nestlings a few days before leaving the nest are often spotted looking out from nest cavity, and from the characteristic colour features of their faces it is possible to assume the number of nestlings. Fledging of young birds from the nest usually progresses gradually and it can last several days. As a consequence of these circumstances, in most cases it is necessary to make more than one visit to each nest at short intervals in order to ascertain nest productivity. If this is not possible to keep up for some reason, the data are usually distorted and the number of young birds cannot be stated. This is also the reason why in some data on breeding from Slovakia the number of young birds is not known (in 57 located nests the frequency of unknown breeding success represents 43.9% of occasions).

Results and discussion

Proved breedings

In this part of the contribution the authors evaluate 78 confirmed breedings of Eurasian pygmy owls in Slovakia. Breeding has so far been found in 25 orographic units of Slovakia (Fig. 1). The oldest data on breeding with the find of a clutch originates from June 5, 1846 in the surround-

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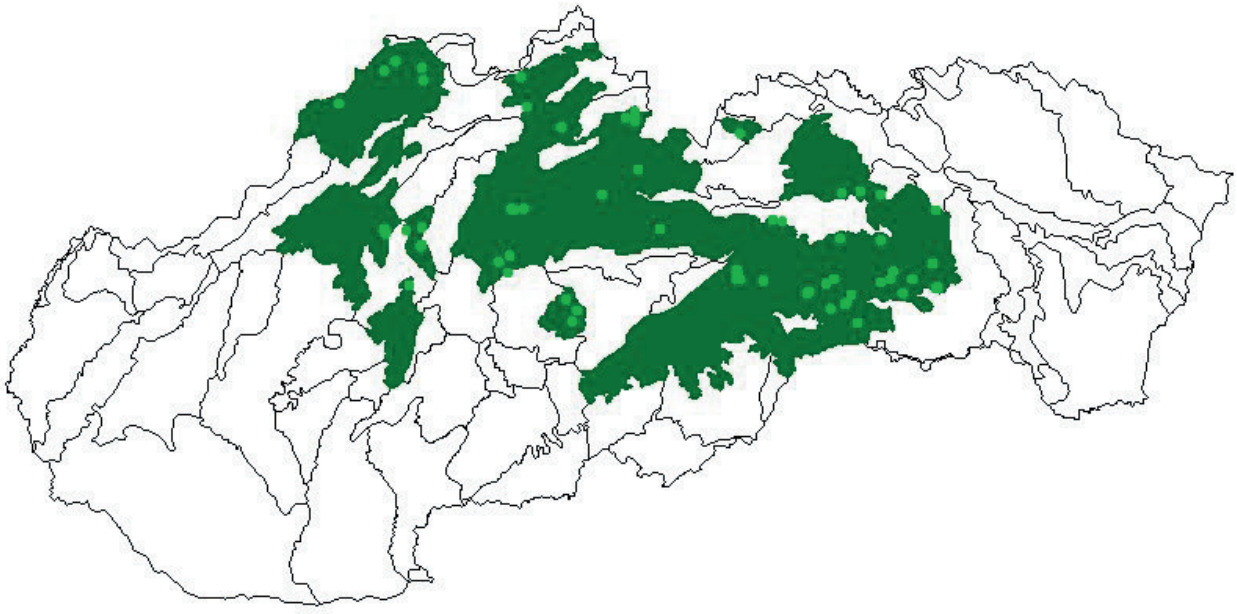


Fig. 1. Breeding of the Eurasian pygmy owl (*Glaucidium passerinum*) in Slovakia. The orographic units, where nests or fledged families has been found (dark-green colour), approximate position of breeding sites (light green dots).
Obr. 1. Hniezdenie kuvička vrabčieho (*Glaucidium passerinum*) na Slovensku. Orografické celky, v ktorých boli nájdené hniezda alebo vyletené rodiny (tmavozelená farba), približná lokalizácia hniezdisk (svetlozelené body).

ings of Banská Bystrica (J. S. Petényi in Matoušek 1962). It is not possible to assign this data to any orographic unit, or link it to any specific habitat, because the exact location of the nest is not known. The other data can be divided into 57 finds of nests (Tab. 1, Fig. 2) and to other finds of confirmed breeding: 20 finds of fledged young and one find of an adult with an incubation bald spot (J. Palášthy in Mošanský 1979; Tab. 2, Fig. 2). These are linked to one of the orographic units in Slovakia.

An overview of orographic units of Slovakia with so far confirmed breeding (nest or fledglings) is presented in map form (Fig. 1). Breeding has been confirmed in the following orographic units (the number of found nests/breedings is given in brackets): Javorníky Mts (3), Turzovská vrchovina Mts (2), Podbeskydská vrchovina Mts (1), Oravská Magura Mts (1), Oravská vrchovina Mts (1), Západné Tatry Mts (4), Liptovská kotlina Basin (1), Belianske Tatry Mts (1), Levočské vrchy Mts (2), Strážovské vrchy Mts (5), Žiar Mts (4), Vtáčnik Mts (1), Veľká Fatra Mts (3), Starohorské vrchy Mts (3), Nízke Tatry Mts (3), Poľana Mts (3), Stolické vrchy Mts (1), Revúcka vrchovina Mts (6), Slovenský raj Mts (2), Volovské vrchy Mts (24), Slovenský kras Mts (1), Branisko Mts (1), Šarišská vrchovina Mts (1) and Čierna hora Mts (2). This overview does not reflect the real distribution of Eurasian pygmy owls in Slovakia, because this area is even broader than the area of these orographic units. It is more a reflection of the intensity of ornithological research, besides other studies focusing on this owl species, especially at higher altitudes in Slovakia.

Characteristics of the breeding habitat

On the basis of so far ascertained known cases of breeding, where the breeding habitat has been evaluated (n = 69) we selected the following characteristics, as well as some further, less frequent types of breeding habitat:

1. Forest habitats at the lower limit of natural distribution of the fir, oak-hornbeam forests with lime and fir (the eastern part of the Volovské vrchy Mts and in the Šarišská vrchovina Mts), at altitudes 450–550 m. Age of forest grows in vicinity of nests and in broader surroundings was 60–80 years, forest composition was oak, hornbeam, fir, beech, ash, with other trees mixed in. In Eurasian pygmy owl territories found below 550 metres,

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Tab. 1. Synopsis of Eurasian pygmy owl nests found in Slovakia
Tab. 1. Prehľad nálezov hniezd kuvičkov vrabčích na Slovensku

1	2	3	4	5	6	7	8	9
N1	?	surroundings of Banská Bystrica	5 June 1846	clutch / násada		?	?	?
N2	Belianske Tatry Mts	?	1 July 1973		3	?	*Ptri*	?
N3	Levočské vrchy Mts	Bijacovce, Páršivá	28 April 1977	after 6 June 1977	3	(beech)	box / búdka	3.0
N4	Žiar Mts.	Budiš	1983	21 June 1983	3	aspen	*Dmaj*	5.0
N5	Žiar Mts.	Budiš	1989	before 25 June 1989	min. 2	beech	natural	6.0
N6	Volovské vrchy Mts	Košice, Kamenný hrb	13 May 1989	8–13 June 1989	4	fir (dry)	*Dmaj*	1.9
N7	Čierna hora Mts	Vysoký vrch	17 June 1989	end of June 1989	4	fir (dry)	*Dmaj*	10.0
N8	Volovské vrchy Mts	Košice, Kamenný hrb	31 March 1990	3–5 June 1990	5	fir (dry)	*Dmaj*	1.9
N9	Čierna hora Mts	Vysoký vrch	25 April 1990	ca. 15–18 June 1990	5	fir (dry)	*Dmaj*	10.0
N10	Veľká Fatra Mts	Skalná Alpa	10 June 1990		?	fir	*Ptri*	3.0
N11	Volovské vrchy Mts	Košice, Bankov	1 April 1990	14 June 1990	min. 1	oak	*Dmaj*	5.0
N12	Podbeskydská vrchovina Mts	Oravská Lesná, Okáľka	18 April 1990		?	spruce		7.5
N13	Volovské vrchy Mts	Bankov	10 April 1991	16 June 1991	3	oak	*Dmaj*	6.0
N14	Veľká Fatra Mts	Skalná Alpa	5 June 1991		?	spruce	*Ptri*	4.0
N15	Volovské vrchy Mts	Opátka, Košiarisko	2 April 1991	17–23 June 1991	5	beech (dry)	*Dmaj*	7.0
N16	Volovské vrchy Mts (Galmus)	Olcnava	14 June 1991	early June 1991	?	larch	natural	3.5
N17	Poľana Mts	Predná Poľana	29 May 1991		?	spruce	*Ptri*	3.0
N18	Turzovská vrchovina Mts		13 June 1991		4	spruce	*Dmaj*	6.5
N19	Javorníky Mts	Zákopčie, Petranky	1991	unsuccessful breeding	0	spruce	*Dmaj* / *Ptri*	
N20	Veľká Fatra Mts	Veľká Smrekovica	7 June 1992			fir		5.0
N21	Poľana Mts	Hrončecký Grúň	12 June 1994		?	spruce	*Dmaj*	5.0
N22	Volovské vrchy Mts	Košice, Bankov	3 May 1994	after 9 July ?	?	oak	*Dmaj*	4.0
N23	Nízke Tatry Mts	Ilanovská dolina	end of June 1993	end of June 1994	2 or 3	spruce	*Ptri*	1.7
N24	Starohorské vrchy Mts	Jelenská skala	30 May 1995		?	fir	*Ptri*	3.5
N25	Revúcka vrchovina Mts	Veľký Radzim	9 April 1995	end of June 1995	?	aspen	*Dmaj*	9.0
N26	Nízke Tatry Mts	Ilanovská dolina	end of June 1994		?	spruce	*Ptri*	1.7
N27	Volovské vrchy Mts	Košice, Bankov	31 May 1997		?	oak	*Dmaj*	6.0
N28	Strážovské vrchy Mts	Tužina, Jelení hrebeň	12 March 1997	15 July 1997	?	fir (dry)	*Dmaj*	6.0
N29	Strážovské vrchy Mts	Tužina, Hvizdák	20 May 1998	26 June 1998	3	ash	*Dmaj*	4.0
N30	Liptovská kotlina Basin	NR Švihrová	end of July 1994	?	?	spruce		2.5
N31	Starohorské vrchy Mts	Graniarka	28 May 1999		?	spruce	*Ptri*	6.0

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10	11	12	13	14	15
?				Petényi in Matoušek 1962	
?		?		Klaus et al. 1982	
?	spruce (beech) 40–(60) y.	800	S	E. Hrtan in Danko 1988	
S	fir, beech 70–80 y.	600	N	L. Bohačík	
E	fir, beech 70–80 y.	600	N	L. Bohačík	200 m from nest in 1983 / 200 m od hniezda v r. 1983
S	beech, oak, fir 60–80 y.	520	SW	S. Pačenovský, A. Kürthy	
W	fir, beech, sycamore 100 y.	780	S	S. Pačenovský, A. Kürthy, D. Rusina	
S	beech, oak, fir 60–80 y.	520	SW	S. Pačenovský, A. Kürthy	same nest as in 1989 / to isté hniezdo ako v r. 1989
W	fir, beech, sycamore 100 y.	780	S	S. Pačenovský	same nest as in 1989 / to isté hniezdo ako v r. 1989
NW	fir, beech	1025		M. Saniga	feeding of young in nest by adult / kŕmenie mláďat v hniezde dospelým vtákom
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský, A. Kürthy	
W	spruce, beech, compartment cutting	780		M. Demko	April 18, mating, M and F in nest hole, May 24, pellets below nest / párenie 18. 4., vletovanie M aj F do dutiny, 24. 5. vývržky pod hniezdom
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	same tree, but other nest hole as in 1990 / rovnaký strom, ale iná dutina ako v r. 1990
SE	spruce–beech	1250		M. Saniga	juv. in nest, M with food / mláďatá v hniezde, M s potravou
W	fir, beech, sycamore 40–75 y.	750	SE	S. Pačenovský	
	spruce, larch 40–60 y.	740	SW (low)	S. Pačenovský, K. Takáč	May 9, heard F, June 14, found nest, but juv. already fledged out, numerous pellets below / 9. 5. počutá F, 14. 6. nájdené hniezdo už po vyletení juv., množstvo vývržkov pod hniezdom
SW	spruce, beech, maple, rowan 100–150 y.	1200		A. Krištín	feeding of juv. at nest / kŕmenie juv. v hniezde
	spruce 70–80 y.			J. Korňan	
	spruce 80 y.			J. Korňan	unsuccessful breeding, found clutch of 4 cold eggs / neúspešné hniezdenie, nájdená násada 4 zachlad. vajec (leg. J. Kizek)
S	rowan–spruce	1450		M. Saniga	youngs fed by F in nest / mláďatá v hniezde kŕmené F
NE	spruce, beech 100–200 y.	890		A. Krištín	feeding in nest / kŕmenie v hniezde
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	old nest from year 1990, July 9 F still in nest – ca. unsuccessful breeding / staré hniezdo z 1990, 9. 7. F stále pri hniezde – asi neúspešné hniezdenie
SW	spruce, fir, beech and maple mixed in	900	SE	P. Vrlík	
NW	fir, spruce	950		M. Saniga	youngs fed by F in nest / mláďatá krmené F v hniezde
SW	beech, spruce, aspen and birch mixed in, 80 y.	700	W	S. Pačenovský	juv. possibly fledged between June 10 and 30, pellets below nest / juv. mohli vyletieť medzi 10. 6. a 30. 6.
SW	spruce, fir, beech and maple mixed in	900	SE	P. Vrlík	same nest as in 1994 / to isté hniezdo ako v r. 1994
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	same tree as in 1990, 1991, 1994 / rovnaký strom, ako v 1990, 1991, 1994
W	beech, fir, spruce 10–120 y.	750	W	K. Šotnár	
NW	spruce, ash, fir, beech, maple, rowan 60–80 y.	700	W	K. Šotnár	
	pine, spruce, rowan mixed in	830		P. Vrlík	nest found in IX., M at cavity with pellets from breeding season / hniezdo nájdené v júli, M pri dutine s vývržkami (leg. Vrlík & Borsík)
W	fir–spruce	850		M. Saniga	M at occupied nest hole with food / M pri hniezdnej dutine s potravou

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Tab. 1. continuation
Tab. 1. pokračovanie

1	2	3	4	5	6	7	8	9
N32	Poľana Mts	Čierny Grúň	1 June 1999		?	spruce	*Dmaj*	5.0
N33	Vtáčnik Mts	Hradec, Kuncľová	16 June 1999	24–26 June 1999	4	spruce	*Ptri*	7.0
N34	Javorníky Mts	Zákopčie, u Fľašíka, Osobité	18 March 1999	before 27 June 1999	2	spruce	*Dmaj*	12.0
N35	Volovské vrchy Mts	Volovec	7 July 2000	before 7 July 2000	4	beech	*Dmaj*	6.0
N36	Stolické vrchy Mts	Rejdová, Mlynná dolina valley	2000		?	spruce		
N37	Revúcka vrchovina Mts	Rejdová, Buč	2000		?	spruce	*Ptri*	
N38	Revúcka vrchovina Mts	Rejdová, Krišťáková	2002		?	spruce		?
N39	Turzovská vrchovina Mts	Jurošovský vrch	16 April 2003		0	spruce	*Dmaj*	5.0
N40	Strážovské vrchy Mts	Tužina, Hvizdák	16 April 2005	5–10 June 2005	5	aspen	*Dmaj*	
N41	Revúcka vrchovina Mts	Rejdová, Krišťáková	2005		?	spruce	*Dmaj*	
N42	Západné Tatry Mts	Oravice, nad Šufákom	26 July 2006	before 26 July 2006	3	spruce		8.0
N43	Starohorské vrchy Mts	Glezúr	3 June 2007		min. 2	beech	natural	5.0
N44	Žiar Mts	Slovenské Pravno	21 June 2007	23–25 June 2007	3	black pine	*Dmaj*	4.0
N45	Západné Tatry Mts (Osobitá)	Predná Kremenná	June 2008	16 June 2008	3	spruce (dry)	*Dmaj* / *Ptri*	2.5
N46	Západné Tatry Mts	Peciská	17 June 2008		?	spruce	*Dmaj*	12.0
N47	Volovské vrchy Mts	Štós, Tupý vrch	3 May 2008	after 21 June 2008	min. 2	spruce (dry)	*Dmaj*	1.5
N48	Revúcka vrchovina Mts	Rejdová, Buč	2008		?	spruce	*Dmaj*	
N49	Revúcka vrchovina Mts	Rejdová, Páleniská	2009		?	spruce	*Dmaj*	
N50	Volovské vrchy Mts	Košice, Bankov	4 June 2009	before 4 June 2009	2	fir (dry)	*Dmaj*	6.0
N51	Strážovské vrchy Mts	Hvizdák	29 April 2009	25–28 June 2009	2	aspen	*Dmaj* / *Ptri*	6.0
N52	Strážovské vrchy Mts	Hvizdák	4 April 2010	7–11 June 2010	2	beech (dry)	natural	4.1
N53	Žiar Mts	Kľačno, Pod Závozmi	8 April 2010	3–5 June 2010	min. 1	maple	*Dmaj*	4.0
N54	Volovské vrchy Mts	Štós, Tupý vrch	9 April 2010	after 3 June 2010	3	spruce (dry)	*Dmaj*	1.5
N55	Volovské vrchy Mts	Štós, Štósky vrch	13 April 2010		0	fir (dry)	*Dmaj*	4.0
N56	Volovské vrchy Mts	Majerská dolina valley	14 June 2010	14–15 June 2010	3	beech (dry)	*Dmaj*	1.8
H57	Západné Tatry Mts	Oravice, Suchá dolina valley	8 June 10		?	aspen	*Dmaj*	13.0

1 – nest code / kód hniezda; 2 – mountain range / pohorie; 3 – site / lokalita; 4 – nest finding date / dátum nálezu hniezda; 5 – fledged young date / dátum pozorovania vyletených mláďat; 6 – no. of fledged juveniles / počet vyvedených mláďat; nest hole / hniezdna dutina: 7 – tree / strom; 8 – origin / pôvod; 9 – hight above ground / výška nad zemou [m]; 10 – orientation / orientácia; 11 – habitat / age of forest // biotop / vek porastu; 12 – altitude / nadmorská výška [m]; 13 – slope orientation / sklon svahu; 14 – source / zdroj; 15 – notes / poznámky

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10	11	12	13	14	15
NW	spruce, beech, maple 100–150 y., edge	1130		A. Krištín	feeding in nest / kŕmenie v hniezde
	spruce, maple, beech 60–80 y.	700	SW	K. Šotnár	
S	spruce 80–100 y.	550	S	M. Špilák	
SW	beech, sycamore, maple, ash 60–100 y.	950	SW	S. Pačenovský	
	spruce 60 y.	1040	NW	Z. Petrovics	
	spruce 60–80 y.	845	N	Z. Petrovics	
	spruce, 60–80 y.	970	SE	Z. Petrovics	
SW	spruce 70–90 y.	620	ridge	M. Špilák	May 27, found 2 eggs, abandoned nest / 27. 5. nájdené 2 vajcia, zanechané hniezdo
W	beech, spruce, ash 60–80 y.	700	SW	K. Šotnár	
	spruce 60–80 y.	1030	N	Z. Petrovics	
	subalpine spruce forest	1260	N	R. Michalec in litt.	
SE	spruce, beech, sycamore	800		M. Saniga	min. 2 juv. in nest / min. 2 juv. v hniezde
NW	black pine, mixed in spruce, larch, beech 90 y.	650	SW	L. Bohačík	
W	spruce, fir, beech 150 y.	1020		V. Michalec	
	spruce boggy forest	840		R. Michalec	found nest with pellets below / nájdené hniezdo a pod ním vývržky
S	fir, spruce, beech 60 y.	1000	NW	S. Pačenovský	
	spruce 60 y.	770	N	Z. Petrovics	
	fir, beech, spruce 80 y.	950	SE	Z. Petrovics	
W	oak, hornbeam, fir, beech, 60–80 y.	450	S	S. Pačenovský	600 m from nest tree used by *G. pass.* in 1990, 1991, 1994, 1997 / 600 m od hniezdneho stromu používaného *G. pass.* v r. 1990, 1991, 1994, 1997
W	beech, spruce, ash, poplar 60–80 y.	656	NW	K. Šotnár	same nest as in 2005 / to isté hniezdo ako v 2005
NW	beech, spruce, fir 60–90 y.	654	SW	K. Šotnár	300 m from nest tree in 2009 / 300 m od hniezdneho stromu v 2009
SW	spruce, beech, maple 50–70 y.	674	SW	K. Šotnár	
S	fir, spruce, beech 60 y.	1000	NW	S. Pačenovský	same nest as in year 2008 / to isté hniezdo ako v 2008
S	fir, spuce, larch 40–60 y.	800	NW	Š. Matis	on April 13, mating and M and F in nest, on June 9, in nest hole incubating *P. ater* / 13. 4. párenie a M aj F pri dutine, 9. 6. však v dutine inkubovala *P. ater*
S	beech, spruce	1100	SE	A. Gajdošová	
	beech, fir, spruce	990		R. Michalec	feeding of juv. in nest / kŕmenie juv. v hniezde

breedings in repeatedly occupied nests are indicated by bold / tučným písmom sú vyznačené hniezdenia v opakovane obsadených hniezdach;
Ptri – Picoides tridactylus, *Dmaj – Dendrocopos major*

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Tab. 2. Synopsis of records of fledged Eurasian pygmy owl families and of approved breedings without finding a nest
Tab. 2. Prehľad údajov o nálezoch vylietaných rodín kuvička vrabčieho a o dokázaných hniezdeniach bez nálezu hniezda

1	2	3	4	5	6	7	8	9	10
J1	Šarišská vrchovina Mts	Cemjata near Prešov	1960	3	fir		ca. 450		V. Baranyi, J. Palásthy in Danko 1988
J2	Branisko Mts	NE part of range / SV časť	24 May 1960	*					Palásthy in Mošanský 1979
J3	Volovské vrchy Mts	Kojšov, N from Kojšovská hoľa	11 July 1981	3	fir, beech, spruce		ca. 900		J. Lipták in Danko 1988
J4	Slovenský raj Mts	Hrabušice	2 August 1984	3					Z. Vlach in Danko 1988
J5	Volovské vrchy Mts	Pipitka	17 July 1990	min. 2	spruce		ca. 1200	N	S. Pačenovský, K. Takáč
J6	Volovské vrchy Mts	Štós, kúpele	18 July 1990	min. 2	fir		ca. 750		S. Pačenovský, K. Takáč
J7	Volovské vrchy Mts	Zlatá Idka, Kobylia hora	1 July 1991	?	fir, beech		ca. 800		L. Mošanský
J21	Javorníky Mts	Papradnianska dolina valley	10 June 1993	3	fir, beech	older / starší	850		A. Kürthy, J. Chavko
J8	Oravská vrchovina Mts	Horná Lehota, Hrúzova jama	23 June 1994	5	beech, spruce, other broadl.		680		D. Karaska, M. Gonšor
J20	Levočské vrchy Mts	Jablonov, Rakytie	16 July 1994	4	fir, beech		650		A. Kürthy, M. Kürthyová, M. Dravecký
J9	Nízke Tatry Mts	Hodrušská dolina valley, Veľký bok	end of July 1994	min. 2	spruce	old / starý	1400	W	P. Vrlík, M. Krajčí
J10	Volovské vrchy Mts	Starovodská dolina valley, Kobyliar	21 July 2001	4	spruce	60	1000		S. Pačenovský
J11	Slovenský kras Mts	Zádielska dolina valley, Havrania skala	4–5 July 2004	3	spruce, beech, maple	120	680		S. Pačenovský
J12	Oravská Magura Mts	Zázrivá, Okrúhlica	28. June 2005	min. 2–3	spruce, fir	100–110	1025	S	D. Karaska, M. Gonšor
J13	Volovské vrchy Mts	Zlatý stôl	23–24 July 2005	3	spruce	60	1200		S. Pačenovský
J14	Slovenský raj Mts	Prielom Hornádu	29 June 2006	2	spruce, alder, fir, beech	50	620	SE	S. Pačenovský
J15	Volovské vrchy Mts	Štós, Tupý vrch	7 June 2007	4	fir, spruce, beech	60	1000	NW	S. Pačenovský
J16	Volovské vrchy Mts	Kojšovská hoľa, Tri studne	18 August 2007	3	spruce	50	1000	ridge	K. Takáč
J17	Volovské vrchy Mts	Kojšovská hoľa, Biely kameň	18 August 2007	2 or 3	fir, beech, spruce	80	1140	ridge	K. Takáč
J18	Volovské vrchy Mts	Štós, Tupý vrch	12 August 2008	2 or 3	fir, beech, sycamore	120	850	NE	S. Pačenovský
J19	Volovské vrchy Mts	Žakarovský vrch	22 June 2009	min. 3	fir, beech, spruce	old / starý	760		K. Takáč

1 – code / kód; 2 – mountain range / pohorie; 3 – site / lokalita; 4 – date / dátum; 5 – no of juveniles fledged / počet vyvedených mláďat; 6 – habitat; 7 – forest age / vek porastu; 8 – altitude / nadmorská výška [m]; 9 – slope orientation / orientácia svahu; 10 – source / zdroj; * 1 adult with bald part at abdomen due to incubation / 1 adult s hniezdnou nažinou

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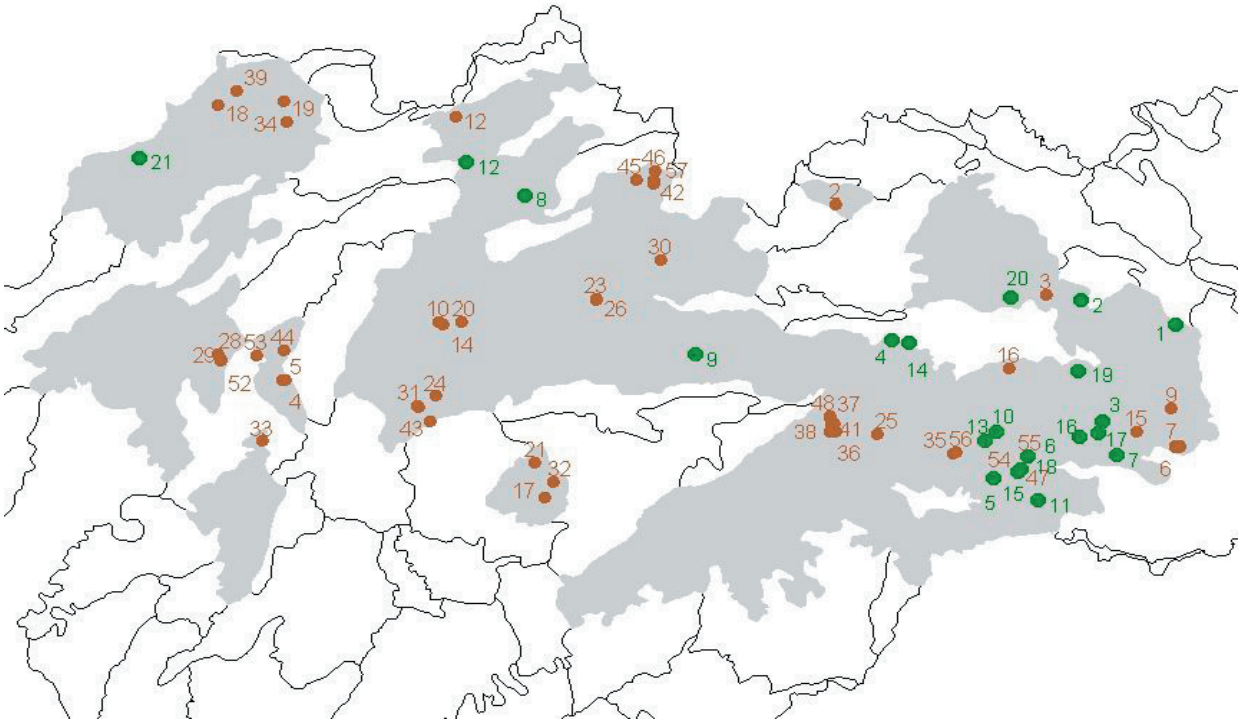


Fig. 2. Found nests (brown dots) and fledged youngs observations (green dots) of Eurasian pygmy owls in Slovakia. For site numbers see tables 1 and 2. The grey colour indicates orographic units with ascertained breeding of the Eurasian pygmy owl.
Obr. 2. Nájdené hniezda (hnedé body) a pozorovanie vyletených mláďat (zelené body) kuvičkov vrabčích na Slovensku. Čísla lokalít sú uvedené v tabuľkách 1 a 2. Sivá plocha označuje orografické celky s dokázaným hniezdením kuvička vrabčieho.

abundance of fir was usually at least 30%. Breeding in that specific habitat type was found 8× (11.3%), but in most cases these breedings were repeatedly found in the same territories. We assume that only a very small part of the Slovakian population breeds in such habitats, even if the species is present in that habitat type as a continual resident. A stable population of pygmy owls is present in this habitat type, which is proved by repeatedly occupied nest sites, but also by persistently occupied territories and localities. As an example we can mention the location Kamenný hrb close to Košice, occupied by the Eurasian pygmy owl persistently for at least 40 years. The first time the species was found here in 1969 by Danko (1988).

2. Fir-beech and fir forests, sometimes with other tree species mixed in (e. g. sycamore and other species of maple, ash, beech-sycamore forests with fir). Often these forest habitats are natural and semi-natural (Figs 3, 5, 10), with trees aged 40–120 years and spread even higher, with an altitude range of 600–800 (1025) m. These habitats are characterized by presence of fir trees in varying abundance, from less than 10% up to 100%. Fir-beech forests are naturally distributed in our forested mountains approximately between 550–800 m, sometimes locally up to 1025 m. In the eastern part of the Volovské vrchy Mts these habitats are linked continuously to habitat type 1. Breeding of Eurasian pygmy owls in these habitat types has also been found in the Čierna hora Mts, Veľká Fatra Mts (Skalná Alpa), Revúcka vrchovina Mts and in further mountain ranges. Breeding in this habitat type was found 15× (21.1%). Fir-beech forests in Slovakia are among the natural habitats of the Eurasian pygmy owl (fifth vegetation level), and it is possible to state that the distribution of these forest habitats in the above-mentioned altitude range optimal for these forests is optimal also for distribution of Eurasian pygmy owls, which is proved by the high incidence of nests found in this habitat type.

3. Spruce-beech-fir forests and fir-spruce forests at altitudes of 800–1200 m, usually old, natural and semi-natural forests growing in mountainous conditions, with occurrence of the three main determining tree species. The

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Fig. 3. Habitat of the Eurasian pygmy owl: Carpathian submontane fir-beech forests. Štós, territory Tupý vrch NE, Volovské vrchy Mts, 10 June 2010.
Obr. 3. Biotop kuvička vrabčieho: horské jedľovobukové lesy. Štós, teritórium Tupý vrch SV, Volovské vrchy, 10. jún 2010.

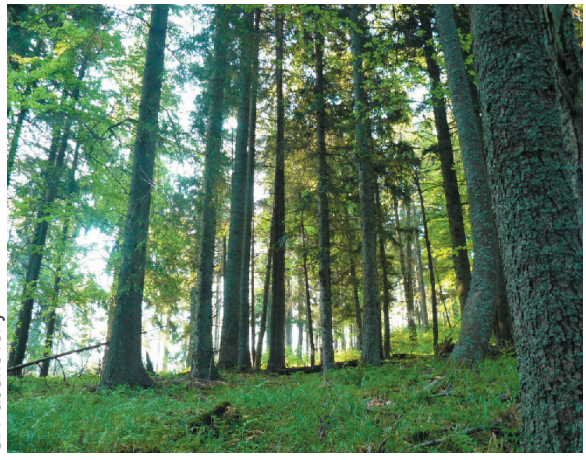

S. Pačenovský

Fig. 4. Breeding habitat of the Eurasian pygmy owl. Štós, territory Tupý vrch NW, Volovské vrchy Mts, 10 June 2010.
Obr. 4. Hniezdny biotop kuvička vrabčieho, Štós, teritórium Tupý vrch SZ, Volovské vrchy, 10. jún 2010.


S. Pačenovský

Fig. 5. Habitat of the Eurasian pygmy owl: mountainous fir, beech and spruce forests, 800–1000 m a. s. l. Štós, Volovské vrchy Mts, 14 March 2009.
Obr. 5. Biotop kuvička vrabčieho: horské lesy s výskytom jedle, buka a smreka, 800–1000 m n. m. Štós, Volovské vrchy, 14. marec 2009.

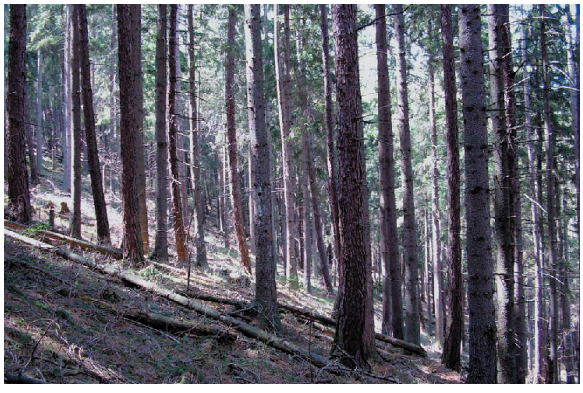

Z. Petrovics

Fig. 6. Breeding habitat of the Eurasian pygmy owl in productive forest with prevalence of spruce. Rejdová, Revúcka vrchovina Mts, 5 March 2005.
Obr. 6. Hniezdny biotop kuvička vrabčieho v hospodárskom lese s prevahou smreka. Rejdová, Revúcka vrchovina, 5. marec 2005.

age of these forests is often very high (e. g. 100–200 years at Hrončecký grúň in Poľana Mts, A. Krištín in litt.), but in the Volovské vrchy Mts these habitats are usually 50–120 years old, because at these altitudes only very few spruce forests could reach higher age in these mountains (Figs 4, 9). Breeding in this habitat type was found particularly in the Veľká Fatra Mts, Nízke Tatry Mts and Poľana Mts, less often in the Volovské vrchy Mts, in total 15× (21.1%). It is also possible to regard this habitat as one of the typical types for distribution of pygmy owls in Slovakia.

4. Habitats with distinctive occurrence of spruce, predominantly productive forests, with more or less modified structure, at altitudes of 550–1200 m, even if the spruce does not find its optimum distribution at these altitudes. Various coniferous and deciduous tree species are mixed in, such as larch, fir, ash or aspen. Breeding of Eurasian pygmy owls in this habitat type is typical for some parts of the Volovské vrchy Mts, for Stolické vrchy Mts and Revúcka vrchovina Mts (surroundings of Rejdová, Fig. 6), for Strážovské vrchy Mts, Vtáčnik Mts, Žiar Mts, Javorníky Mts, Turzovská vrchovina Mts, Podbeskydská vrchovina Mts, as well as for a number of other Slovakian mountains with managed forests with prevalence of spruce. Breeding in this habitat type was found 24×

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(33.8%). It seems that most of the confirmed breedings of the species (in the period 1989–2010; Tabs 1, 2) took place in this type of habitat. This means that distribution of spruce is important for the distribution of Eurasian pygmy owls. The age of these forests is different, usually 40–80 years, rarely higher. Particular parts of pygmy owl territories could comprise very young forest growth (forest nurseries, young wood) and these structures could even be vital because they can offer hiding opportunities both for adults and young fledged birds, but forest growth with sufficient range of breeding opportunities, e. g. cavities made by woodpeckers, could generally be provided only by forest aged at least 50–60 years.

5. Habitats of natural mountain spruce forests, spruce forests with rowan, spruce forests with bilberries in the undergrowth, and spruce-beech forests at altitudes of 1200–1450 m, in the most valuable types of natural montane forests at high altitudes close to the upper tree limit in Slovakian conditions. The age of these forests is often very high, e. g. 100–150 years in the Poľana Mts (A. Krištín in litt.), and 150 years in the Západné Tatry Mts (V. Michalec in litt.). In this habitat type breeding by Eurasian pygmy owls has been found in the Nízke Tatry Mts, Veľká Fatra Mts, Poľana Mts and the Západné Tatry Mts, so far 5× (7.1%). Occurrence of the Eurasian pygmy owl at these altitudes was already known, and a number of further territories of Eurasian pygmy owls is known at these heights and in these habitats, e.g. in the Vysoké Tatry Mts, Západné Tatry Mts and Nízke Tatry Mts, the Kriváńska Fatra Mts and other high mountains of Slovakia (e.g. Bališ 1972, Danko 1988, Pačenovský & Shurulinkov 2008), but only very few nests have been found in these habitats, because they are hardly accessible for closer research due to harsh weather in spring.

6. Habitats with prevalent occurrence of pines, at altitudes of 650–850 m, whereby breeding in these unusual habitats has been found in the Liptovská kotlina Basin in a habitat with scots pine, and in the Žiar Mts in a habitat with occurrence of black pine. Breeding in habitats with prevalence of pines has been found in Slovakia only 2× (2.8%).

7. Overgrown pasture at forest edges in the Oravská vrchovina Mts with occurrence of beech, spruce, alder, aspen, wild cherry. A fledged family (a possible breeding) was found in this specific habitat only 1× (1.4%). Despite this figure it is possible to assume that in these locally relatively commonly distributed habitats of overgrown pastures on the borderline of continuous forests (Orava, Spiš and Šariš Regions), the species should be present more often.

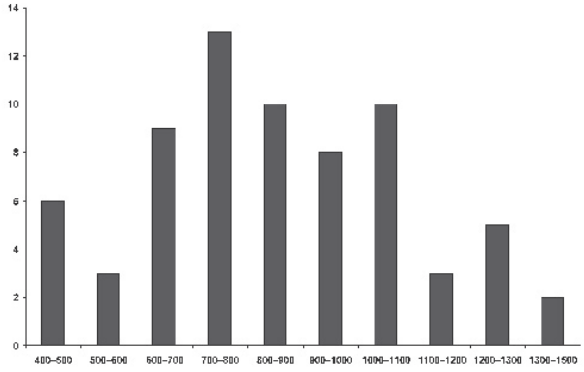


Fig. 7. Distribution of elevations (m a. s. l.) of found nests of Eurasian pygmy owls in Slovakia. Axis y – number of cases.
Obr. 7. Rozloženie nadmorských výšok (m n. m.) nájdených hniezd kuvičkov vrabčích na Slovensku. Os y – počet prípadov.

8. Waterlogged spruce forest, Oravice, Peciská. A habitat fairly similar to the type with occurrence of scots pine in the Liptovská kotlina Basin (type 6), but in this waterlogged forest spruce prevails in the forest growth, not pine. Altitude 840 m. Breeding in this habitat was found 1×, which means 1.4% of ascertained breedings.

The results indicate that the breeding distribution of the Eurasian pygmy owl in Slovakia follows the distribution of the fir and spruce, and breeding has also been confirmed in habitats with distinctive occurrence of scots pine and black pine. Breeding by Eurasian pygmy owls has also been found in a number of natural habitats, including montane spruce forests, Euro-Siberian coniferous forests, fir-spruce forests, beech and fir-beech flowering forests, sycamore-beech forests with fir, oak-hornbeam forests with lime and fir, as well as in productive cultures of spruce.

Practically all these habitat types of the Eurasian pygmy owl in Slovakia are present in similar form or in resembling variations in other central European countries as well. The Central European population of the Eurasian pygmy owl is described by Mikkola & Sackl (1997) as an isolated, probably a post-glacial one, of relict character, living in a cold montane zone from which it became distributed into secondary habitats. In the Bavarian Forest and in the Fichtelgebirge and Erzgebirge Mts the pygmy owl occupies a cold montane region, as well as the sub-montane vegetation levels (Schönn 1980) at altitudes from 400–1200 m. Natural forest areas of different central European countries have been more or less changed by anthropogenous influence (Schönn 1980). In the Czech Republic the pygmy owl occupies mainly old coniferous

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V. Michalec



S. Pačenovský

Fig. 9. Nest cavity of the Eurasian pygmy owl in a dry spruce. Volovské vrchy Mts, Tupý vrch, 9 June 2010.
Obr. 9. Hniezdna dutina kuvička vrabčieho v suchom smreku. Volovské vrchy, Tupý vrch, 9. jún 2010.

←

Fig. 8. Nest cavity of the Eurasian pygmy owl in a living spruce. Západné Tatry Mts, Osobitá, 12 June 2008.
Obr. 8. Hniezdna dutina kuvička vrabčieho v živom smreku. Západné Tatry, Osobitá, 12. jún 2008.

and mixed forests at medium altitudes in the mountains (Šťastný et al. 2006).

Regarding the structural components of habitats, we can also mention the presence of some elements found in breeding habitats and probably playing some role in the selection of nest sites, being specific for breeding habitats and differentiating them from the surrounding environment: increased presence of woodpecker holes, often in dry trees, stumps and dead, broken trunks – found for example at breeding habitats in the Nízke Tatry Mts, Volovské vrchy Mts, proximity to the edge of contiguous forest growth, e. g. presence of a small meadow, clearing or glade (Volovské vrchy Mts, Vtáčnik Mts, Strážovské vrchy Mts, Žiar Mts, Turzovská vrchovina Mts, Podbeskydská vrchovina Mts), a glade overgrown by dense natural regeneration of young trees up to 50 m from the nest (Turzovská vrchovina Mts, Javorníky Mts), vicinity of a spring of water (Nízke Tatry Mts), a meadow overgrown by dense natural regeneration of young trees close to the nest site (Nízke Tatry Mts, Strážovské vrchy Mts, Žiar Mts) a peat-bog close to the nest (Liptovská kotlina Basin). Similar characteristics of breeding habitat of the Eurasian pygmy owl and similar determining factors for the habitat were generally defined also by Schönn (1980): presence of old forest growth with relatively high representation of conifers, closeness of water, adequate number of cavities, lower predatory and competitive pressure. The value of silence and retreat is not regarded as a very significant factor by these authors in selection of the nest site, and in fact an opposite example is described from the Elbsandsteingebirge Mts, where an occupied nest site was found nearby a frequently-used forest track. We can not quote an experience of this kind yet in Slovakia, because in the studied areas the Eurasian pygmy owl territories were located away from noisy asphalt roads, and only a small number of the nests found were placed close to forest tracks.

According to the data of Scherzinger (1970) the nest is often located in a marginal part of the territory, as well as close to the edge of forest growth. Similar data are also indicated by our findings in Slovakia, with more nests located close to forest edges, to meadows, open areas or glades, even if we ourselves did not evaluate this factor. Scherzinger (1970) also quotes that closeness to water is a valuable factor for breeding territories, and this fact is explained by the need for water intake (drinking) by the

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Fig. 10. Habitat of the Eurasian pygmy owl with a nest-tree – a dry snag of beech, Tužina, Strážovské vrchy Mts, 29 April 2010.
Obr. 10. Biotop kuvička vrabčieho s hniezdnym pahýľom buka, Tužina, Strážovské vrchy, 29. apríl 2010.


K. Šotnár

Fig. 11. Male of the Eurasian pygmy owl in front of the nest cavity, Tužina, 29 April 2010.
Obr. 11. Samec kuvička vrabčieho pred hniezdnou dutinou, Tužina, 29. apríl 2010.

female in the egg-laying and the incubation periods. Out of 25 evaluated nests/breeding sites in Slovakia, the closest available surface water (stream, spring) was situated closer than 100 m to the nests in twelve cases (50.0%), closer than 200 m in five cases (20.8%) and only in seven cases was it situated further away (470–590 m; 29.2%). In cases where water was situated far from the nests, these were located high on slopes, close to ridges. On the other hand, some nests situated high on mountain slopes were nevertheless placed close to springs and tributaries of streams. Our data also indicate that closeness of water is really an important factor in selecting the position of the nest, because 70.8% of nests were placed close (less than 200 m) to water. Preference of closeness of water to nests has been consistently demonstrated in the Eastern Alps, in the Westerzgebirge Mts (Saxonia), at Oulu in Finland (Schönn 1980), as well as in several mountain ranges of Slovakia.

Vertical distribution

Based on distribution of the nests found (n=70; Fig. 7) according to their altitude it is possible to state that the vertical distribution of nests is relatively even and follows the distribution of coniferous and mixed forests, mainly with prevalence of spruce and fir, from altitudes around 400–500 m in the Volovské vrchy Mts and Šarišská vrchovina Mts (forests with oak, hornbeam and fir as the predominent tree species), with the possible exception of altitudes between 500–600 m, where the natural distribution of conifers in Slovakia is rare, until the upper


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Fig. 12. Habitat of the Eurasian pygmy owl with a dry nest-tree (sycamore), Kľačno, Žiar Mts, 8 April 2010.
Obr. 12. Biotop kuvička vrabčieho s hniezdnym suchým stromom (javor horský), Kľačno, Žiar, 8. apríl 2010.

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tree line (highest nests/proved breedings were found at 1450 m in the Veľká Fatra Mts and at 1200–1250 m in the Poľana Mts, Veľká Fatra Mts and Nízke Tatry Mts, Tabs 1, 2). At altitudes of 400–600 m only 13.0% of nests were found, from 600–1100 m 72.5% of nests and over 1100 m 14.5% of nests were found. Scherzinger (1970) found seven breeding cavities in the Austrian Alps at altitudes of 1100–1650 m. But in the Alps the Eurasian pygmy owl occurs as a breeding species at substantially higher altitudes than in Slovakia, up to 2100 m (Šťastný et al., 2006). In the Czech Republic the species breeds approximately at altitudes of 320–1260 m, and at Hradec Králové it has even been found as low as 237 m (Šťastný et al. 2006). Altitudinal distribution in the Czech Republic is comparable with that in Slovakia, even if in Slovakia the species breeds even slightly higher than in the Czech Republic, and the lower altitude limit is probably not as low as in the Czech Republic.

Slope orientation

We took notes of the orientation of mountain slopes with nests of Eurasian pygmy owls – mainly in the Volovské vrchy Mts, Strážovské vrchy Mts, Revúcka vrchovina Mts, Stolické vrchy Mts, Čierna hora Mts, Vtáčnik Mts, Žiar Mts, Nízke Tatry Mts and Javorníky Mts to find out the role of orientation of territories. Eurasian pygmy owl territory is divided by Scherzinger (1970) into three components: hiding stand, hunting territory and breeding territory. The hiding stand of a male and the breeding territory are not equal in area, and the distance between hiding stand of a male and breeding site in Austria (Ennstal, Patcherkofel) could be 500–800 metres according to Scherzinger (1970). Based mainly on the authors' experience of the situation in the Volovské vrchy Mts, territories of the species cover approximately 30–100 ha, and their natural borders are mountain ridges, edges of forest growths, meadows and open areas (glades), or forest tracks, and that is the reason why orientation of slopes is in most cases similar for all pygmy owl territories. From the sample of 38 slopes with nests of Eurasian pygmy owls nine slopes were oriented to SW (23.7%), nine to SE (23.7%), four to S (10.5%), five to NW (13.2%), three to W (7.9%), four to NW (10.5%), one to NE (2.6%) and three to N (7.9%). This summary itself shows that orientation of slope probably does not play a determining role in selection of territory or nest, because the breeding slopes in the examined sample were oriented in different directions, only with moderate dominance of SW and SE orientation, and some slopes were even oriented directly to N. The fact that the surveyed sample contains no slope oriented to E is explained by specific conditions in the mountain ranges surveyed, from which the sample originated – most of the ranges extend in a W–E direction, and thus only a few slopes are oriented directly to E. In other mountain ranges, e. g. extending in N–S direction, the results would be different, because of other prevailing orientations of slopes. Generally it seems that orientation of nest slope has no determining value for selection of territory or nest site of Eurasian pygmy owls, which is in accordance with a similar statement by Kloubec (1987).

Characteristics of the nest

Nest tree. As many as 25 nest holes (n=53) were found in spruce (alive, or dry; Figs 8, 9), ten in fir, six breedings took place in beech (Fig. 10), four in oak, four in aspen. From other tree species a breeding cavity was found on one occasion each in larch, ash, dry maple and black pine, and one breeding took place in a nest-box. Numerous breeding cavities (Tab. 1) were located in dry trees and broken stumps. This is almost a rule in the case of firs, because almost every nest found in fir trees was located in dry and broken stumps, but nests were also found in dry spruces, maple (Fig. 12) and beech trees. One breeding was found in a wooden nest-box prepared from the original trunk of a tree, placed on a beech in the Levočské vrchy Mts at Bijacovce in 1977 (Danko 1988). We assume that this nest-box was occupied by the pygmy owl because of a lack of older forest growth in the territory of the owl, where young, 40-year-old conifers prevailed. Breeding in nest-boxes is listed as rare, and there is a note of one case of breeding in a nest-box for starlings in an abandoned settlement a few metres from the forest edge, and another case of breeding in Norway (Schönn 1980), though breeding in nestboxes is slightly more frequent in Finland (Mikkola 1983).

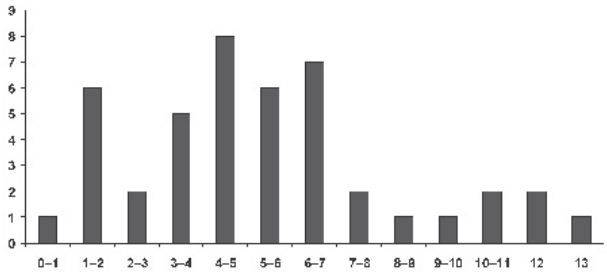


Fig. 13. Height of found nests over ground (m). Axis y – number of cases.
Obr. 13. Výška nájdených hniezdnych dutín nad zemou (m). Os y – počet prípadov.

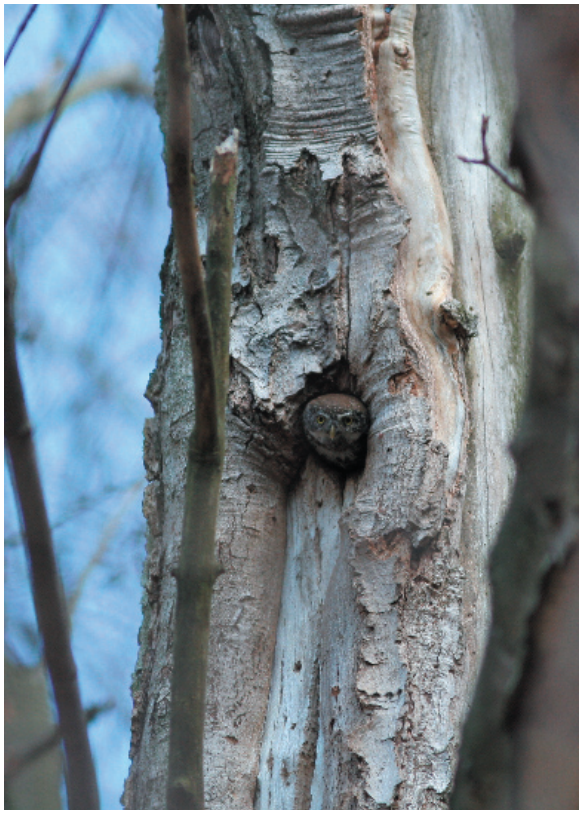
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Schönn (1980) mentions the following species of nest trees found in central Europe: spruce, pine, fir, larch, aspen, ash, rowan, oak, beech, birch, sycamore and apple trees. The majority of these tree species have also been found in Slovakia as nest trees, with exception of rowan, birch and apple trees. A new finding, not mentioned yet in the literature, is the breeding of Eurasian pygmy owls in a black pine found at Slovenské Pravno in the Žiar Mts in 2007 (Bohačík in litt.). Hudec et al. (1983) mention the following nest trees in the former Czechoslovakia: 5× spruce, 2× pine and beech, 1× fir and apple tree.

In Finland 47% of nests were in spruce, 39% in aspen, 12% in pine and 2% in birch (Mikkola 1983). In the Austrian Alps Scherzinger (1970) found the nests always in spruces, less often in healthy, large spruce trees, and most of the nests were in weak, thin, still-living trees with dying or fallen branches, and some were also in dry and broken spruce stumps.

Number of cavities in a nest tree. The Eurasian pygmy owls very often preferred such trees which have more than one cavity (Scherzinger 1970). Presence of more cavities represents a safety factor for these owls. At least eleven cases of breeding in trees with more than one cavity have also been found in Slovakia, in the Volovské vrchy Mts, Čierna hora Mts, Strážovské Mts, Žiar Mts, Nízke Tatry Mts, Revúcka vrchovina Mts, and the Podbeskydská vrchovina Mts. The highest known number of cavities (seven) was found in a nest tree (oak) used in the years 1990, 1991, 1994 and 1997 at Košice at the site Bankov. They had been excavated by *Dendrocopos major*, and simultanously with the Eurasian pygmy owl there were 1–2 pairs of *Sturnus vulgaris* and one pair *Sitta europaea* also breeding in this tree in other woodpecker cavities. The Eurasian pygmy owl occupied cavities placed in the lower parts of the tree at heights of 4–6 m, while *S. vulgaris* and *S. europaea* nested in cavities in the higher part of the trunk.


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Figs 14, 15. Male (on the left) and female (on the right) of the Eurasian pygmy owl in a nest cavity, Kľačno, Žiar Mts, 8 April 2010. The male enters the nest cavity quite exceptionally, usually only in very early stages of breeding season, e. g. in case of nest-showing display.
Obr. 14, 15. Samec (vľavo) a samica (vpravo) kuvička vrabčieho v hniezdnej dutine, Kľačno, Žiar, 8. apríl 2010. Samec navštevuje hniezdnu dutinu iba výnimočne, obyčajne len v skorých štádiách hniezdenia, napr. pri ukazovaní dutiny samici.

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Repeatedly occupied breeding cavity and territory. Apart from theBankov location near Košice, occupation of the same breeding cavity in different years has been found repeatedly also in other locations in the Volovské vrchy Mts: at Kamenný hrb near Košice in 1989 and 1990, at Opátka in 1991 and 1992 (in the second case breeding of Eurasian pygmy owls was interrupted, probably due to the close neighbourhood of a breeding pair of *Strix aluco*), at Tupý vrch above Štós in 2008 and 2010, and probably also earlier in 2007. Repeatedly occupied nests in the same cavity were also found at Vysoký vrch in the Čierna hora Mts in 1989 and 1990, in Iľanovská dolina valley in the Nízke Tatry Mts in 1993 and 1994, and at Tužina (Hvizdák) in the Strážovské Mts in 2005 and 2009.

Repeated occupation of the same territory, with breeding in another nest cavity, was also found several times. We found this for example at Bankov near Košice, where in Eurasian pygmy owl territory "B1", after the old breeding tree, the already mentioned drying oak tree with many cavities, had been uprooted by a storm, in 2009 a pair of pygmy owls bred in the same territory 300 m further away, probably in a dry fir. A similar kind of shifting of nest position was also found at Buč in the Revúcka vrchovina Mts near Rejdová in 2000 and 2008, where the distance of the two nest trees from each other was 250 m, in the Žiar Mts (Bohačík in litt) above the village Budiš in 1983 and 1989, where the two nest trees were at a distance of 200 m from each other, and at Tužina in the Strážovské Mts, where in 2010 the Eurasian pygmy owl bred 300 m further away compared with the years 2005 and 2009.

Repeated occupation of the same nest cavity within two years is mentioned by Scherzinger (1970), but data on observation of one territory on a longer-term basis are missing. Del Hoyo et al. (1999) stated that pair bonds lasted only one year, but after autumn they could be renewed again.

Synchronous breeding by two pairs close to one another. Synchronous breeding by two pairs close to one another should not be a rare phenomenon, if we are aware of the high densities of Eurasian pygmy owls in suitable habitats in Slovakia (Pačenovský 1995, Pačenovský & Shurulinkov 2008), but two nests of different pairs close to one another in the same year is a rare occurrence. Pačenovský (1993) mentions such a case from the year 1990, when two pairs of pygmy owls (in territories "B1" a "K1") were breeding only 400 m one from another, even if on opposite sides of the same ridge. An interesting coincidence happened on the southern slopes of the Volovec Mt. in 2000 and 2010, when two nests of Eurasian pygmy owls were found only 550 m one from another, independently by S. Pačenovský and A. Gajdošová. These nests were probably also located in two different territories, because each of them was placed on different sides of the same lateral ridge. Two pairs of nests in such neighbouring territories were also found by Z. Petrovics near Rejdová at the Krišťáková site in 2002 and 2005, and at the Páleniská site in 2000 and 2009, at distances of 700 and 1000 m from one another respectively. M. Saniga found two pairs of nests, probably belonging to two different territories of Eurasian pygmy owls in the Veľká Fatra Mts in 1990 and 1991 at altitudes of 1025 and 1250 m, and in the Starohorské Mts at neighbouring sites Graniarka and Glezúr in 1999 and 2007. There is a note from the Czech Republic (Kučera 1981) of the shortest distance between two occupied nests only 250 m one from another, from Finland only 450 m from each other (Mikkola 1983).

Origin of nest cavity. From 47 evaluated cases 25 breeding cavities had been excavated by *Dendrocopos major* and in ten cases by *Picoides tridactylus*. In a further nine cavities excavated by woodpeckers their origin could not be uniquely determined (mostly cavities of older origin) and their producer was stated only as a woodpecker (*D. major* or *P. tridactylus*). Only in four cases has breeding been proved in a natural cavity (hollow tree): 2× beech (Žiar Mts, Starohorské vrchy Mts.), 1× larch (Volovské vrchy Mts – Galmus) and 1× partially dry maple (Žiar Mts, Fig. 12).

Scherzinger (1970, 1972) and Schönn (1980) mention owls breeding in cavities excavated by *D. major*, *P. tridactylus* and by *Picus viridis*, and as a rare event also natural cavities. Out of 58 nests in Finland, Mikkola (1983) presents eight situated in nestboxes and 50 in nest holes excavated by *D. major*, *P. tridactylus* and by *Picus canus*. The species *D. major*, *P. tridactylus* and *P. canus* are mentioned as producers of cavities for Eurasian pygmy owls also by Mikkola & Sackl (1997).

The altitude distribution of cavities excavated by the *D. major* and by the *P. tridactylus* is interesting. Cavities excavated by the *P. tridactylus* were situated at altitudes of 700–1250 m in the Vtáčnik Mts, Poľana Mts, Veľká Fatra Mts, in Západné Tatry Mts, Belianske Tatry Mts, Stolické vrchy Mts (Šotnár 2004, Klaus et al. 1982, V. Michalec, Z. Petrovics, M. Saniga, and P. Vrlík in litt.). Cavities excavated by the *D. major* were situated between 470–1130 m, and above 1000 m only three cavities were found at altitudes 1000, 1030 and 1130 m. These altitudinal ranges well represent the distribution of these two woodpecker species in Slovakia (Pavlík 2002, Pačenovský

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2002), and the upper limit of distribution of the *D. major* is particulary visible. *P. tridactylus* breeds in Slovakia also at lower altitudes, with the lowest known cavity excavated by this species and occupied by the Eurasian pygmy owl at 700 metres in the Vtáčnik Mts, but at lower altitudes the Eurasian pygmy owl prefers cavities of the *D. major*, probably because of the higher rate of their occurrence, since below 700 m *P. tridactylus* is rare. In addition, *D. major* is one of the 'busiest' European woodpeckers in terms of producing cavities (Gorman 2004), and for this reason it plays an important role in supplying cavities for the Eurasian pygmy owl. In Slovakia this percentage is 53.2%, based on our own data of all occupied breeding cavities. This figure could be even higher, because it was not possible to identify the precise origin of some cavities, especially older ones.

It is interesting that in 2010 a nest of the pygmy owl was found in a cavity excavated by *Dendrocopos medius* at an altitude of only 290 m only 1.8 km from the Slovakian border in Hungary, in the Aggtelek National Park (A. Schmidt, S. Pačenovský unpubl.), so the use of nest cavities excavated by this species of woodpecker is not excluded even in similar habitats in Slovakia at low altitudes.

Height of nest cavity above ground. Fig. 13 indicates the range of preference of breeding cavity above ground (n = 44). One breeding cavity occupied by pygmy owls in the Stolické vrchy Mts was lower than 1 m above ground level (Z. Petrovics in verb.), and breeding has been found 6× at heights 1–2 m above ground level, but the majority of cavities (26) were situated at heights 3–7 m, with four cavities over 10 m high, and the highest known occupied nest was located at a height of 13 m. The average height of nest holes is 5.01 m. In the Eastern Alps Scherzinger (1970) found heights of breeding cavities (n=7) ranging between 3.5–14 m, in the Bavarian Forest (Scherzinger 1974) between 0.6–14 m (n=13), and in the former Czechoslovakia (Hudec et al. 1983) between 4–7 m high (n=11).

Orientation of nest cavity. We studied the orientation of 40 nest cavities occupied by Eurasian pygmy owls. Orientations in each direction were found, with a lack of distinctive preference for any one direction. Most cavities (10) were oriented to W (25%), nine to S (23.1%), seven to SW (17.9%), six to NW (15.4%), four to N (10%), and the lowest number of cavities were oriented to SE (2.0%), E (1.0%) and NE (1.0%).

In the literature we found only notes by Scherzinger (1970) on seven nest cavities in the Eastern Alps, of which every cavity was oriented in a different direction. In any case, cavities are usually made by woodpeckers, so selection by owls of any particular direction is already limited.

It seems that orientation of nest cavity does not play a determining role in selection of breeding cavity by Eurasian pygmy owls, even if there was some prevalence of cavities oriented to W, S, SW and NW.

Reproductive behaviour

Pre-mating behaviour and mating. Specific displays which take place before the subsequent coupling of partners in the third phase of mating of Eurasian pygmy owls include drawing the attention of the female. In this period the male uses offering behaviour to show a suitable nest hole to the female. In most cases the showing of only one nest hole was observed (Scherzinger 1970, Schönn 1980). Interesting behaviour was seen on March 12, 1997 in the Strážovské Mts, when a male first showed the female one nest hole in an uprooted dry spruce. The male entered the cavity first, but after a while he flew out from it. Immediately the male was followed by the female, which entered the cavity too, and after this inspection both birds flew across a glade and the display with showing of a cavity was repeated at a dry stump of a fir with another cavity. Finally this pair occupied the second cavity in the dry fir. During the day they copulated several times, e. g. on March 30, 1997 at 12:00, 12:30 and 12:50 hours (Šotnár 2004).

On another occasion on April 4, 2009 between 10:00–11:00 hours a pair of Eurasian pygmy owls was seen copulating three times in total, about 50 m away from the nest hole. The female uttered "see, see" calls and using offering behaviour attracted the male to mate, and the male only from time to time answered with a typical "deu" call. After the last copulation the female has flew into the nest hole (Šotnár 2009).

Another observation in the Žiar Mts on April 8, 2010 between 12:00–14:30 hours was effected partly by the presence of an observer at the site and by his short imitation of a territorial call. The male responded with quiet territorial calls from about 20 m from the nest cavity and attracted the female to copulate. When the male was approached by the observer, he flew into the nest hole (Fig. 14). After a while both partners appeared in the entrance of the cavity briefly one after another and uttered their typical calls and displayed defensive, intimidating behaviour (Figs 15, 16). Then the male flew out from the nest hole and called the female and within ten minutes she also flew out and sat close to the male. Throughout the next ten minutes or so, both partners attracted one another to mate with

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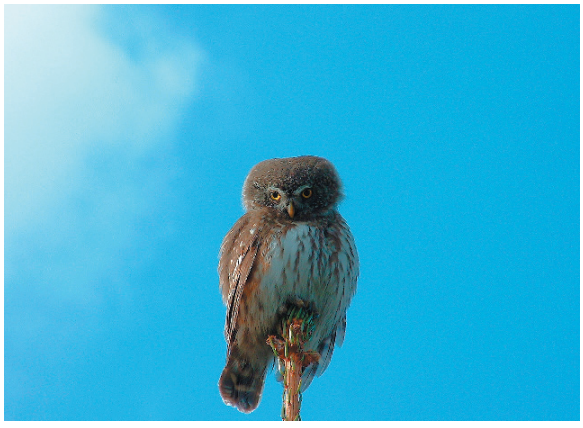

K. Šotnár

Fig. 16. Agonistic behaviour of a male Eurasian pygmy owl: threat. Kľačno, Žiar Mts, 4 April 2003.
Obr. 16. Agonistické správanie samca kuvička vrabčieho: hrozba. Kľačno, Žiar, 4. apríl 2003.


K. Šotnár

Fig. 17. Copulation of Eurasian pygmy owls, Kľačno, Žiar Mts, 8 April 2010.
Obr. 17. Párenie sa kuvičkov vrabčích, Kľačno, Žiar, 8. apríl 2010.

calls and visual signals. Finally the male came closer to the female and within a few seconds flew onto her back and they copulated, which was followed by waving of wings and keeping of balance (Fig. 17). The act lasted 7–8 seconds and was followed by trilling and screeching calls. After finishing the copulation the female returned to the nest cavity. Another mating episode took place after about twenty minutes, and it was followed by the same calls and ritualized displays. These observations also suggest that the male shows more than one cavity to the female, as described by Jansson (1964), and that Eurasian pygmy owls in the third phase of mating copulate in the vicinity of the nest hole and during daylight, usually in the morning hours and around noon (from 10:00–13:30 hours), which is in accordance with other reports (König 1968, Scherzinger 1974, Schönn 1980).

Copulation by Eurasian pygmy owls connected with nest-showing was also observed on April 13, 2010 above Štós in the Volovské vrchy Mts (Š. Matis & J. Popovics in litt.). First they noted calls by the female, which was observed about ten meters from the cavity, sitting in a spruce tree at a height of six meters close to the trunk. Just after this they also spotted the male, sitting about three meters lower in a beech tree and uttering from time to time a quiet "deu" call (timed at 8:14 hours). After about five minutes the birds copulated, and after copulation the male flew into the cavity, where it stood for about two minutes and then flew out in the direction of the female.

Unusual observations were made on November 2 and 4, 1989 in the Kamenný potok valley near Košice (Pačenovský & Kürthy 1992). Behaviour resembling nest-showing displays by pygmy owls was observed in the period of autumn mating, between 16:25 and 16:50 hours. As stated by Scherzinger (1970) and Schönn (1980), nest-showing displays are connected with the third and final phase of spring mating, although they can also sporadically occur earlier, during the first (territorial) and second phases of spring mating, but these authors do not mention nest-showing behaviour in connection with autumn mating. An even more explicit case of entering the tree cavity in the autumn season was observed by P. Vrlík and M. Kaliský (P. Vrlík in litt., www.birding.sk) on October 26, 2004 at the end of Michalovo valley in the Nízke Tatry Mts. The male was attracted by the observers' imitation of territorial calls, and flew into the cavity in a dry stump of a spruce, stood there for several minutes and then intensively defended its territory with calls. We assume that in this case it could be more a reaction to the presence of humans and defence from intruders, rather than an attempt by the male to show the nest cavity to a female, but in any case, the fact of entering the cavity in a territory defended by a male bird in the autumn season is noteworthy.

Copulation by Eurasian pygmy owls was observed by the first author eleven times in total between 1989–2010, in the months February – May. The temporal distribution of the observed mating behaviour was the following: February 1×, March 3×, first half of April 5×, second half of April 1×, beginning of May 1×. Mating behaviour by pygmy owls observed during March could be connected

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with the already mentioned third phase of spring mating, while three of the cases from the first half of April could be associated with the egg-laying period and early stage of incubation. With regard to the time of day when mating was observed, 36.4% of the mating displays were seen in the morning hours (6:15–6:50 hours), 18.2% during the daytime before noon, and 45.4% cases occurred in the evening, crepuscular phase of the owls' activity (after 19.00 hours). Regarding the dates of observation of mating displays, two occasions stand out from the others: one early – in February and one late – in May. The early occasion of copulation (February 2, 1989) was probably stimulated by imitation of territorial calls by the observer, which lured first the male and then the female in Perlová dolina valley near Gelnica in the Volovské vrchy Mts. Copulation was repeated twice afterwards, at 6:15 and 6:20 hours, and took place in the top of a young spruce (Pačenovský & Kürthy 1992). Schönn (1980) connects mating behaviour first of all with the third phase of spring mating, and it should take part close to the nest cavity, just 30–50 m from it. We suppose that this early occasion of mating behaviour could be a case of unfinished copulation, described by Scherzinger (1970), which takes only 2–3 seconds, thus shorter than completed copulation, lasting 5–8 seconds. The assumption that an early act of copulation might not be directly connected with breeding would also result from specification of the breeding season as April – July (del Hoyo et al 1999). The unusually late case of copulation was observed by S. Pačenovský on May 3, 1994 near Košice in the Volovské vrchy Mts. This display was connected with nest-showing. The male attracted the female into the cavity and copulated with her, and they uttered calls "djo-djo-djo" at 19:50 hours. The female flew into one of the cavities in an oak tree at a height of six meters. It is interesting that this behaviour, typical for the final phase of spring mating, was observed at a time when incubation of the clutch should have been going on. Another unusual circumstance was that breeding in 1994 did not finally take place in the nest hole shown to the female on May 3, but in another nest hole in the same oak tree located just two meters lower. Thus this male also showed more than one cavity to the female, and she also entered more than one cavity. In the scientific literature we have not found any notes on copulation observed during the incubation period. On the other hand, our observed case of late copulation display could really belong to the third phase of spring mating, with the beginning of breeding shifted for some reason to later in the season, to the beginning of May.



K. Šotnár

Fig. 18. Nestlings in age of 30 days often look out from entrance of nest cavity, Kľačno, Žiar Mts, 23 June 2009.
Obr. 18. Mláďa vo veku 30 dní sa často ukazuje v otvore dutiny, Kľačno, Žiar, 23. jún 2009.

Egg-laying period

The clutch and incubation period. During the first days of egg-laying the female is minimally active and calls very seldom. She sits at all hours with fluffed feathers near the nest hole or stays for longer periods in the cavity. Beginning of egg-laying takes place between April 8 and May 4 (Schönn 1980). Our data fall into this period, based on findings of the beginning of egg-laying on April 6–8, and in another nest on April 10–12 (Šotnár 2009). The female starts to incubate just after laying the next to last or the last egg. The eggs are laid at intervals of 2–4 days on the bare floor of the cavity, and after a time they are surrounded by pellets (Jansson 1964, Scherzinger 1970). During incubation the female leaves the breeding cavity only for short periods, to take the prey from the male or to fly to a cached haul. Pauses in incubation are regular around dawn or dusk, rare in the hours before or around midday. The female answers the attracting calls

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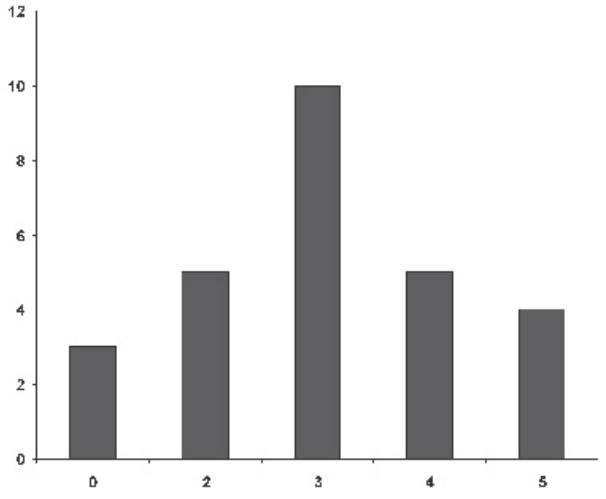


Fig. 19. Productivity of young of Eurasian pygmy owl in Slovakia. Axis x – number of fledged young, axis y – number of cases; n = 49 nests in period 1973–2010.
Obr. 19. Produktivita hniezdenia kuvičkov vrabčích na Slovensku. Os x – počet vyvedených mláďat, os y – počet prípadov; n = 49 hniezd v období 1973–2010.

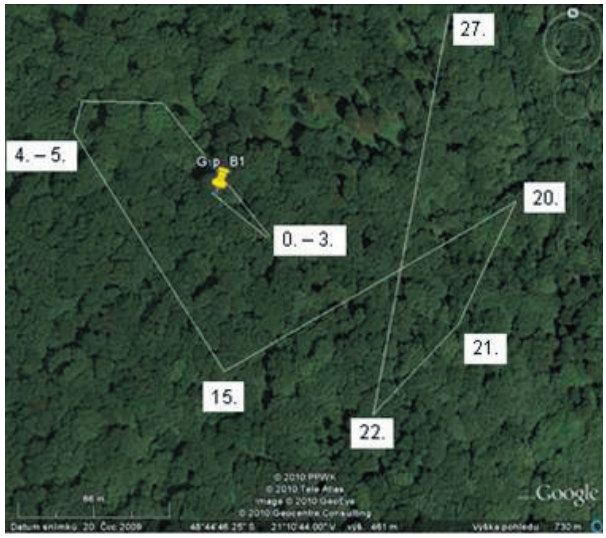


Fig. 20. Route of movements of fledged family in year 1991 at locality Bankov near Košice. A yellow dot – the nest site, numbers indicate days after fledging.
Obr. 20. Trasa pohybu mláďat v roku 1991 na lokalite Bankov pri Košiciach. Žltý bod – hniezdo, čísla označujú dni po vyletení.

of the male with her own begging calls, and in a while she appears in entrance of the cavity. From there she flies to the strong lateral branches of a tree close to the nest cavity (10–20 m), and after further calls she takes the prey from the male. She either starts consuming it here or flies to another, more silent place. Leftovers stay in caches on a branch, on a ledge in a tree, or in the top of a dry snag, or sometimes the female takes them into the cavity (Schönn 1980, Šotnár 2004).

The complete clutch consists of 3–10 eggs (Mikkola 1983). In the nest cavities studied between 1989–2010, clutches of 1×3, 1×4, 1×5 and 1×6 eggs were laid.

We should mention a few observations of a pair breeding at the Kamenný hrb site near Košice in 1990. This pair manifested strictly diphasic activity in the incubation period, linked to dawn and dusk. The female was incubating very steadily towards the end of April (April 24) – around halfway through the incubation. The male had to call to her in the morning with the brought prey for seven minutes, until she flew out from the cavity, and she remained out from it only for two minutes. In the evening, at dusk this female was out from the nest cavity only for one minute and immediately flew back in (with food). During the day neither did the female leave the nest, nor did the male show up (Pačenovský 1993). In the period of incubation it is possible to observe a process of ritualized food presentation by the male to the female, because this activity is done usually not further than 20 m from the nest. Because three pygmy owl nests observed in 1990 were located at very different heights above ground level (1.9 m, 5 m and 10 m), it was possible to compare differences in the spatial activity of these three pairs, as well as the activity of another pair breeding in 2010 at a height of 1.50 m above the ground. Height of spatial activity depends namely on the height of the breeding cavity. While the male usually flies at tree-top level and only comes lower near to nest and makes contact with the female when he gives the prey to the female, or when they mate, females behave in a different way. The female has starkly limited spatial activity. If she leaves the breeding cavity, she usually does not fly further than 15–20 m from the nest. Later, as the female spends more time resting on lateral branches near the nest, it is possible to find plenty of pellets, feathers from prey (usually tail- and wing-feathers from passerine prey). Results of comparison of spatial activity of four pygmy owl females breeding in cavities located at different heights are given in Tab. 4. The resting branches of three breeding females were between 2–6 m high, and most of their spatial activity (flying, resting, feeding) near the nest took place at heights of 6–12 m, and it seems that the height of spatial activity depends on the height of the nest cavity. This is in accordance with the findings of Scherzinger (1970) and Schönn (1980): the female's roosting-place in the vicinity of the nest is selected at the level of the nest cavity.

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Parental care for young birds

Care for nestlings. Young are hatched at short intervals, or more precisely at the same time, because the female starts to incubate only after laying the next to last or the last egg. Length of incubation period is 28–30 days and the process of hatching lasts from the end of May till beginning of June (Scherzinger 1970, 1974). In Slovakia hatching has been observed on May 25 (Šotnár 2009).

In this period the activity of the male in delivery of food increases. The female often attacks him when the male remains in the vicinity of the nest hole after food delivery. The male then flies away and returns with prey from a cache or with a new catch. After hatching of the young the female starts her clean-up activities in the nest hole. She throws out or carries away the leftovers of prey, pellets or egg-shells. A female was once observed in the Strážovské Mts on June 13, throwing a sterile and partly leaked egg out from nest hole. At that time the nestlings were about two weeks old (Šotnár 2009).

Egg-shells were also found below several nests in the Volovské vrchy Mts. In the second phase of caring for the young in the nest, the number of food deliveries increases, and Eurasian pygmy owls are active during daylight as well. The following cases have been observed in Slovakia: 2–3 prey items/day in the incubation period, and 5–7 prey items/day brought by males to two nests in eastern Slovakia (Pačenovský 1993), as well as diurnal activity of pygmy owls during the period of care for nestlings. The female stops spending the night in the nest hole when nestlings are 10–14 days old. During the last days of care for the nestlings she stays near the nest cavity (Scherzinger 1970 and Schönn 1980). In most cases the female uses favourite roosting-places near the nest, usually in coniferous trees at the level of the nest cavity. Here she waits for the male to arrive with prey, or she devotes herself to comfort behaviour. Nestlings aged 21–25 days appear in the entrance of the nest hole, and in their age 25–34 days they stay in it even longer (Fig. 18). Once in the Strážovské Mts on July 23, a female flew to her roost at 11: 45 hours and proceeded with comfort behaviour, defecation and a rain bath. After that the female called the nestlings and they answered her from the nest cavity, and at the age of 29 days they appeared for the first time in the entrance of the cavity (Šotnár 2009). In this case the age of the nestlings when they frst appeared in the cavity is notable, because this is higher than ever previously reported in the literature. For spatial activity of adults near the nest hole and for height of roosting--places and for ritualized prey-delivery in the period of parental care for nestlings, the same relation to the height of the nest hole applies as we found during the period of incubation.

Production of young

The production of young was evaluated in 57 cases, 34 of which were successful (69.7%). The number of young produced was established precisely in 27 breedings, from which 80 young fledged (Fig. 19), so the average number of fledglings/nest was 2.96. In accidental finds of families of fledged young, the number of occasions with exactly established number of fledglings was considerably higher, approaching 100%. Average number of fledglings in accidentally-found fledged 19 families was 2.97. It seems that relatively lower numbers of young fledged in years with less suitable conditions, with high precipitation and cold weather in May and June leading to unsuitability of conditions in these years: in rainy, colder years, typically in 2009 and 2010, the number of fledged young/nest was lower than the long-term average: in 2009 it was only 2.33 and in 2010 only 2.0. These average numbers of fledged young are slightly lower than would be indicated by the data collected from Austria and Germany, and much lower than indicated by data from northern Europe, although the high average numbers of fledglings in northern Europe are apparently connected with more extreme oscillations between peaks in food-availability, especially vole-rich and vole-poor years, than in central Europe, where Eurasian pygmy owl populations are not subject to such dramatic cycles of abundance related to small mammals. Data from Slovakia also indicate that breeding success was dramatically reduced in the period between 1991 and 2005. In three consecutive years 1989–1991 (Tab. 1) the number of fledged young (8 breedings with exact numbers of fledglings: 4, 4, 5, 5, 3, 5, 4, 0) was on average 3.75 fledglings/nest, which indicates much higher breeding success than was found in the six years 2005–2010 (9 breedings with exact numbers of fledglings 5, 3, 3, 3, 2, 2, 2, 3, 3) with on average only 2.88 fledglings/nest. Numbers of young fledged/nest have dropped by almost one young/nest within about 15–20 years. Relatively lower numbers of fledged young found accidentally soon after their fledging in the years 2004–2009 confirmed this decline (six families with exactly established numbers of fledglings 3, 3, 2, 4, 3, 3), giving average breeding success of 3.0 nestlings/fledged family. Data from Slovakia thus indicate reduction in overall breeding success of Eurasian pygmy owls since the 80. and 90. in comparison with breeding success at the end of the first decade of the 21st century. These results need to be compared with data from other researchers,

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Tab. 3. Fledglings movements and parental care near nest at Bankov near Košice in year 1991
Tab. 3. Pohyb vyletených mládat a rodičovská starostlivosť pri hniezde na Bankove pri Košiciach v roku 1991

date / dátum	day after fledging / deň od opustenia hniezda	fledglings distance from nest / vzdialenosť mláďat od hniezda [m]	parental care and notes / rodičovská starostlivosť a poznámky
16. June	0	30	male brings food / samec prináša korisť
17. June	1	ca. 12	
19. June	3	8	female feeds fledglings / samica kŕmi mláďatá
22. June	6	50	
23. June	7	100	
25. June	9	100	
1. July	15	30	female feeds fledglings; it heavily moulting (no tail feathers) and stops reacting on begging calls from juvenile birds / samica kŕmi mláďatá, silne pŕchne (nemá chvostové perá) a prestáva reagovať na žobravé hlasy mláďat
5. July	20	250	male hunts, brings prey for fledglings, they take food from him, female absents / samec loví, prináša korisť, mláďatá si sami preberajú potravu, samica nie je prítomná
6. July	21	200	
7. July	22	100	
12. July	27	300	

and looking for possible reasons should be the subject of further studies.

In 1999 in western Germany 57 young fledged out of 17 nests and the average was 3.3 young/nest, while in north-eastern Norway the average number of hatched young per egg was 0.5–0.9, a result of variation in number of eggs per clutch (5.8–7.3) and availability of food (del Hoyo et al. 1999). For comparison, Hudec et al. (1983) mentioned a case of six young in a nest. Weather plays an important role in influencing breeding success, e.g. late snow can lead even to abandonment of clutches at a crucial stage of incubation (Scherzinger 1974), and in Finland the start of breeding is shifted to the end of April and hatching occurs in the period of highest availability of food (Mikkola 1983). Extreme figures for clutches in the north of Europe are more striking than in central Europe.

The average number of eggs laid in different countries of Europe was compared by Mikkola (1983): average clutch in Austria was only 4.5 eggs/nest (range 4–6), in Sweden it was 5.9 eggs (4–7) and in Finland 5.4 eggs (4–10). The average number of fledged young also depends on clutch figures: in Finland an average of 5.1 young (3–7) fledged from 16 nests, in the Bavarian Forest (Scherzinger 1974) it was 4.3 fledglings on average from 13 nests, from which only 3.3 fledglings survived to the end of the breeding season. In years poor in food, in low--vole years, it seems that many fledglings die from hunger and as a consequence of cannibalism due to food-shortage. Breeding success in the north is much better in years with increasing numbers of voles. The Eurasian pygmy owl is thus highly dependent on voles for the successful survival of its young (Kellomaki in Mikkola 1983), and the species cannot compensate compensate for the lack of voles with bird prey in low-vole years.

Parental care after fledging

Briefly before fledging young Eurasian pygmy owls stay longer and longer in the entrance of the cavity. They strive to get out and again return back to the cavity. With circular motions of the head they observe the surroundings of the nest cavity and disappear back inside fast after catching any sound or spotting any movement nearby. They leave the nest cavity at the age of 27–34 days, often between 7:30 and 13:00 hours. They are able to fly a distance of 20 to 30 m. From the entrance they fly directly, or get onto a close branch first (Schönn 1980). In Slovakia the fledging of young has been observed in detail only in a few cases. They left their nests in an overall time span of 3–6 days between the fledging of the first and the last fledged nestling, and they did not return subsequently to the nest cavity. Once the young are fledged the family stays about 2–3 weeks in the breeding territory. Fledglings hide in the tops of high trees or in young dense forest (Scherzinger 1970, Schönn 1980). Klaus et al. (1982) mention their observation from the Belanské Tatry Mts, where five days after fledging they found a family 10–30 m from the nest

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Tab. 4. Characteristics of spatial activity in four Eurasian pygmy owl females in nests with different heights
Tab. 4. Charakteristika priestorovej aktivity štyroch samíc kuvička vrabčieho v hniezdach s rozličnou výškou

site / lokalita	mountain range / pohorie	year / rok	nest cavity height / výška hniezdnej dutiny [m]	resting branch height / výška odpočinkového konára [m]	flight activity height at nest site / výška letovej aktivity pri hniezde [m]
Kamenný hrb	Volovské vrchy Mts	1990	1.9	2.0	6.0
Bankov	Volovské vrchy Mts	1990	5.0	9.0	8.0–10.0
Vysoký vrch	Čierna hora Mts	1990	10.0		10.0–12.0
Tupý vrch	Volovské vrchy Mts	2010	1.5	6.0	6.0–10.0

tree. Scherzinger (1974) found fledglings after a week in two sites at a distance of 20 m from the nest tree. Wiesner & Rudat (1983) found that parental care (with food-supply) for fledged Eurasian pygmy owls continued until the 72nd day of their life, and they followed three families for periods of 43, 36 and 31 days after fledging and found that females started to moult about two weeks after their young fledged, while males supplied the fledglings with food and led them through the territory until they were aged about ten weeks.

Šotnár once observed the fledging of two young from one nest on June 25 and 28. In the next year this pair of Eurasian pygmy owls bred 300 m away, and two young fledged on June 8 and 11 (two weeks earlier than in the previous year). The female attracted her fledglings to fly downhill and into the tops of trees. Just after fledging they could fly well, but they were not as skilled at landing on branches. After five days they kept to the tree-tops at heights of 10–18 m and at a distance of 50 m from the nest tree. After ten days they remained at a distance of about 80 m from the nest, where one of the fledglings was observed at a height of 17 m, busy consuming a mouse (*Apodemus* sp.).

A family of Eurasian pygmy owls was observed in 1990 at the Bankov site near Košice about seven days after fledging of the young, while the fledglings were fed by the female at a distance of 75 m from the nest tree. The next year at another nest the fledglings were seen at a distance of 350 m from nest tree four days after they left the nest. They were sitting on branches of firs at a height of 12 m and higher. The female fed them all day long, but with highest intensity during the morning and evening hours. In the hours before and around noon the female fed her fledglings with prey usually from caches made on tree-branches, because the male from this pair brought food mainly during dawn and dusk, but not during daylight. The longest observation of fledglings took place in 1991 again at the Bankov site. The route of movements of this family (Tab. 3, Fig. 20) was observed 27 days after fledging (June 16 – July 12). The overall distance covered by this family in the territory of this pair was about 700 m, and on the 27th day after fledging the family was only 300 m from their nest-tree (Fig. 20). During the first few days food was brought by the male and young were fed by the female. On the 9th day after fledging the female lost her tail feathers through moulting, and stopped reacting to the repeated begging calls of the fledglings (Tab. 3). Feeding by the female was no longer observed after June 25. The fledglings were found again on July 1, high in the tops of broad-leaved trees. The male delivered food to the fledglings until the last observation of this family on July 12. The fledglings were sitting on that day high in the tops of ash trees, and gave begging calls even during daylight. It is interesting that they did not prefer conifers (firs) to hide in, but mainly lower, dense beeches and high ashes with dense tree-tops, overhanging the forest canopy. The fledglings often changed their position from tree to tree, and on the 22nd day after fledging they made some hunting attempts, albeit unsuccessfully.

Accidental finds of fledged young in the months June – August have been made by several observers in different parts of Slovakia (Tab. 2). On the basis of these finds it is not possible to state the age of fledglings precisely, because the exact date of their fledging is not known. Nine cases of observation of fledged families fell in June, ten in July and two in August. The earliest observation of a fledged family fell on June 4 (year 2009, Košice, locality Bankov) and later cases fell at end of June and beginning of July. The two latest cases of observation of fledglings fell in August: on August 2, 1984 observed three juveniles Vlach at Hrabušice (Danko 1988) and two fledged families were heard on August 18, 2007 on a ridge of the Volovské vrchy Mts at the Tri studne and Biely kameň sites at a distance about 3.5 km one other (K. Takáč in litt).

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Breeding losses and unsuccessful breeding

In cases of unsuitable climatic conditions during the breeding season, breeding can be interrupted or Eurasian pygmy owls do not breed at all. It is not unusual that while caring for their young in the nest cavity one of the parents disappears. Schönn (1980) names the following negative impacts leading to interruption of breeding. In one nest with eight eggs the female incubated the clutch for 60 days, but no young hatched. In the following years the eggs did not have any embryos, because the breeding site was sprayed with insecticide containing DDT. In another breeding territory the male disappeared while the young still needed care, and the female consumed all nestlings due to lack of food. In another case the female was lost during the mating season, which resulted in fallout of breeding, because the male could not attract another female. Canibalism, or more precisely cronism, was found by Klaus et al. (1982) in one pair, where because of food shortage just one young fledged and two others were consumed in the nest cavity. Sometimes cases of disturbance by nuthatch (*Sitta europaea*) or dormouses (*Glis glis*, *Dryomys nitedula*) occur, which occupy the breeding cavities of Eurasian pygmy owls. Also disturbance by pine marten was found (März 1964). In the Český les Mts and Šumava Mts in the Czech Republic, three young pygmy owls were found in pellets of *G. passerinum* in the breeding season, and one young pygmy owl in the Góry Stolowe Mts in Poland, probably as a result of cannibalism (Mikusek et al. 2001). When evaluating the food of eight owl species from the material of 225,441 food items in Slovakia, the Eurasian pygmy owl was found only in three items of food of *Strix aluco* which means 0.004% (Obuch 2010). Eurasian pygmy owl remains were also found in food of *Falco peregrinus* at the Dolný Harmanec site in central Slovakia (Obuch in litt.).

In Slovakia the following disturbing factors have been found, causing fallout of breeding or breeding loss. In the case of one pair surveyed for a long period in the Strážovské Mts in 2006, breeding was interrupted due to human activities – felling of trees done in the vicinity of the nest tree. Three years later during the period of care for the nestlings the male disappeared from the site and the female took care of the two young alone. Shortly after fledging both young became the prey probably of *Pernis apivorus* or *Accipiter nisus*, both of which were breeding near the Eurasian pygmy owls (Šotnár 2009). Killing of a freshly-fledged young Eurasian pygmy owl was found in 1990 at a nest in the Volovské vrchy Mts near Košice, on the basis of a find of feathers from the ragged young. The suspected predator would be *Strix uralensis*, because an adult specimen of this owl had been observed at the pygmy owls' nest the day before, when two young had been already fledged and left the nest, and the female Eurasian pygmy owl reacted with excited warning calls.

An abandoned nest cavity with two cold eggs for some uncertain reason was found on May 27, 2003 in the Turzovská vrchovina Mts (M. Špilák in litt.) and another one with a clutch of four cold eggs in 1991 in the Javorníky Mts (J. Korňan in litt.).

Habitats at some sites with ascertained breeding of Eurasian pygmy owls have been completely destroyed as a consequence of clear-cutting of all forest tracts heavily attacked by bark-beetle, e. g. recently the breeding habitat in the Turzovská vrchovina Mts where a pair of pygmy owls were breeding in 2003, and in the Javorníky Mts in 1999 (M. Špilák in litt), as well as some of the previously-known breeding sites of the pygmy owl in the Nízke Tatry Mts, already clear-cut for the same reason (P. Vrlík in litt.).

Eco-ethology of the species in the breeding season

In this section we present some notable observations on comfort behaviour, interactions of Eurasian pygmy owls with diurnal raptors, interspecific interactions between Eurasian pygmy owls and other owl species, woodpeckers and passerines breeding in tree cavities as well as intraspecific competition.

1. Comfort behaviour and interactions with diurnal raptors

A male Eurasian pygmy owl was observed on April 11, 2010 in the Žiar Mts at 12:45 hours nearby the nest cavity performing a number of actions relating to comfort behaviour (Figs 21A–J). Preening of feathers started at the breast, continued over the shoulders, wings, tail and abdomen, and finished with preening of the legs (Figs 21B–D). These actions were followed by standing on one leg (Fig. 21E) and later by drowsing on a branch with fluffed feathers (Fig. 21F).

This phase of rest was followed by another phase of actions signalising flight away, particularly stretching of all one side of the body, the legs and wings (Figs 21G–J). Immediately before flying away the owl displayed stretching of its wings (Figs 21H–J). Before the pygmy owl could finish its actions related to comfort behaviour, *Accipiter gentilis* appeared and flew past about 200 m from the Eurasian pygmy owl. The pygmy owl immediately

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took up a safety posture of stiffness, it assumed an upright position and uttered an alarm-call "kju-vit".

In another case, on April 29, 2010 (Strážovské vrchy Mts) at 13:00 hours a male of Eurasian pygmy owl sat resting also near the nest hole, facing the cavity. When it spotted *Accipiter nisus* passing by about 150 m away, it immediately contracted its body and appeared optically much thinner than usual, and remained motionless. When *A. nisus* had flown away, the Eurasian pygmy owl turned and with fast steps and its still "thinned" body it crept towards the end of the branch it was perching on. It stretched itself forwards at a 60° angle and stood for a while in this posture, so it looked like part of a dry branch. The Eurasian pygmy owl then perched on the branch for a long time, with its back turned towards the cavity and looking in the direction where *A. nisus* had disappeared.

In 2009 in the Strážovské vrchy Mts nests of several diurnal raptors were found at the following distances from the nest cavity of a pair of Eurasian pygmy owls (species/distance of raptor from pygmy owl nest): *Pernis apivorus* – 7 m, *Accipiter nisus* – 230 m, *Buteo buteo* – 250 m, *Aquila pomarina* – 500 m, *Accipiter gentilis* – 700 m. *Strix aluco* was also observed at a distance of 300 m. The cumulation of these predatory factors very likely resulted in the killing of a pygmy owl male and two fledglings (Šotnár 2009).

2. Interspecific interactions with other owls

Competition of the Eurasian pygmy owl with *Strix uralensis* and with *Strix aluco* was studied. In fir-beech forests of eastern Slovakia the Eurasian pygmy owl lives quite often sympatrically with *S. uralensis*, but less often with *S. aluco*. Experience from the Volovské vrchy Mts shows that presence of *S. uralensis* in the vicinity, or in the territory of the Eurasian pygmy owl the latter has no reason for leaving its breeding site, even if it has some influence on pygmy owl's, e. g. it often stops calling and avoids direct contact with *S. uralensis*, when the latter calls or appears (Pačenovský 1995). Similar results with no effect on breeding success of pygmy owls was demonstrated by a case in 2009, when at the Kamenný potok site in the Volovské vrchy Mts close to Košice a pair of pygmy owls raised two young despite having two pairs of of *S. uralensis* breeding at a distance of 600 m from their nest, even though the pygmy owls' breeding territory was surrounded from either side by another territory of *S. uralensis*.

A male pygmy owl in the Vtáčnik Mts was heard calling at about noon on March 1, 1994, but when it registered a single *S. uralensis* flying by, it immediately stopped calling (Šotnár 2004).

The Eurasian pygmy owl avoids contact with *S. aluco*, the reason being the potential risk of becoming the tawny owl's prey – the killing of a pygmy owl by *S. aluco* in its territory is decribed by Melde (1989) and Mikusek et al.(2001). The close vicinity of *S. aluco* has, it seems, more drastic effect on the course of pygmy owls' breeding than the proximity of *S. uralensis*. This is expressed in several ways. Voice activity of a pair of Eurasian pygmy owls breeding in close proximity to a pair of *S. aluco* was dramatically reduced. A pair of Eurasian pygmy owls observed in April 1992 at Opátka in the Volovské vrchy Mts stopped breeding or abandoned a previously selected cavity, when a pair of *S. aluco* nested only 30 m away from them. It is not known if this pair of pygmy owls bred at all in that year, or selected another nest cavity for breeding, located further away from the nest of *S. aluco*. The same pair of Eurasian pygmy owls had successfully raised five young the year before, when a nest of *S. aluco* nest was located 500 m from their nest (Pačenovský 1995).

In Slovakia, the Eurasian pygmy owl exists in large parts of its distribution area sympatrically with *Aegolius funereus*. Even if the mutual interaction of these two owl species has not been a matter of closer study, on October 29, 1993 one attack by *A. funereus* on a pygmy owl was observed at the northern edge of the Muránska planina Mts (Uhrin & Pačenovský 1997). This case happened in the evening time at dusk, when the activities of both species overlapped. Reactions of *A. funereus* to imitations of territorial calls of the Eurasian pygmy owl have been noted several times, and this has happened in the Czech Republic as well, from where such occasions are described by Kloubec (1987, 1992), who even recommends imitation of calls of the pygmy owl as a method suitable for recording the incidence of other owls, including *A. funereus*. Scherzinger (1970) and Schönn (1980) also mention their observations of an attack by *A. funereus* on a pygmy owl and aggressive behaviour by *A. funereus* at night against human imitation of a pygmy owl's call.

Mikkola (1983) notes the similarity of habitats of these two owl species, but it is not clear to what extent *A. funereus* is an enemy of the Eurasian pygmy owl. On the one hand there is a case of predatory killing of a pygmy owl by *A. funereus*, but on the other hand there is also a case from Finland when both species nested in the same tree, with their nest cavities located only four m from one another. These owls met only during daylight hours and during that time aggressive behaviour was expressed only by the female of Eurasian pygmy owl against female *A. funereus*, and no reverse action was ever seen.

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Fig. 21. Comfort behaviour of a male of Eurasian pygmy owl, Kľačno, Žiar Mts, 11 April 2010. A – rest, B – preening on shoulder, C – preening on abdomen, D – preening of a leg, E – rest on one leg, F – rest with fluffed feathers, G–I – stretching of a leg and wing, H–J – stretching of wings. All photographs K. Šotnár.

Obr. 21. Komfortné správanie samca kuvička vrabčieho, Kľačno, Žiar, 11. apríl 2010. A – odpočinok, B – čistenie peria na ramene, C– čistenie peria na bruchu, D – čistenie nohy, E – odpočinok na jednej nohe, F – odpočinok s našuchoreným perím, G–I – strečing nohy a krídla, H–J – naťahovanie krídiel. Všetky fotografie K. Šotnár.

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3. Competitive behaviour with other cavity-breeders

Competition between the Eurasian pygmy owl and other cavity-nesting species (*Sitta europaea* and *Dendrocopos major*) was observed. *D. major* systematically prevented repeated breeding by one pair of Eurasian pygmy owls in the Volovské vrchy Mts in an oak tree with several cavities (excavated by *D. major*). During 19 years of observation of the site continously occupied by the Eurasian pygmy owl this species has bred in the oak only four times and in all other years *D. major* has bred in this tree. Dominant behaviour by *D. major* in its breeding territory towards the Eurasian pygmy owl has been demonstrated. Its behaviour has been dominant, even aggressive to the extent of preventing the owl from breeding in its own breeding territory. Aggressive defending of its breeding territory against *D. major* on the part of an Eurasian pygmy owl was also observed, even if the owl did not turn out to be so successful in possession of the nest-tree as the woodpecker (as indicated by the frequency of years when the tree was used for breeding by the Eurasian pygmy owls or by *D. major*). During those years when pygmy owls bred in this oak tree, other cavity-dwelling species could also take advantage of breeding in other holes in the same tree: one pair of *S. europaea* and 1–2 pairs of *Sturnus vulgaris*, but simultanous breeding by the Eurasian pygmy owl and *D. major* in the same tree has not been observed.

At a nest of Eurasian pygmy owls in the Revúcka vrchovina Mts an attack by a great spotted woodpecker on the female pygmy owl was observed on April 9, 1995. It was probably even before the start of incubation and egg-laying, when the male had flown to the nest hole. At first the female owl would not enter the cavity because of the woodpecker's attacks, but she finally entered it when the woodpecker left. Scherzinger (1970) and Schönn (1980) describe contrary examples of attacks by Eurasian pygmy owls on *D. major*.

Breeding by another pair of pygmy owls in the Volovské vrchy Mts was prevented by a pair of *S. europaea*,

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which walled up the entrance to the cavity in a dry fir with clay, thus preventing this pair of Eurasian pygmy owls from breeding in it. This cavity in the dry fir had been used for breeding by the pygmy owls for the preceding two years, but in the following years they would no longer breed in the cavity. What appeared to be simultanous breeding by pairs of nuthatches and pygmy owls in the same tree was also found by M. Demko (in litt.) in 1990 at Oravská Lesná in the Podbeskydská vrchovina Mts.

Not as a case of competition, but more as an interesting phenomenon, we note that in 1989 Bohačík (in litt.) found an occupied nest of European pygmy owls in the Žiar Mts in close proximity to a nest used by a pair of black storks (*Ciconia nigra*).

4. Conspecific competition

Intraspecific competition occurs among Eurasian pygmy owls in a distinct way, most strikingly during the period of spring mating in the first half of April, when neighbouring males demarcate the borders of their territories with calls, and several mutual conflicts and combats appear (Scherzinger 1970, Schönn 1980, Mikkola 1983). From this point of view it is surprising that despite the striking territoriality of the species, two pairs can breed as close to one another as 400 m (Pačenovský 1993, Pačenovský & Kürthy 1992), as found in 1990, when two simultanously occupied nest holes were observed, and the nests were located on either side of the same mountain ridge.

Conclusion

Accessible data on 78 breedings of the Eurasian pygmy owl (*Glaucidium passerinum*) in Slovakia are evaluated in the contribution, ranging from the oldest known data on breeding from the year 1846 up until the year 2010. The authors prepared their results from field research on the breeding biology of the species, based on studies of 22 breedings (16 nests, some of which were occupied repeatedly) and seven finds of fledged families in the period 1989–2010, and they collected further as yet unpublished data from a number of ornithologists active in Slovakia on 31 nests and finds of nine fledged families from the years 1983–2010. The overview is also complemented by seven already published, older sets of data on breeding of the species, originating from the period 1846–1984.

The results indicate that breeding of the Eurasian pygmy owl has been confirmed in 24 orographic units, at altitudes of 450(400)–1450 m in coniferous and mixed forests with distinctive representation of spruce (*Picea abies*) and fir (*Abies alba*), from the lowest natural distribution of the fir in Slovakia up as far as the upper tree limit.

Nests of Eurasian pygmy owls have been found in a number of basic habitat types (with percentage of ascertained breeding in each habitat type): 1. forests with fir between 450–550 m – 11.3%, 2. fir-beech and fir forests between 600–800 (1050) m – 21.1%, 3. beech-spruce-fir forests between 800–1200 m – 21.1%, 4. habitats with distinctive representation of spruce at lower altitudes, in productive forests (between 550–1200 m) – 33.8%, 5. habitats of old, natural montane spruce forests between 1200–1450 m – 7.1%, 6. habitats with prevalent representation of scots pine (*Pinus silvestris*) and black pine (*Pinus nigra*) between 650–850 m (Liptovská kotlina Basin and Žiar Mts) – 2.8%, 7. overgrown pasture-land with adjacent forest (Oravská vrchovina Mts) – 1.4%, 8. waterlogged spruce forest (Západné Tatry Mts) – 1.4%. The highest frequency of nests was thus found in spruce forests, in fir-beech forests and in beech-spruce-fir forests.

Among the structural components of Eurasian pygmy owl habitats, the significant factors evaluated in Slovakia were mainly old coniferous and mixed forests, presence of dry trees with numerous hollow trunks and woodpecker cavities, and close proximity of small meadows and glades. A number of nests were located in forest edge zones, and proximity of water to the nest cavity was also an important factor. Out of 22 evaluated nests of the Eurasian pygmy owl in Slovakia, as many as 17 (70.8%) were situated not further than 200 m from water.

High prevalence of nests (72.5%) was found at altitudes between 600–1100 metres, 13% above and 14.5% below that range. The average altitude for 70 evaluated nests and fledged families in Slovakia was 840 m, which is lower than in the Austrian Alps, but slightly higher than in the Czech Republic. With the exception of orientation to the east, all other directions were found in the orientation of slopes in the breeding territories of Eurasian pygmy owls, and no direction was markedly preferred. As many as 25 nestholes were located in spruce, both in living and dead and broken trees, ten in fir (with significant prevalence of dead stumps), six breedings took place in beech, four in oak, four in aspen, and of other tree species there was one instance each of breeding in larch, dry maple and black pine, and one breeding took place in a nest-box. On several occasions occupation of the same nest was found repeatedly, the highest number of such occasions being 4× in the same tree in a period of eight years, on three occasions a shift in nest location of 200–350 m within the same territory was found, and two neighbouring nests were found occupied at the same time by neighbouring pairs as close as 400 m from one another. Out of 47 evaluated cases of identified nest holes, 25 had

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evidently been excavated by the great spotted woodpecker (*Dendrocopos major*) and ten by the Eurasian three-toed woodpecker (*Picoides tridactylus*), while the other cavities were excavated by one or other of these woodpecker species, without closer specification. On four occasions breeding took place in a natural cavity (2× beech, 1× larch and 1× partially dry maple). The lowest situated nest was found less than 1 m above ground level, and the highest one was located 13 m above the ground; out of 44 evaluated nest holes the greatest number, 26, were situated between 4–7 metres high. Production of young was evaluated in 56 cases, 34 of which were successful (69.7%). The precise number of fledglings was found in 27 cases of breeding, from which 80 nestlings fledged, an average of 2.96/nest. This average is slightly lower than that calculated in Austria or Germany. In the colder than usual years of 2009 and 2010, which were poorer in food availability and characterized by high precipitation, the numbers of fledglings were even lower: on average only 2.3 and 2.0 fledglings per nest respectively. The average number of fledglings from eight Slovakian nests in three consecutive years (1989 to 1991) was 3.75 per nest, but the same parameter from nine Slovakian nests in six later years (2005 to 2010) dropped to 2.88. This indicates a diminishing trend in nest productivity.

These results should be compared with the conclusions of other authors, and looking for possible reasons for the decline should become a matter for further study. Parental care for the young after their fledging was observed in detail in the Volovské vrchy Mts. In one case the young were followed for seven days after leaving the nest, and in that time they were fed by the female at a distance of 75 m from the nest. On another occasion the movements of fledglings in the territory after their fledging continued for as long as 27 days. The overall distance covered by the family was about 700 m, and on the 27th day after leaving the nest the fledglings were 300 m away from the nest, and food was brought to them only by the male, because the female did not show interest in the fledglings from the 9th day after they left the nest, because she was moulting and she had already lost her tail feathers.

On other occasions disturbance due to human activity (felling of trees) was recorded as the reason for abandoned breeding attempts. Such disturbance can be extreme, for example in the Kysuce Region in the Javorníky and Turzovská vrchovina Mts, two breeding sites with nests in 1999 and 2003 were later destroyed because of the complete removal of those forest tracts attacked by bark-beetles. In 2009 in the Strážovské Mts a curious case was observed where the male disappeared during the period of parental care of the nestlings, but the female continued to feed her two nestlings alone until they fledged. Just after fledging these fledglings were killed by a predator, probably by *Pernis apivorus* or *Accipiter nisus*, both of which were breeding nearby.

The authors made several remarkable ethological observations in the life on Eurasian pygmy owls. In the Strážovské vrchy Mts the 'nest-showing' of more than one cavity in its territory by the male to the female was observed. Copulation by one pair of Eurasian pygmy owls in the Žiar Mts was observed several times in detail and also photo-documented. Nest-showing display was observed in the spring season also in the Volovské vrchy Mts, and in the same mountain range a little-known autumn season nest-showing display was seen, confirmed also in the Nízke Tatry Mts. Copulation was observed a total of eleven times in the years 1989–2010, during the months February – May with the following frequency: February 1×, March 3×, first half of April 5×, second half of April 1×, beginning of May 1×. On one occasion the movements of fledglings in the territory after their fledging were observed for 27 days.

Interactions of Eurasian pygmy owls with diurnal raptors, owls and other cavity-breeders were also documented. In the Strážovské vrchy Mts the breeding of an owl pair at a relatively close distance to the nests of various diurnal raptors was documented as follows (species/distance of raptor nest from Eurasian pygmy owl nest): *Pernis apivorus* 7 m, *Accipiter nisus* 230 m, *Buteo buteo* 250 m, *Aquila pomarina* 500 m, *Accipiter gentilis* 700 m. In the Volovské vrchy Mts a pair of Eurasian pygmy owls successfully bred at a distance of 600 m from two nests of *Strix uralensis*, and another pair bred at a distance of 500 m from a nest of *Strix aluco.* The breeding of another pair of *Strix aluco* just 30 m from a cavity used by a pair of Eurasian pygmy owls led to unsuccessful breeding/abandoned nest by this pair. Competitive behaviour was observed between the owls and other cavity-breeders such as *Sitta europaea* and *Dendrocopos major*, and an occasion of predatory killing of an owl fledgling by *Strix uralensis* was suspected. On another occasion an attack by *Aegolius funereus* on a Eurasian pygmy owl was observed.

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