Slovak Raptor Journal 2010, 4: 47–79

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

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Abstract: Accessible data on 78 breeding occurences of the Eurasian Pygmy Owl (*Glaucidium passerinum*) in Slovakia are evaluated. Data from the oldest known breeding in 1846 to 2010 were used. The breeding of this species has been proved in 24 orographic units, in elevations from 450 (400) to 1450 m a. s. l. 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 a high 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 elevations between 600–1100 m a. s. l., with 13% over 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. On one occasion each nests were found 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, have been found at the same time as close as 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 characterised 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 (felling of trees) 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 a 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 in the years 1989–2010, during months February-May with the following frequency: February 1×, March 3×, 1st half of April 5×, 2nd 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 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 the unsuccessful breeding/abandoned nest of 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 predation of an owl fledgling by *Strix uralensis* was suspected. An attack by *Aegolius funereus* on a Eurasian Pygmy Owl was also observed.

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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Acnowledgements: The authors would like to express their thanks to L. Bohačík, M. Demko, A. Gajdošová, M. Gonšor, D. Karaska, J. Korňan, A. Krištín, A. Kürthy, Š. Matis, R. Michalec, V. Michalec, L. Mošanský, J. Obuch, Z. Petrovics, M. Saniga, M. Špilák, P. Vrlík and K. Takáč for providing valuable data, to Š. Danko for providing of literature, to A. Kürthy for elaboration of maps, translation of foreign literature and help in the field in research on Pygmy Owl nests in years 1989–1991 in orographic units Volovské vrchy Mts and Čierna hora Mts, and to K. Takáč also for help in locating of Eurasian Pygmy Owl nests in year 1991. This work has been partially supported financially from small member´s project of Raptor Protection of Slovakia no. MČP/56110002.

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Introduction

The Eurasian Pygmy Owl (*Glaucidium passerinum*) is distributed in Slovakia at most of northern part of Central Slovakia and in large part of eastern part of the country (Danko et al. 2002, Pačenovský 2005). Its distribution area is comprised by almost uninterrupted zone of forested mountains with occurrence of coniferous and mixed forests. From its lowest known distribution in a spruce forest with larch, hornbeam and oak mixed in as low as about 300 m a. s. l. in northern part of the Tribeč Mts (Šotnár, unpubl.) till several habitats with different representation of fir and spruce till the highest forest limit in Veľká Fatra, Malá Fatra, Vysoké Tatry and Nízke Tatry Mts in elevations 1400–1650 m (Bališ 1972, Danko et al. 2002, Pačenovský & Shurulinkov 2008). Usually avoids coherent deciduous forests, but it seems, that it should not be a rule (Danko et al. 2002). Its occurrence has been found thus as well as in deciduous forests with just islets of young coniferous trees or only with forest nurseries of coniferous trees, or conifers mixed into grows of deciduous forests in lower rate as 30% respectively. It has been found also in deciduous forest with only a few conifers. It breeds thus in different habitats and in considerably different elevations. There are several available data on distribution of the population based on data from spring mating (March – April) and autumn mating (August – October), not as many data from breeding season (April – July). There is a lack of direct finds of breeding cavities, because location of nest site is considerably difficult because of secretive way of life of the species in this season of the year. Our knowledge based on a few tens of found nests is not adequate and this is also the result of low number of ornithologists specialised on research of this owl species and it undoubtedly does not correspond with the massive altitudinal distribution of the species across several vegetation zones.

Older literary data on breeding from Slovakia had been resumed by Matoušek (1962) and Ferianc (1979), A. Mošanský (1979) elaborated primarily the museum-based data from East Slovakia. In the book „Fauna of ČSSR“ (Hudec et al. 1983) is stated in connection with the Eurasian Pygmy Owl population, that in that time its distribution in Slovakia had been much less known, as in the Czech Republic. From area of Slovakia are mentioned only general information on breeding in higher positions of forested mountains. These data were taken over from earlier sources and concrete data on breeding has not been mentioned. An overview of published data on the Eurasian Pygmy Owl from former East-Slovakian region from earliest known data from the 19th century until year 1988 has been resumed by Danko (1988). An overview of literary data refilled by own observations and more up-todate information collected from local ornithologists and mentions five cases of breeding (Belianske Tatry Mts, Levočské vrchy Mts, Šarišská vrchovina Mts, Volovské vrchy Mts and Slovenský raj Mts). But until year 1988 only very few concrete data on nests in Slovakia has been available. Probably the oldest known nest record from our territory is a note on a clutch from year 1846 from surroundings of Banská Bystrica (J. S. Petényi in Matoušek 1962). Further find of a nest from Slovakia has been described by Klaus et al. (1982) from the Belianske Tatry Mts.

Research of distribution of the species after year 1989 has been dealing particularly by S. Pačenovský, A. Kürthy in Eastern Slovakia in co-operation with further ornithologists and K. Šotnár in Central Slovakia. Their results has 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).

Work of authors Mikusek et al. (2001) disserts on food of the Eurasian Pygmy Owl in Central Europe, including Slovakia. In some of above mentioned works also concrete data on breeding and nests had been mentioned. Actual accessible data on areal and altitudinal distribution of the species in Slovakia, preferred types of habitats and on densities has been summarised in the comprehensive work on birds of Slovakia (Danko et al. 2002). Several newer findings on breeding biology and ethology of the species published Šotnár (1998, 2004, 2009, 2010). Findings on densities of the species from a number of Slovakian mountains from elevations 800–1650 m has been compared with densities in Bulgarian mountains by Pačenovský & Shurulinkov (2008).

A target of this contribution is to summarise and evaluate data of known cases of proved breeding of the Eurasian Pygmy Owl found until now in Slovakia and evaluation of knowledge on reproduction-behaviour, ethology and competitition with other species. The presented work is partially based on data already published earlier, but its substantial part is composed by new and yet unpublished data. A goal of this work is to fill in the gap in knowledge from eco-ethology of breeding of the Eurasian Pygmy Owl in Slovak ornithological literature and comparison of the findings with other data from distribution area of the species in Europe.

Material and methods

Territories of Eurasian Pygmy Owls has been searched in autumn and spring seasons. Breeding territories has been located on the basis of knowledge on calling spots of males in spring season. Presence of Eurasian Pygmy Owls is possible to ascertain easily at the site during spring, or autumn mating in months March – April and August – October respectively. Registration of its acustic displays is probably the only effective method of finding the occurrence of *Glaucidium passerinum* (Scherzinger 1970, Kloubec 1992). In survey of known territories of Eurasian Pygmy Owls emphasis has been given especially to ascertainment of presence of the female in breeding territory. 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 period of mating, incubation, care for nestlings and care for fledglings after they left the nest.

First of the authors has used in survey of Eurasian Pygmy Owl territories especially twilight peaks of activity of the species (morning twilight and evening dusk), in breeding season observed eco-ethology of the species also during daylight. The second author used a similar method with a difference in preferred period of the day, because even breeding territories of Eurasian Pygmy Owls located during daylight periods and almost every nest found during daylight.

A basic material for evaluation of results were field observations and notes of the authors from 22 breedings of the Eurasian Pygmy Owls (some nests has been used for breeding repeatedly in more than one season) from years 1989–2010 (Tab. 1) and notes of eight fledged families of Eurasian Pygmy Owls in 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 (Fig. 1, 2; Tab. 1, 2).

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

Outline of results has been completed also by seven data on breeding of Eurasian Pygmy Owls (1 clutch, two nests, 4 fledged families) from years 1846–1984, already published earlier by other authors (Tab. 1, 2).

Habitat surrounding of the found nests of Eurasian Pygmy Owls has been characterised by a cathalogue of habitats of Slovakia (Eliáš et al. 1991), comparative abundance of individual tree species in these habitats had been estimated. In case of data on nests taken over from other ornithologists we had to learn on their decriptions of habitats and further details connected with location of these nests.

The Eurasian Pygmy Owl breeds in smaller nest cavities, thus we meet a methodological problem in controll of its nests. A substantial part of reproduction – cycle of the species is hidden from eyes of observers, these cavities are unaccessible or only hardly accessible and so it is not simple to obtain unambiguous information on numbers of fledged young birds. In cases of lower positioned nest cavities their visual controll has been made by using the help of a small mirror. Older nestlings few days before leaving the nest are often looking out from nest cavity and from characteristic colour features of their faces is possible to assume the number of nestlings. Fledging of young birds from nest is being in progress usually gradually and it can last several days. In consequense of above mentioned reasons in most cases is needeed to make more than one visit at nest in a short interval in order to ascertain nest productivity. If this was from some reason not possible to keep, usually data are distorted and number of young birds is not possible to state. This is also the reason, why in some data on breeding from Slovakia number of young birds was not known (in 57 located nests number of unknown breeding sucess represents 43.9% of occasions).

Results and discussion

Proved breedings

In this part of the contribution the authors will evaluate 78 proved breedings of the Eurasian Pygmy Owl from Slovakia. Breeding has been yet found in 25 orographic units of Slovakia (Fig. 1). The oldest data on breeding, find of a clutch originates from June 5, 1846 from surroundings of Banská Bystrica (J. S. Petényi in Matoušek

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).

1962). This data is not possible to assign to any orographic unit, or bind to any specific habitat, because exact location of the nest is not known. The other data we can divide into 57 finds of nests (Tab. 1, Fig. 2) and to other finds of proved breeding: 20 finds of fledged youngs and one find of an adult with an incubation bald spot (J. Palášthy in Mošanský, 1979; Tab. 2, Fig. 2). These are bound to one of orographic units of Slovakia.

Overview of orographic units of Slovakia with yet approved breeding (nest or fledglings) is demonstrated at a map (Fig. 1). Breeding has been yet proved in the following orographic units (in brackets is a number of found nests/breedings): 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 real distribution of the Eurasian Pygmy Owl in Slovakia, because this area is even broader, as area of above mentioned orographic units. It is more a reflection of an intensity of ornithological research, besides other targets focused on this owl species, especially in higher elevations of Slovakia.

Chracteristics 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 characteristic, as well as some further, less frequent types of breeding habitat:

1. Forest habitats at lower limit of natural distribution of the fir, oak-hornbeam forests with lime and fir (eastern part of the Volovské vrchy Mts and in Šarišská vrchovina Mts), in elevations 450–550 m a. s. l. 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 m a. s. l. abundance of fir was usually at least 30%. Breeding in that specific habitat

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 Jun 1846	clutch/ násada		?	?	?
N2	Belianske Tatry Mts	?	1 July 1973		3	?	*Ptri*	?
N3	Levočské vrchy Mts	Bijacovce, Pár̆šivá	28 Apr 1977	after 6 Jun 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 Mar 1990	3–5 Jun 1990	5	fir (dry)	*Dmaj*	1.9
N9	Čierna hora Mts	Vysoký vrch	25 Apr 1990	ca. 15–18 June 1990	5	fir (dry)	*Dmaj*	10.0
N10	Veľká Fatra Mts	Skalná Alpa	10 Jun 1990		?	fir	*Ptri*	3.0
N11	Volovské vrchy Mts	Košice, Bankov	1 Apr 1990	14 June 1990	min. 1	oak	*Dmaj*	5.0
N12	Podbeskydská vrchovina Mts	Oravská Lesná, Okáľka	18 Apr 1990		?	spruce		7.5
N13	Volovské vrchy Mts	Bankov	10 Apr 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 Apr 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 Jun 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 Jun 1992			fir		5.0
N21	Poľana Mts	Hrončecký Grúň	12 Jun 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	Iľanovská 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 Apr 1995	end of June 1995	?	aspen	*Dmaj*	9.0
N26	Nízke Tatry Mts	Iľanovská 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 Mar 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

10	11	12	13	14	15
?				Petényi in Matoušek 1962	
?		?		Klaus et al. 1982	
?	spruce (beech) 40–(60) y.	800	S	E. Hrtan sen. 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
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
W	fir, beech, sycamore 100 y.	780	S	S. Pačenovský	same nest as in 1989
NW	fir, beech	1025		M. Saniga	feeding of young in nest by adult
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 and both M and F in nest hole, May 24, pellets below nest
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	same tree, but other nest hole as in 1990
SE	spruce–beech	1250		M. Saniga	juv. in nest, M with food
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
SW	spruce, beech, maple, rowan 100–150 y.	1200		A. Krištín	feeding of juv. at nest
	spruce 70–80 y.			J. Korňan	
	spruce 80 y.			J. Korňan	nest found by J. Kizek, unsuccessful breeding, found clutch of 4 cold eggs
S	rowan–spruce	1450		M. Saniga	youngs fed by F in nest
NE	spruce, beech 100–200 y.	890		A. Krištín	feeding in nest
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	old nest from year 1990, July 9 F still in nest – possibly unsuccessful breeding
SW	spruce, fir, beech and maple mixed in	900	SE	P. Vrlík	
NW	fir, spruce	950		M. Saniga	youngs fed by F in nest
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
SW	spruce, fir, beech and maple mixed in	900	SE	P. Vrlík	same nest as in 1994
N	oak, hornbeam, beech, fir, lime, 60–80 y.	470	SE	S. Pačenovský	same tree as in 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 by Vrlík and Borsík in IX., M at cavity with pellets from breeding season

Tab. 1. continuation
Tab. 1. pokračovanie

1	2	3	4	5	6	7	8	9
N31	Starohorské vrchy Mts	Graniarka	28 May 1999		?	spruce	*Ptri*	6.0
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 Mar 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 Apr 2003		0	spruce	*Dmaj*	5.0
N40	Strážovské vrchy Mts	Tužina, Hvizdák	16 Apr 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 Apr 2009	25–28 June 2009	2	aspen	*Dmaj* / *Ptri*	6.0
N52	Strážovské vrchy Mts	Hvizdák	4 Apr 2010	7–11 June 2010	2	beech (dry)	natural	4.1
N53	Žiar Mts	Kľačno, Pod Závozmi	8 Apr 2010	3–5 June 2010	min. 1	maple	*Dmaj*	4.0
N54	Volovské vrchy Mts	Štós, Tupý vrch	9 Apr 2010	after 3 Jun 2010	3	spruce (dry)	*Dmaj*	1.5
N55	Volovské vrchy Mts	Štós, Štósky vrch	13 Apr 2010		0	fir (dry)	*Dmaj*	4.0
N56	Volovské vrchy Mts	Majerská dolina valley	14 June 2010	14–15 Jun 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

10	11	12	13	14	15
W	fir–spruce	850		M. Saniga	M at occupied nest hole with food
NW	spruce, beech, maple 100–150 y., edge	1130		A. Krištín	feeding in nest
	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
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
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
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 Eurasian Pygmy Owl in years 1990, 1991, 1994, 1997
W	beech, spruce, ash, poplar 60–80 y.	656	NW	K. Šotnár	same nest as in year 2005
NW	beech, spruce, fir 60–90 y.	654	SW	K. Šotnár	300 m from nest tree in 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
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
S	beech, spruce	1100	SE	A. Gajdošová	
	beech, fir, spruce	990		R. Michalec	feeding of juv. in nest

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

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

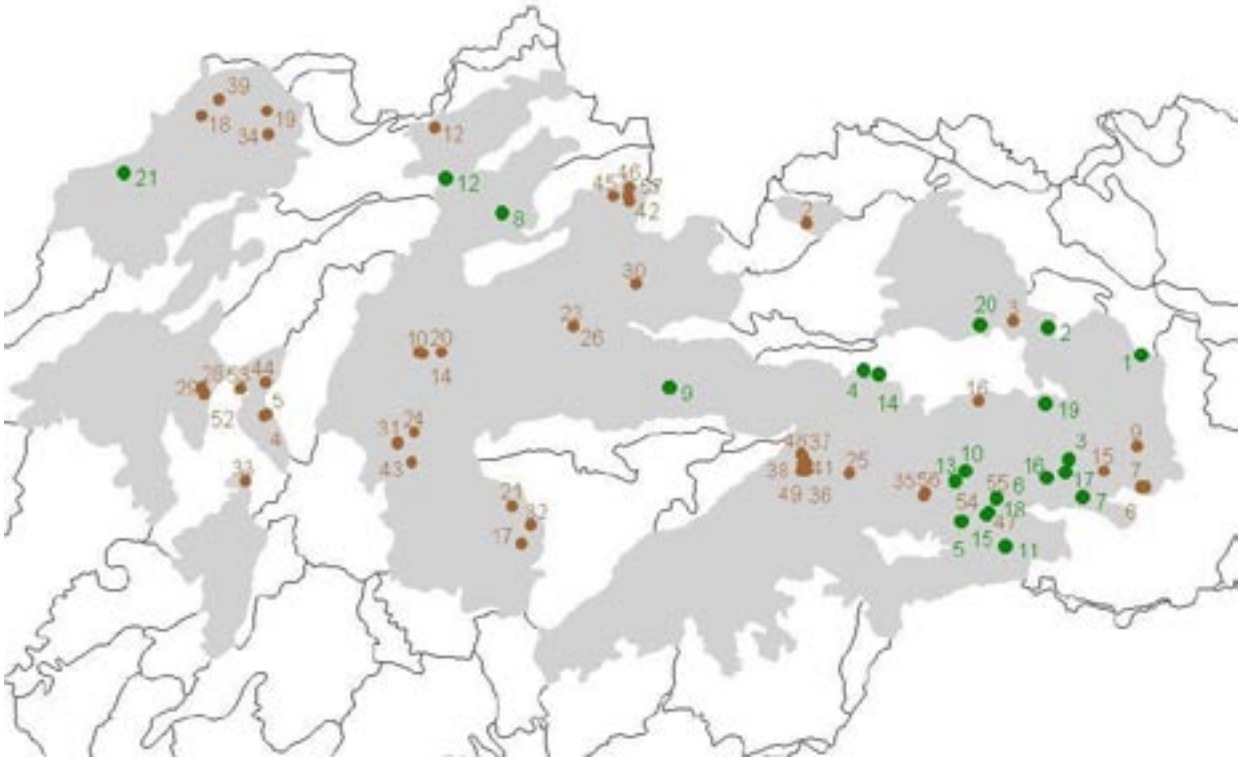


Fig. 2. Found nests (brown dots) and fledged youngs observations (green dots) of Eurasian Pygmy Owls in Slovakia. For site numbers see tables 1 and 2. The grey colour indicates orographic units with ascertained breeding of the Eurasian Pygmy Owl.
Obr. 2. Nájdené hniezda (hnedé body) a pozorovanie vyletených 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.

type has been found 8× (11.3%), but in most cases these breedings has been repeatedly found in the same territories. We assume, that only considerably small part of the Slovakian population breeds in such habitat, even if the species is present in that habitat type as a continual resident. A stable population of Eurasian Pygmy Owls is present in this habitat type, what is proved by repeatedly occupied nest sites, but also by persistently occupied territories and localities. As an example we can mention location Kamenný hrb close to Košice, occupied by the Eurasian Pygmy Owl persistently at least for 40 years. First time the species has been found here in year 1969 by Danko (1988).

2. Fir-beech and fir forests, sometimes with other tree species mixed in (sycamore and other species of maples, ash, beech-sycamore forests with fir etc.), often these forest habitats are natural and semi-natural (Fig. 3, 5, 10), age of forests from 40–120 years and even higher, altitudinal span is 600–800 (1025) m a. s. l. These habitats are characterised by presence of fir, in different abundance, from less than 10% until 100%. Fir-beech forests are naturally distributed in our forested mountains approximately from 550–800 m a. s. l., sometimes locally until 1025 m a. s. l. In eastern part of the Volovské vrchy Mts these habitats bind continuously to habitat type 1. Breeding of the Eurasian Pygmy Owl in these habitat type has been found also in Čierna hora Mts, in Veľká Fatra Mts (Skalná Alpa), in Revúcka vrchovina Mts and in further mountain ranges. Breeding in this habitat type has been found 15× (21.1%). Fir-beech forests belong in Slovakia to natural habitats of the Eurasian Pygmy Owl (5th vegetation level), and it is possible to state, that distribution of these forest habitats in above mentioned altitudinal span optimal for these forests is optimal also for distribution of Eurasian Pygmy Owls, what is proved by a high rate of nests found in this habitat type.

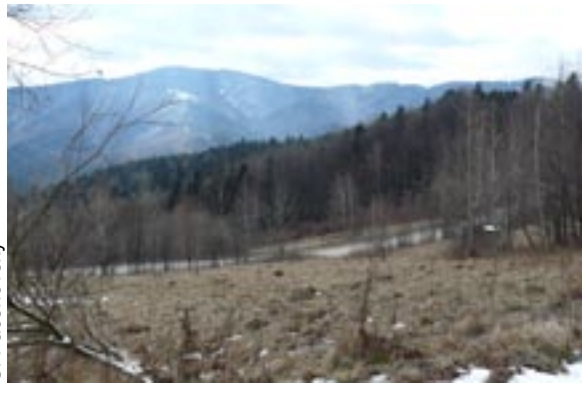
3. Spruce-beech-fir forests and fir-spruce forests in elevations 800–1200 m, usually old, natural and semi-natural forests growing in mountainous conditions, with occurrence of the three main determining tree species. Age of the forests is often very high (e. g. 100–200 years

S. Pačenovský

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.

at Hrončecký grúň in Poľana Mts, A. Krištín in litt.), in Volovské vrchy Mts these habitats are usually 50–120 years old, because in these elevations could reach in these mountains higher age only very few spruce forests (Fig. 4, 9). In this habitat type has been found breeding particularly in the Veľká Fatra Mts, in Nízke Tatry Mts, in Poľana Mts, less often in Volovské vrchy Mts, in total 15× (21.1%). This habitat type is also possible to regard as one of typical habitat types for distribution of Eurasian Pygmy Owls in Slovakia.

4. Habitats with distinctive occurrence of spruce, predominantly forests used as productive forests, with more or less modified structure, in elevations 550–1200 m a. s. l., even if the spruce does not found its optimum of distribution in these elevations. Different coniferous and deciduous tree species are mixed in, as larch, fir, ash, aspen and others. 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 economic forests with prevalence of spruce. Breeding in this habitat

type has been found 24× (33.8%). It seems, that most of found breedings of the species (in years 1989–2010; Tab. 1, 2) took part in this type of habitat. It means, that distribution of spruce is important for distribution of Eurasian Pygmy Owls. Age of forests is different, usually 40–80 years, sometimes higher. Particular parts of Eurasian Pygmy Owl territories could be comprised by very young forest grows (forest nurseries, young wood) and these structures could be even vital because they can offer hidig opportunities both for adults and young fledged birds, but forest grow with sufficient offer of breeding opportunities, e. g. cavities made by woodpeckers could generally provide only a forest of age at least 50–60 years, and more.

5. Habitats of natural mountain spruce forests, spruce forests with rowan, spruce forests with billberries in undergrowth, and spuce-beech forests in elevations 1200–1450 m a. s. l., in the most valuable types of natural montane forests in high elevations close to upper tree limit in conditions of Slovakia. Age of forests is often very high, e. g. 100–150 years in Poľana Mts (A. Krištín in litt.), 150 years in Západné Tatry Mts (V. Michalec in litt.). In this habitat type breeding of the Eurasian Pygmy Owl has been found yet in Nízke Tatry Mts, in Veľká Fatra Mts, in Poľana Mts and in Západné Tatry Mts, so far 5× (7.1%). Occurrence of the Eurasian Pygmy Owl at these elevations was already known, a number of further territories of Eurasian Pygmy Owls is known from these elevations and these habitats, e. g. in Vysoké Tatry Mts, Západné Tatry Mts and Nízke Tatry Mts, in Krivánska Fatra Mts and other high mountains of Slovakia (Bališ 1972, Danko 1988, Pačenovský & Shurulinkov 2008 and others), 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, in 650–850 m a. s. l., breeding in these unusual habitats has been found in Liptovská kotlina basin – 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 edge in Oravská vrchovina Mts with occurrence of beech, spruce, alder, aspen, wild cherry. A fledged family has been found in this specific habitat – a possible breeding 1× (1.4%). Even if it is possible to assume, that in these locally relatively commonly distributed habitats of overgrown pastures in a line of division with connected forests (Orava, Spiš, Šariš regions) would be the species present more often.

8. Underflooding spruce forest, Oravice, Peciská. A habitat slightly similar to habitat type with occurrence of the scots pine in Liptovská kotlina basin (type 6), but in this underflooded forest prevails in the forest growth spruce, not pine (in elevation 840 m). Breeding in this habitat found 1×, it means 1.4% of ascertained breedings.

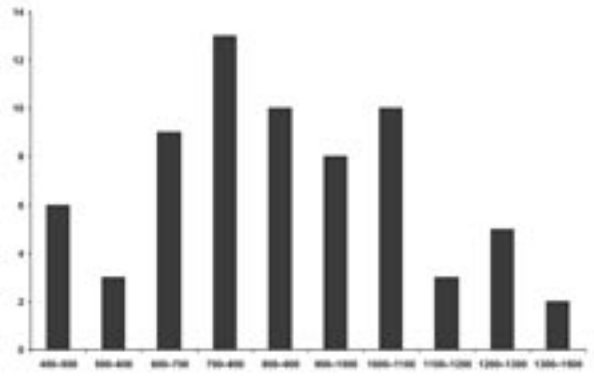


Fig. 7. Distribution of elevations (m a. s. l.) of found nests of Eurasian Pygmy Owls in Slovakia. Axis y – number of cases.
Obr. 7. Rozloženie nadmorských výšok (m n. m.) nájdených hniezd kuvičkov vrabčích na Slovensku. Os y – počet prípadov.

The results indicate, that breeding distribution of the Eurasian Pygmy Owl follows in Slovakia distribution of the fir and spruce and breeding has been proved also in habitats with distinctive occurrence of the scots pine and black pine. Breeding of the Eurasian Pygmy Owls has been found also 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 above characterised habitat types of the Eurasian Pygmy Owl from Slovakia are present in similar form or in resembling variatons also in other Central European countries. The Central European population of the Eurasian Pygmy Owl is characterised by Mikkola & Sackl (1997) as an isolated, probably a post-glacial one, of relict character, living in cold montane zone, from which it had been distributed into secondary habitats. In the Bavarian Forest, Fichtelgebirge and in Erzgebirge the Eurasian Pygmy Owl occupies a cold, montane region, as well as the sub-montane vegetation levels in elevations 400–1200 m. Natural forest associations of different Cetral European countries are more or less changed by antropogenous influence (Schönn 1980). In the Czech Republic the Eurasian Pygmy Owl occupies mainly old coniferous and mixed forests in the mountains and in middle altitudes (Šťastný et al. 2006).

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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.

From structural components of habitat we can mention also presence of some elements found in breeding habitats and playing probably some role in selection of nest site and being specific for breeding habitat and deifferentiate it from surrounding environment: increased presence of woodpecker holes, often in dry trees, stumps and dead, broken trunks – found e. g. at breeding habitats in the Nízke Tatry Mts, Volovské vrchy Mts, proximity of edge of contiguous forest grow, e. g. presence of a little 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 nest (Turzovská vrchovina Mts, Javorníky Mts), vicinity of a spring of a stream (Nízke Tatry Mts), a meadow overgrown by dense natural regeneration of young trees close to nest site (Nízke Tatry Mts, Strážovské vrchy Mts, Žiar Mts) a peat-bog close to nest (Liptovska kotlina basin). Similar characteristics of breeding habitat of the Eurasian Pygmy Owl and similar determining factors for the habitat, generally were defined also by Schönn (1980): presence of old-grown forests with relatively high representation of conifers, closeness of water, adequate amount of cavities, lower predatory and competitive pressure. Value of silence and retreat are not regarded as too notable factor by this author in selection of the nest site and an opposite example is described from Elbsandsteingebirge Mts, where an occupied nest site has been found nearby of a frequently used forest track. An experience of this kind we can not prove yet from Slovakia, because in studied areas were Eurasian Pygmy Owl territories located farther from noisy asphalt roads and only a small part of found nests has been placed close to forest tracks. Value of silence and of placid, undisturbed environment for breeding territory of Eurasian Pygmy Owls is regarded in Slovakia by authors of this contribution as a relatively substantial factor.

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

female in period of egg-laying and in incubation period. From 25 evaluated nests/breeding sites from Slovakia the closest available surface water (stream, spring) had been situated from these nests closer than 100 m in twelve cases (50.0%), closer than 200 m in five cases (20.8%) and only in seven cases was situated farther (470–590 m; 29.2%). In cases, when water had been situated far from nests, these nests had been placed high in slopes, close to ridges. But, on the other hand, some nests despite of the fact, that they had been situated high on mountain slopes, were placed close to springs and tributaries of streams. Also our data indicate, that closeness of water is really an important factor in selection of position of the nest, because 70.8% of nests had been placed close (less than 200 m) from water. Preference of closeness of water to nests had been consistently proved in the Eastern Alps, in Westerzgebirge (Saxonia), at Oulu in Finland (Schönn 1980), as well as in several mountain ranges of Slovakia.

Vertical distribution

Based on distribution of the found nests (n=70; Fig. 7) according to elevation is possible to present a statement, that vertical distribution of nests is relatively even and follows distribution of coniferous and mixed forests, mainly with prevalence of spruce and fir, from elevations around 400–500 m a. s. l. in Volovské vrchy Mts and Šarišská vrchovina Mts (forests with oak, hornbeam and fir as determining tree species) maybe with an exception of elevations between 500–600 m a. s. l., where natural distribution of conifers in Slovakia is rare, until upper tree

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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.

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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.

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

Slope orientation

We took notes of orientation of mountain slopes with nests of Eurasian Pygmy Owls – mainly in 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. Territory of Eurasian Pygmy Owl is divided by Scherzinger (1970) on three components: hiding stand, hunting territory and breeding territory and hiding stand of a male and breeding territory are not equal and a distance between hiding stand of a male and breeding site in Austria (Ennstal, Patcherkofel) could be according to Scherzinger (1970) 500–800 m. Based mainly on experience of authors of the contribution from Volovské vrchy Mts comprise territories of the species approximately 30–100 ha and their natural borders are mountain ridges, edges of forest grows, meadows or open areas (glades), forest tracks, etc. and that is the reason why orientation of slopes is in most cases equal for all territory of Eurasian Pygmy Owl. From the sample of 38 slopes with nests of Eurasian Pygmy Owls nine slopes has been 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%). Already this outline shows, that orientation of slope probably do not play determining role in selection of territory or nest, because examined sample of breeding slopes has been oriented to different directions, only with moderate dominance of SW and SE orientation and some slopes has been oriented even directly to N. The fact, that in the surveyed sample has not been found a slope oriented to E, is explained by specific conditions in surveyed mountain ranges, from which originated the sample – most of the ranges are stretched in W–E direction and only few slopes are thus oriented directly to E. In other mountain ranges, e. g. stretching in N–S direction would be the results 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, what is in accordance with a similar statement of Kloubec (1987).

Characteristics of the nest

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

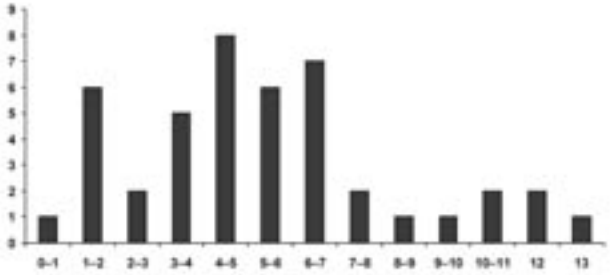
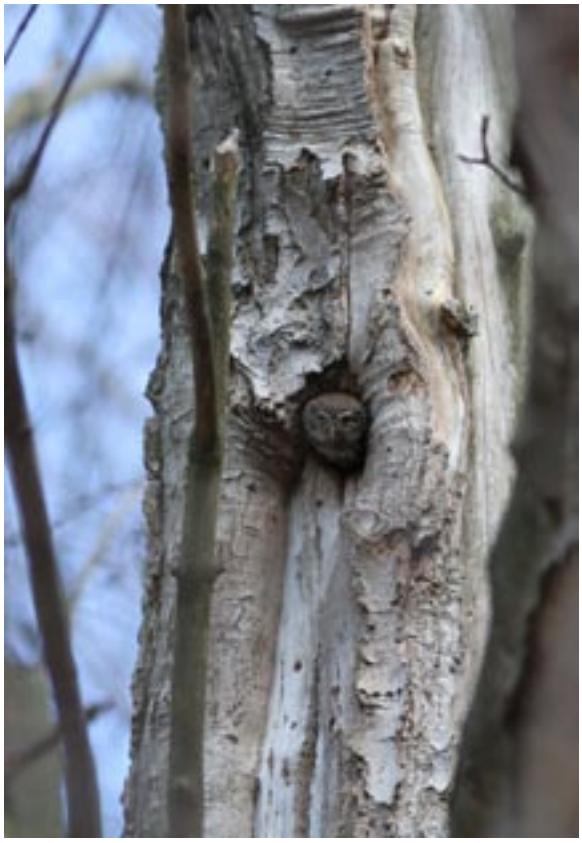


Fig. 13. Height of found nests over ground (m). Axis y – number of cases.
Obr. 13. Výška nájdených hniezdnych dutín nad zemou (m). Os y – počet prípadov.

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 tree. Majority of these tree species has been found also in conditions of Slovakia as nest trees, with exception of a rowan, birch and apple tree. As a new finding, not mentioned yet in literature, is a breeding of Eurasian Pygmy Owl in a black pine, found at Slovenské Pravno in Žiar Mts in year 2007 (Bohačík in litt.). Hudec et al. (1983) mention for former Czechoslovakia the following nest trees: 5× spruce, 2× pine and beech, 1× fir and apple tree.

In Finland 47% of nests has been 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, most of nests has been in weak, thin, still living trees with dying or fallen branches and some has been also in dry and broken spruces, snags.

Number of cavities in a nest tree. The Eurasian Pygmy Owls very often preferred such tree, which has more than one cavity (Scherzinger 1970). Presence of more cavities represents for Eurasian Pygmy Owls a safety factor. Also in Slovakia at least eleven cases of breeding in a trees with more than one cavity has been found (Volovské vrchy Mts, in Čierna hora Mts, Strážovské vrchy Mts, Žiar Mts, Nízke Tatry Mts, Revúcka vrchovina Mts, Podbeskydská vrchovina Mts). The highest known number of cavities (seven) has been in a nest tree (oak) used in 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 were breeding in this tree in other woodpecker cavities also 1–2 pairs of *Sturnus vulgaris* and one pair of the *Sitta europaea*. The Eurasian Pygmy Owl occupied cavities placed in lower parts of the tree in hight 4–6 m, *S. vulgaris* and *S. europaea* have bred in cavities placed in the higher part of the trunk.



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Figs 14, 15. Male (left) and female (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.

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

Repeated occupation of the same territory, with breeding in another nest cavity has been found also several times. We found it e. g. at location Bankov near Košice, where in Eurasian Pygmy Owl territory „B1" after the old breeding tree, the already mentioned drying oak tree with many cavities has been uprooted by a storm, in year 2009 the pair of Eurasian Pygmy Owls has bred in the same territory 300 m farther, probably in a dry fir. Similar kind of shifting of nest position has been found also in Revúcka vrchovina Mts near Rejdová at location Buč in years 2000 and 2008, distance of the two nest trees one from another was 250 m, in the Žiar Mts (Bohačík in litt.) over village Budiš in years 1983 and 1989, where the two nest trees were in a distance 200 m one from another and in the Strážovské vrchy Mts at Tužina, where the Eurasian Pygmy Owl in year 2010 has bred 300 m farther, as in 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) state lasting of pair bonds only one year, but after autumn they can be again renewed.

Synchronical breeding of two pairs close to one another. Synchronical breeding of two pairs close to one another should not be a rare phenomenon, if we are aware of 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 only seldomly can be found. Pačenovský (1993) mentiones such case from year 1990, when two pairs of Eurasian Pygmy Owls (in territories „B1" a „K1") were breeding only 400 m one from another, even if at opposit sides of the same ridge. An interesting accordance happened in southern slopes of the Volské vrchy Mts in years 2000 and 2010, when two nests of Eurasian Pygmy Owls have been found only 550 m one from another, independently by S. Pačenovský and A. Gajdošová. These nests are located probably in two different territories, because each of them has been placed at different sides of a same side-ridge. Two couples of nests in such neighbouring territories have been found also by Z. Petrovics near Rejdová at sites Krišťáková in years 2002 and 2005 and at site Páleniská in years 2000 and 2009 in a distance 700 and 1000 m one from another respectively. M. Saniga found two couples of nests, belonging probably to two different territories of Eurasian Pygmy Owls in Veľká Fatra Mts in years 1990 and 1991 in elevations 1025 m a. s. l. and 1250 m a. s. l. and in Starohorské vrchy Mts at nearby sites Graniarka and Glezúr in years 1999 and 2007. There is a note from the Czech Republic (Kučera 1981) of the lowest 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 further nine cavities excavated by woodpeckers their origin has not been uniquely determined (mostly cavities of older origin) and their producer has been stated only as a woodpecker (*D. major* or *P. tridactylus*). Only in four cases has been proved breeding 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 breeding in cavities excavated by *D. major*, *P. tridactylus* and by *Picus viridis*, as a rare event also natural cavities. Mikkola (1983) presents from 58 nests in Finland eight situated in nestboxes and 50 in nest holes excavated by *D. major*, *P. tridactylus* and by *Picus canus*. Species *D. major*, *P. tridactylus* and *P. canus* are mentioned as producers of cavities for Eurasian Pygmy Owls also by Mikkola & Sackl (1997).

Altitudinal distribution of cavities excavated by the *D. major* and by the *P. tridactylus* is interesting. Cavities excavated by the *P. tridactylus* had been situated in elevations 700–1250 m a. s. l. in 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* had been situated in 470–1130 m a. s. l., and over 1000 m had been found only three cavities in elevations 1000, 1030 and 1130 m a. s. l. These altitudinal spans well represent distribution of these two woodpecker species in Slovakia

(Pavlík 2002, Pačenovský 2002), especially upper limit of distribution of the *D. major* is well visible. *P. tridactylus* breeds in Slovakia also in lower altitudes, as the lowest known cavity occupied by the Eurasian Pygmy Owl and excavated by this species (700 m a. s. l. in the Vtáčnik Mts), but in lower elevations the Eurasian Pygmy Owl prefers cavities of the *D. major*, probably because higher rate of their occurrence, because below 700 m a. s. l. is *P. tridactylus* rare. In addition, *D. major* is one of the 'busiest' European woodpeckers in terms of producing cavities (Gorman 2004), and for that reason it plays an important role in supplying cavities for the Eurasian Pygmy Owl. In Slovakia this percentage is based on our own data of 53.2% 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 only 1,8 km from the Slovakian border in Hungary, in the Aggtelek National Park has been in year 2010 found a nest of the Eurasian Pygmy Owl in a cavity excavated by *Dendrocopos medius* in elevation only 290 m (A. Schmidt, S. Pačenovský unpubl.), so using of nest cavities excavated by this species of woodpecker is not excluded even in similar habitats of Slovakia in low elevations.

Height of nest cavity over ground. At Fig. 13 is indicated the relation of preference of breeding cavity over ground (n = 44). One breeding cavity in the Stolické vrchy Mts has been occupied by the Eurasian Pygmy Owl lower as one meter over ground level (Z. Petrovics in verb.), 6× has been found breeding in height 1–2 m over ground level, majority of cavities (26) had been situated in height 3–7 m and 4 cavities over height ten meters, the highest known occupied nest has been placed in height 13 m. Average hight of nest is 5,01 m. In the Eastern Alps found Scherzinger (1970) height of breeding cavities (n = 7) in span 3.5–14 m, in the Bavarian Forest (Scherzinger 1974) in span 0.6–14 m (n = 13), in former Czechoslovakia (Hudec et al. 1983) in a span 4–7 m (n = 11).

Orientation of nest cavity. We evaluated orientation of 40 nest cavities occupied by Eurasian Pygmy Owls. Orientations to each directions had been found, with a lack of a distinctive preference of any of directions. Most cavities, ten had been oriented to W (25%), nine had been oriented to S (23.1%), seven cavities had been oriented to SW (17.9%), six cavities had been oriented to NW (15.4%), 4 cavities had been oriented to N (10%), the lowest number of cavities had been oriented to SE (2.0%), E (1.0%) and NE (1.0%).

In the literature we found only notes of Scherzinger (1970) to seven nest cavities in the Eastern Alps, from which every cavity had been oriented to different direction. Besides of that, cavities are usually made by woodpeckers, so selection of any 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 intervene between a subsequent approximation of both partners in the third phase of mating of Eurasian Pygmy Owls include drawing of attention of the female. In this period the male by means of an offering behaviour offers shows a suitable nest hole to the female. In most cases showing of only one nest hole has been found (Scherzinger 1970, Schönn 1980). Interesting behaviour has been observed on March 12, 1997 in Strážovské vrchy Mts, when a male showed to female first one nest hole in the uprooted dry spruce. The male attended the cavity first, but after a while he flew out from it. Immediately a male was followed by a female, entering the cavity too and after inspection of the cavity both birds flew across a glade and the display with showing of a cavity has been repeated at a dry stump of a fir with another cavity. Finally this pair occupied the second cavity in a dry fir. During the day they copulated several times, e. g. on March 30, 1997 at 12:00, 12:30 and 12:50 hour (Šotnár 2004).

In another occasion on April 4, 2009 from 10:00–11:00 hour the pair of Eurasian Pygmy Owls has been copulating in total three times, about 50 m far from the nest hole. The female uttered „see, see" calls and by offering behaviour attracted the mail to mating and the male only from time to time answered by typical „deu" call. After the last copulation the female has flown into the nest hole (Šotnár 2009).

Another observation on April 8, 2010 from 12:00–14:30 hour in the Žiar Mts has been effected partly by presence of an observer at the site and by his short imitation of a territorial call. The male called by silent territorial calls from about 20 m from the nest cavity and attracted the female to copulation. After approaching the male by the observer the male 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 an agonistic, intimidating behaviour (Fig. 15, 16). When the male flew out from the nest hole, called the female and the female within ten minutes flew out and sat close to the male. Through about next ten minutes both partners attracted by calls and


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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.


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

visual signals one another to mating behaviour. Finally the male came closer to the female and within a few seconds flew on her back and they copulated, followed by wawing of wings and keeping of balance (Fig. 17). The act lasted 7–8 seconds and has been followed by thrilling and screeching calls. After finishig the copulation the female returned to the nest cavity. The other mating passed after about 20 minutes and it has been followed by the same calls and ritualised displays. From above described observations results, that the male shows to the female even more than one cavity, as it has been proved e. g. by Jansson (1964) and that Eurasian Pygmy Owls in the third phase of mating copulate in vicinity of the nest hole and do it during daylight, usually in morning hours and about noon from 10:00–13:30 hours, what is in accordance with other works (König 1968, Scherzinger 1974, Schönn 1980).

Copulation of Eurasian Pygmy Owls connected with nest-showing has been observed also on April 13, 2010 at the Štós mountain in Volovské vrchy Mts (Š. Matis & J. Popovics in litt.). First they noted calls of the female, which has been observed about ten meters from the cavity. The female sat at a spruce in height six meters close to the trunk. Just after that they spotted also the male, sitting about three meters lower on a beech tree and uttered from time to time a silent „deu" call (8:14 hours). After about five minutes the birds were copulating and after copulation the male flew into the cavity, where it stood about two minutes and then flew out in a direction to the female.

Unusual observations were seen on November 2 and 4, 1989 in the Kamenný potok valley near Košice (Pačenovský & Kürthy 1992). Behaviour resembling nest-showing display of Eurasian Pygmy Owls has been observed in period of autumn-mating, between 16:25 and 16:50 hours. As it is stated by Scherzinger (1970) and Schönn (1980), nest-showing dispaly is connedcted with the third, the final phase of spring-mating, even if it can sporadically occurs already during the 1st (territorial) and 2nd phase of the spring-mating, but these authors do not mention nest-showing behaviour in connection with the autumn-mating. Even more excplicit case of entering the tree cavity in autumn season has been observed by P. Vrlík & M. Kaliský (P. Vrlík in litt., www.birding.sk) on October 26, 2004 in the Nízke Tatry Mts in the end of Michalovo dolina valley. The male has been attracted by the observers by imitation of territorial calls and it flew into the cavity in a dry stump of a spruce, stood there for several minutes and than intensively defended its territory by calls. We assume, that in this case it could be more a reaction on presence of humans and defence from intruder, as an attempt of a male to show a nest cavity to a female. In any case, the fact of entering a cavity in a territory defended by a male bird in autumn season is noteworthy.

Copulation of the Eurasian Pygmy Owls had been observed by the first author during years 1989–2010 in total eleven times, in months February – May. Temporal distribution of the observed mating behaviour had been the following: February 1×, March 3×, 1. half of April 5×, 2.

half of April 1×, beginning of May 1×. Mating behaviour of Eurasian Pygmy Owls observed during March could be connected with the already mentioned 3rd phase of spring mating, three cases from 1st half of April could be associated with egg-laying period and early stage of incubation. From point of view of the daytime, when copulation had been observed, 36.4% of observed mating displays were seen in morning hours (6:15–6:50 hours), 18.2% during daytime, before noon and 45.4% cases fall to evening, crepuscular phase of activity of Eurasian Pygmy Owls (after 19. hours). According to terms of observation of mating displays two occasions are beside of the others: one early – from February and one late – from May. The early occasion of copulation (February 2, 1989) had been probably recalled by imitation of territorial call by the observer, which lured first the male and then the female in the Perlová dolina valley near Gelnica in the Volovské vrchy Mts. Copulation had been repeated twice afterwards, at 6:15 and 6:20 hours and took place in the tip point of a young spruce (Pačenovský & Kürthy 1992). Schönn (1980) connects mating behaviour first of all with the 3rd phase of the 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, as a finished copulation, lasting 5–8 seconds. The assumption, that an early act of copulation should not be directly connected with breeding, would result also from termination of the breeding season to April – July (del Hoyo et al 1999). Unusually late case of copulation had been observed by on May 3, 1994 near Košice in the Volovské vrchy Mts. This display has been connected with nest-showing. The male attracted the female into the cavity, copulated with the female and they uttered calls „djo-djo-djo" at 19:50 hours. The female flew into one from cavities in the oak tree in height of six meters. It is interesting, that this behaviour, typical for final phase of spring-mating had been observed in a time, when incubation of the clutch should go on. Another unusual circumstance was, that breeding in year 1994 had finally not take part in the nest hole showed to the female on May 3, but in another nest hole of the same oak tree placed just two meters lower. Also this male showed thus more than one cavity to the female and the female entered also more than one cavity. In scientific literature we did not find a note on copulation observed during incubation period.

On the other hand, our observed case of a late copulation display could really belong to 3rd phase of spring--mating, but beginning of breeding could be from some reason shifted to later season, to 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 first days of egg-laying the female is little active and calls very seldomly. It sits all hours with fluffed feathers nearby nest hole or stays for longer periods in the cavity. Beginning of egg-laying takes part between April 8 and May 4 (Schönn 1980). Our data fall into this period, based on findings of beginning of egg-laying on April 6–8, in other nest on April 10–12 (Šotnár 2009). The female starts to incubate already after laying of next to the last, or of the last egg. The eggs are layed by intervals of 2–4 days on bare underlayer of the cavity and after 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 cached haul. Pauses in incubation are regular during morning dawn or evening dusk, rare in hours before, or about midday. On attracting calls of the

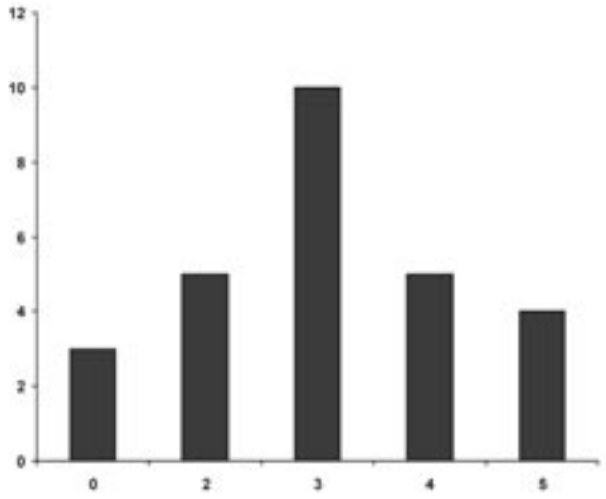

Fig. 19. Productivity of young of Eurasian Pygmy Owl in Slovakia. Axis x – number of fledged young, axis y – number of cases; n = 49 nests in period 1973–2010.
Obr. 19. Produktivita hniezdenia kuvičkov vrabčích na Slovensku. Os x – počet vyvedených mláďat, os y – počet prípadov; n = 49 hniezd v období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

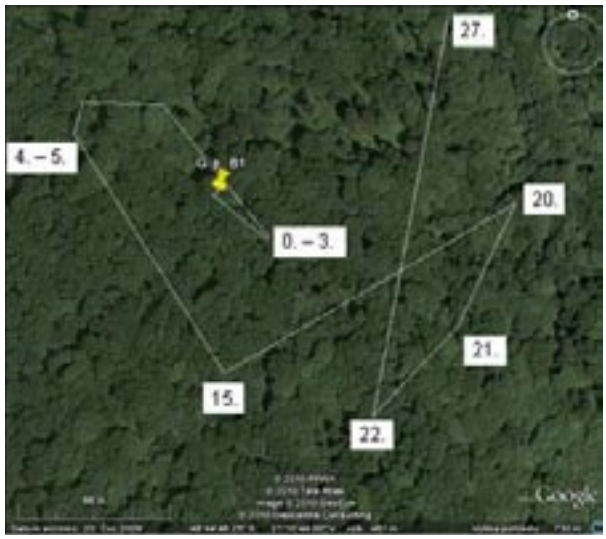

Fig. 20. Route of movements of fledged family in year 1991 at locality Bankov near Košice. A yellow dot – the nest site, numbers indicate days after fledging.
Obr. 20. Trasa pohybu mláďat v roku 1991 na lokalite Bankov pri Košiciach. Žltý bod – hniezdo, čísla označujú dni po vyletení.

male the female answers by female`s begging calls and in a while appears in entrance of the cavity. From there it flies to strong lateral branches of a tree close to nest cavity (10–20 m) and after further calls it takes the prey from the male. Here starts consuming it or flies to another, more silent place.

Leftovers in caches on a branch, on a ledge on a tree, or in a tip of a dry snag, sometimes it brings them into a cavity (Schönn 1980, Šotnár 2004).

The complete clutch consists of 3–10 eggs (Mikkola 1983). In the controlled nest cavities in years 1989–2010 had been layed 1×3, 1×4, 1×5 and 1×6 eggs.

We mention a few observations of a pair breeding at site Kamenný hrb near Košice in year 1990. This pair manifested in incubation period a strictly diphasic activity tied on dawn and dusk. The female has incubating in the end of April (April 24) – around a half of incubation – very steadily. The male had to call in the morning with the brought prey seven minutes, until the female has flown out from the cavity and it was out from it only for two minutes. In the evening, at dusk this female had been out from the nest cavity only for one minute and immediately has flown back (with food). During the day neither did the female leave the nest, nor did the male show up (Pačenovský 1993). In period of incubation is possible to observe process of ritualised food-overtake by the male to female, because this activity is done usually not farther than 20 m from the nest. Because three observed nests of the Eurasian Pygmy Owl had been placed in year 1990 in very different height over ground level (1.9, 5 and 10 m), it was possible to compare differences in spatial activity of these three pairs, as well as activity of another pair breeding in year 2010 in height of 1.50 m over ground. Height of spatial activity depends namely on height of the breeding cavity. While the male flies usually in the height of tops of the trees and it comes lower only near to nest and only in contact with the female – when it gives the prey to the female, when it mates with the female, females behave in a different way. The female has its spatial activity starkly limited. If it left the breeding cavity, usually it did not fly farther, than 15–20 m from the nest. Later, as the female spends more time resting at lateral branches near the nest, it is possible to find plenty of pellets, feathers from prey (usually tail- and hand-feathers from wings of preyed passerines, etc.). Results of comparison of spatial activity of four females of Eurasian Pygmy Owls breeding in cavities placed in different height is indicated on Tab. 4. Resting branch of three breeding females has been placed 2–6 m high and most of spatial activity (flying, resting, feeding) of four females near nest took place in height 6–12 m and it seems, that height of spatial activity depends on height of nest cavity. It is in accordance with findings of (Scherzinger 1970, Schönn 1980): roost of female in vicinity of the nest is placed in a level of the nest cavity.

Parent care for young birds

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

In this period activity of the male in delivery of food is increasing. The female often attacks it, when after food--delivery the male is still in vicinity of the nest hole. The male then flies away and returns with a prey from cache or with a new catch. After hatching of youngs clean-up activities of the female start in a nest hole. She throws away or brings out leftovers of prey, pellets or egg-shells. A female has been observed in Strážovské vrchy Mts on June 13, throwing out from nest hole a sterile and partly leaked out egg. In that time nestlings had been about two weeks old (Šotnár 2009).

Egg-shells had been found also below several nests in the Volovské vrchy Mts. In the second half of care for youngs in a nest number of food-consigns is increasing and Eurasian Pygmy Owls are active also during daylight. Such cases had been proved also in Slovakia: 2–3 prey items/day in incubation period and 5–7 prey items/day brought by a male at two nests in East Slovakia (Pačenovský 1993), also diurnal activity of Eurasian Pygmy Owls in period of care for nestlings had been proved. The female stops spending the night in a nest hole, when nestlings are 10–14 days old. During last days of care for nestlings it stays nearby the nest cavity (Scherzinger 1970, Schönn 1980). In most cases the female is using favourite roosts nearby nest, usually at coniferous trees in a level of the nest cavity. Here waits for arrival of a male with a prey, or is devoted to comfort behaviour. Nestlings in age of 21–25 days appear in entrance of a nest hole and later they stay in it even longer time (Fig. 18). In Strážovské vrchy Mts on July 23, a female at 11: 45 hours has flown to her roost and followed comfort behaviour, defecation and a bath in a rain. After that the female called the nestlings and they answered her from the nest cavity and in age of 29 days they first time appeared in entrance of the cavity (Šotnár 2009). In this case is notable the age of nestlings, when they first appeared in the cavity, because this is higher, as it has been yet stated in the literature. For spatial activity of adults nearby nest hole and for height of the roost and for ritualised prey--delivery in period of parent care for nestlings refers the same relation from height of the nest hole, as we found in period of incubation.

Production of young

The production of young was evaluated in 57 cases, 34 of which were successful (69.7%). Number of produced young was established precisely in 27 breedings, from which 80 young fledged (Fig. 19), average number of fledglings/nest is 2.96. In accidental finds of families of fledged young the number of occasions with exactly estimated number of fledglings is considerably higher, approaching 100%. Average number of fledglings in accidentally found fledged 19 families is 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 reflect unsuitability of conditions in these years: in rainy, colder years as usual of 2009 and 2010 number of fledged young/nest had been lower as long-term average, in year 2009 it was only 2.33 and in year 2010 only 2.0. The found average numbers of fledged young are slightly lower, than it is indicated by that data calculated from Austria and Germany and much lower, than it is indicated by data from Northern Europe, but high average numbers of fledglings in Northern Europe apparently have connection with more extreme oscillations between peak years especially rich and vole low years poor in food-availability, as in Central Europe, where Eurasian Pygmy Owl populations are not subject to such dramatic cycles of abundance reliant to small mammals. Data from Slovakia also indicate, that breeding success has been dramatically reduced between years 1989–1991 and years 2005–2010. In three consecutive years 1989–1991 (Tab. 1) has been number of fledged young (8 breedings with exact number of fledglings: 4, 4, 5, 5, 3, 5, 4, 0) in average 3.75 fledglings/nest, what indicates much higher breeding success, as it has been found in six years 2005–2010 (9 breedings with exactly found number of fledglings 5, 3, 3, 3, 2, 2, 2, 3, 3) in average only 2.88 fledglings/nest. Number of young fledged/nest dropped down almost by one young/nest within about 15–20 years. Reletively lower number of fledged young in years 2004–2009 found accidentally, already after their fledging has proved also that decline (6 families with exactly estimated number of fledglings 3, 3, 2, 4, 3, 3) gives average breeding success of 3.0 nestlings/fledged family. Data from Slovakia thus indicate reduction of overall breeding success of Eurasian Pygmy Owls of breakthrough of 80. and 90. of the 20. Century in comparison with breeding success in the end of 1st decade of the 21st century. These results will be needeed to compare with data of other authors and looking for possible reasons for that should be subject to further studies.

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	

In W Germany from 17 nests 57 young fledged and average is 3.3 young/nest, in NE Norway average number of hatched young/ 1 egg is 0.5–0.9, what is a result of variation in number of eggs per clutch (5.8–7.3) and availability of food (del Hoyo et al. 1999). Hudec et al. (1983) mentioned also a case of six youngs in a nest. Weather plays important role in influencing breeding success, e. g. a late snow can lead even to abandonment of clutches in distinctive stage of incubation (Scherzinger 1974), in Finland start of breeding is shifted to end of April and hatching falls to period of highest availability of food (Mikkola 1983). Extreme values of clutches in the North of Europe are more striking, as in Central Europe.

Amount of layed eggs in different countries of Europe had been compared by Mikkola (1983): average clutch in Austria is only 4.5 eggs/nest (4–6), in Sweden it is 5.9 eggs (4–7) and in Finland is 5.4 eggs (4–10). Also average number of fledged young depends on that: in Finland from 16 nests fledged in average 5.1 young (3–7), in the Bavarian Forest (Scherzinger 1974) from 13 nests in average 4.3 fledglings, from which end of breeding season survived only 3.3 fledglings. In years poor on food, in vole low years it seems, that many fledglings die from hunger and in a consequence of canibalism, as a result of that food-shortage. Breeding success at the North is much better in years with gradation of voles. The Eurasian Pygmy Owl is thus highly dependent on voles for successful survival of its young (Kellomaki in Mikkola 1983) and the species could not compensate by bird prey the lack of voles in low vole years.

Parent care after fledging

Briefly before fledging young Eurasian Pygmy Owls stay even longer in entrance of the cavity. They strive to get out and again return back to the cavity. They observe by circular motions of head surroundings of the nest cavity and disappear in it fastly after catching of any sound or spotting any move nearby. They leave the nest cavity in age 27–34 days, often between 7:30 and 13:00 hours. They are able to fly on a distance 20 to 30 m. From the entrance they fly directly, or get to a close branch (Schönn 1980). In Slovakia has been in details fledging of young observed only in some cases, they left their nests in overall time span of 3–6 days between fledging of the first and the last fledged young and they did not return already to the nest cavity. After fledging of young the family stays about 2–3 weeks in the breeding territory. Fledglings hide in tree-tops of high trees or in a young dense forest (Scherzinger 1970, Schönn 1980). Klaus et al. (1982) mention their observation from the Belianske Tatry Mts, where five days after fledging they found a family 10–30 m from the nest tree. Scherzinger (1974) found them in two sites after a week in a distance 20 m from nest tree. Wiesner & Rudat (1983) found parent care (food-supply) of fledged Eurasian Pygmy Owls until 72. day of their life and they followed three families for

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

a period till 43, 36 and 31 days after fledging and found, that females about two weeks after fledging of young started to moult, while males supplied the fledglings by food and lead them through the territory until their age of about ten weeks.

Šotnár found fledging of two young from one nest on June 25 and 28. In next year this pair of Eurasian Pygmy Owls bred 300 m farther and two young fledged on June 8 and 11 (two weeks earlier than in previous year). The female attracted its fledglings downhills and high to tops of trees. Just after fledging they could fly well, but they were not as skilled in landing on branches. After five days they kept in tree-tops in height 10–18 m in a distance 50 m from nest tree. After ten days they stood still in a distance about 80 m from nest, where one of the fledglings has been observed in a height 17 m by consumption of a mouse (*Apodemus* sp.).

A family of Eurasian Pygmy Owls has been observed in year 1990 near Košice at the site Bankov about seven days after fledging of young, while the fledglings has been fed by the female in a distance of 75 m from nest tree. In the next year at another nest were the fledglings four days after they left the nest in a distance 350 m from nest tree. They sat at branches of firs in a height twelve meters and heigher. The female fed them all day long, but with highest intensity during morning and evening hours. In hours before and about noon the female fed its fledglings by a prey usually from caches made on tree--branches, because a male from this pair brought food mainly during dawn and dusk, but not during daylight. Fledglings have been observed the longest time at site Bankov in year 1991. Route of movements of this family (Tab. 3, Fig. 20) has been observed 27 days after fledging (June 16 – July 12). Overall distance, done by this family in territory of this pair was about 700 m and on the 27. day after fledging the family was only 300 m from their nest-tree (Fig. 20). During first days food had been brought by a male and young had been fed by a female. On 9. day after fledging a female lost its tail feathers and stopped to react on repeated begging calls of fledglings (Tab. 3). Feeding by the female has not been observed already after June 25. Fledglings has been found again on July 1, high in tree-tops of broad-leaved trees. The male delivered food to fledglings until the last observation of this family on July 12. Fledglings have been sitting in that day high in tree-tops of ash trees and gave begging calls even during daylight. It is interesting, that they did not prefer conifers (firs) to hide, but mainly underline, dense beeches and high ashes with dense tree-tops, overhung the forest canopy. Fledglings often changed their position from tree to tree and on 22nd day after fledging they did hunting attempts, even if unsuccessful.

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

Breeding losses and unsuccessful breeding

In case of unsuitable climatic conditions during breeding season breeding can be interrupted or Eurasian Pygmy Owls do not breed at all. It is not unusual, that during care for 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 from eight eggs did not hatch any young and the female incubated the clutch for 60 days. In following years the eggs did not have any embryos, because the breeding site was sprayed by insecticide containing DDT. In another breeding territory a male disappeared during care for young and the female due to lack of food consumed all nestlings. In other case the female had been lost during mating season, what resulted in fallout of breeding, because the male could not attract another female. Canibalism, or more precisely cronism had been found by Klaus et al. (1982) in one pair, where because of food shortage just one young fledged and two others had been consumed in the nest cavity. Sometimes cases of disturbance caused by the *Sitta europaea* do occur, or by dormouses (*Glis glis*, *Dryomys nitedula*), who occupy breeding cavities of Eurasian Pygmy Owls. Also disturbance by the marten was found (März 1964). Three young Eurasian Pygmy Owls had been found in the Czech Republic in the Český les Mts and in the Šumava Mts in pellets of *G. passerinum* in the breeding season and one young Eurasian Pygmy Owl in Poland in Góry Stolowe Mts, probably as a result of canibalism (Mikusek et al. 2001). When evaluating food of eight owl species from a material of 225,441 food items from Slovakia the Eurasian Pygmy Owl had been found only in food of *Strix aluco* in number of three items, it means 0.004% (Obuch 2010). Eurasian Pygmy Owl was found also in food *Falco peregrinus* in site Dolný Harmanec – Central Slovakia (Obuch in litt.).

In Slovakia the following disturbing factors had been found, causing fallout of breeding or breeding loss. In case of one pair surveyed for a long period in the Strážovské vrchy Mts in year 2006 the breeding has been interrupted due to human activities – felling of trees done in vicinity of the nest tree. Three years later during period of care for nestlings a male disappeared from the site and the female took care for two youngs alone. Briefly after fledging both young has been predated probably by *Pernis apivorus* or *Accipiter nisus* breeding both nearby the Eurasian Pygmy Owls (Šotnár 2009). Predation of freshly fledged young Eurasian Pygmy Owl was found in year 1990 at nest in Volovské vrchy Mts near Košice on the basis of a find of feathers from the ragged young. Suspected predator would be *Strix uralensis*, because a specimen of this owl had been observed at nest of Eurasian Pygmy Owls a day before in the time, when two youngs had been already fledged, left the nest and the female Eurasian Pygmy Owl reacted by excited warning calls.

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

Habitats at some sites with ascertained breeding of Eurasian Pygmy Owls has been completely destroyed in a consequence of clear-cutting of all forest tracts heavily attacked by bark-beatles, e. g. recently do not exist the breeding habitat, where a pair of Eurasian Pygmy Owls were breading in year 2003 in Turzovská vrchovina Mts, and in year 1999 in Javorníky Mts (M. Špilák in litt), also some of the previously known breeding sites of the Eurasian Pygmy Owl in the Nízke Tatry Mts had been already clear-cutted from the same reason (P. Vrlík in litt.).

Eco-ethology of the species in breeding season

At this section we present some notable observations from comfort behaviour, interactions of Eurasian Pygmy Owls with diurnal raptors, interspecific interactions between Eurasian Pygmy Owl 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 of Eurasian Pygmy Owl has been observed on April 11, 2010 in the Žiar Mts at 12:45 hours nearby nest cavity by performing a number of actions relating to comfort behaviour (Fig. 21A–J). Preening of feathers started at breast, continued at arms, wings, tail, abdomen and had been finished by preening of legs (Fig. 21B–D). These actions were folowed by standing at one leg (Fig. 21E) and later by drowsing at a branch with fluffed feathers (Fig. 21F).

A phase of rest has been followed by another phase of actions signalising flight away and stretching of all half of a body, of legs and wings (Fig. 21G–J). Immediately before flight away the owl displayed stretching of its wings (Fig. 21H–J). Before finishing of its actions related to comfort behaviour by the Eurasian Pygmy Owl, *Accipiter gentilis* appeared and flown apart about 200 m from the Eurasian Pygmy Owl. The Eurasian Pygmy Owl immediately took a safety posture of stiffness, it took upright position and uttered an alarming „kju-vit".

In another case, on April 29, 2010 (Strážovské vrchy Mts) on 13:00 sat a male of Eurasian Pygmy Owl resting also nearby nest hole, facing the cavity. When it spotted *Accipiter nisus* passing by about 150 m apart, it immediately contracted its body and looked optically a half--thinner, as usually and fall motionless. When *A. nisus* has

flown over the Eurasian Pygmy Owl, it turned and by fast steps and with still „thinned" body crowled towards end of the branch, on which it perched. It stretched itself to the front in angle 60° and stood for a while in this posture, so it looked like a part of a dry branch. The Eurasian Pygmy Owl then perched on the branch for a long time, turned by its back towards the cavity and looked to direction, where *A. nisus* has disappeared.

In year 2009 in the Strážovské vrchy Mts nests of several diurnal raptors has been found in the following distances from nest cavity of a pair of Eurasian Pygmy Owls (species/distance from nest of the raptor from nest of the Pygmy Owl): *Pernis apivorus* – 7 m, *Accipiter nisus* – 230 m, *Buteo buteo* – 250 m, *Aquila pomarina* – 500 m, *Accipiter gentilis* – 700 m. Also *Strix aluco* has been observed in a distance 300 m. A cumulation of above mentioned predatory factors resulted very likely in predation of a male and two fledglings of Eurasian Pygmy Owls (Šotnár 2009).

2. Interspecific interactions with other owls

Competition of the Eurasian Pygmy Owl with *Strix uralensis* and with *Strix aluco* has been surveyed. In fir-beech forests of East Slovakia the Eurasian Pygmy Owl occurs quite often sympatrically with *S. uralensis*, less often with *S. aluco*. On the basis of these experience from Volovské vrchy Mts occurrence of *S. uralensis* in vicinity, or in the territory of the Eurasian Pygmy Owl does not give reason for leaving of breeding site by Eurasian Pygmy Owl, even if it has some influence on behaviour of the Eurasian Pygmy Owl, e. g. it often stops calling and avoids direct contact with *S. uralensis*, when it calls or appears (Pačenovský 1995). Similar results with no effect on breeding success of Eurasian Pygmy Owls has been proved by a case in year 2009, when at site Kamenný potok in Volovské vrchy Mts close to Košice a pair of Eurasian Pygmy Owls fledged two young despite of two pairs of *S. uralensis* breeding in a distance 600 m from nest of the Eurasian Pygmy Owl, while breeding territory of the Eurasian Pygmy Owl has been surrounded from each side by another territory of *S. uralensis*.

A male of the Eurasian Pygmy Owl has been calling on March 1, 1994 in Vtáčnik Mts about noon, but after it registrated a specimen of *S. uralensis* flying by, it immediately stopped calling (Šotnár 2004).

The Eurasian Pygmy Owl avoids contact with *S. aluco*, the reason for that could be a risk of predation – killing of the Eurasian Pygmy Owl by *S. aluco* in its territory is decribed by Melde (1989) and Mikusek et al. (2001). A close vicinity of *S. aluco* has, as it seems, more expressive effect on decourse of breeding, as neighbourhood of *S. uralensis*. It is expressed in several ways. Voice activity of a pair of Eurasian Pygmy Owls beeding in close neigbourhood of a pair of *S. aluco* has dramatically dropped down. It was observed at a pair of Eurasian Pygmy Owls in April 1992 at Opátka in Volovské vrchy Mts, which stopped breeding or abandoned a previously selected cavity, when only 30 m from it a pair of *S. aluco* has bred. It is not known, if this pair of Eurasian Pygmy Owls did not bred at all in that year, or selected another nest cavity for breeding, placed farther from nest of *S. aluco*. The same pair of Eurasian Pygmy Owls fledged successfully five youngs a year before, when a nest of *S. aluco* had been placed 500 m from teir nest (Pačenovský 1995).

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

Mikkola (1983) notes similarity of habitats of these two owl species, but it is not clear, to what extent is *A. funereus* enemy of the Eurasian Pygmy Owl. There is on one hand a case of predation of the Eurasian Pygmy Owl by *A. funereus*, on the other hand there is also a case from Finland, when both species nested in the same tree, while their nest cavities had been placed only four meters one from another. These species met only during daylight and in that time aggressive behaviour had been expressed only by the female of Eurasian Pygmy Owl against female of *A. funereus*, it has been never seen any action vice versa.

3. Competitive behaviour with other cavity-breeders

Competition between the Eurasian Pygmy Owl and other cavity-nesting species (*Sitta europaea* and *Dendrocopos*

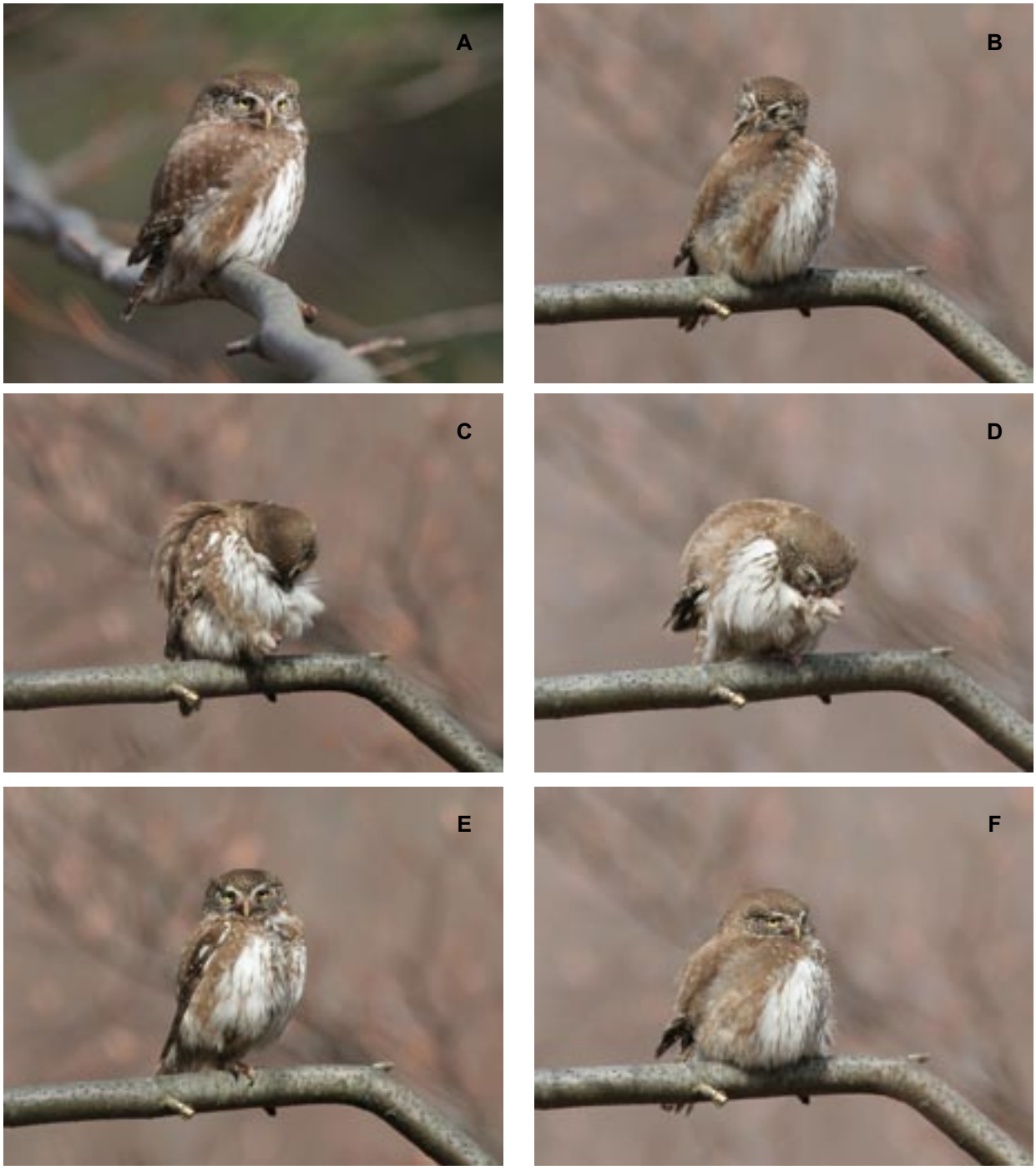

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Fig. 21. Comfort behaviour of a male of Eurasian Pygmy Owl, Kľačno, Žiar Mts, 11 April 2010. A – rest, B – preening on shoulder, C – preening on abdomen, D – preening of a leg, E – rest on one leg, F – rest with fluffed feathers, G–I – stretching of 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.

major) has been observed. *D. major* systematically prevented repeated breeding of one pair of Eurasian Pygmy Owls in the Volovské vrchy Mts in one 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. A dominant behaviour of *D. major* in its breeding territory against Eurasian Pygmy Owl has been proved. Its behaviour has been dominant, even agressive to an extent of preventing of breeding of the owl in its own breeding territory. Aggressive defending of its breeding territory against *D. major* from side of the Eurasian Pygmy Owl has been also observed, even if the owl has not turned up so successful in possession of the nest-tree as the woodpecker (it is indicated by the rate of years, when the tree has been used for breeding by Eurasian Pygmy Owls or by *D. major*). During years, when Eurasian Pygmy Owl has bred in this oak tree, also other cavity-dwelling species could take advantage of breeding in other cavities of the same tree: one pair of *S. europaea* and 1–2 pairs of *Sturnus vulgaris*, but simultanous breeding of the Eurasian Pygmy Owl and *D. major* in the same tree has not been observed.

At nest of Eurasian Pygmy Owls in Revúcka vrchovina Mts had been on April 9, 1995 observed an attack of *D. major* on the female of the Eurasian Pygmy Owl. It was probably even before start of incubation and egg--laying, when the male has flown to the nest hole. The female first because of attacks of the woodpecker did not enter the cavity, but it finally entered it, when the woodpecker has left. Scherzinger (1970) and Schönn (1980) described contrary to that attacks of the Eurasian Pygmy Owl on *D. major*.

Breeding of another pair in the Volovské vrchy Mts was prevented by a pair of *S. europaea*, which walled in the entrance of the cavity in a dry fir by clay, thus preventing this pair of Eurasian Pygmy Owl from breed-

ing in it. This cavity of Eurasian Pygmy Owls in the dry fir had been used for breeding previously for two years afterwards by Eurasian Pygmy Owls, but in following years they already did not breed in the cavity. Probably a simultanous breeding of a *S. europaea* with a pair of Eurasian Pygmy Owls has been found also by M. Demko (in litt.) in year 1990 in Podbeskydská vrchovina Mts at Oravská Lesná.

Not as a case of competition, but more as an interesting occasion we note, that Bohačík (in litt.) found in year 1989 in the Žiar Mts an occupied nest of Eurasian Pygmy Owls in close neigbourhood of occupied nest of the Black Stork (*Ciconia nigra*).

4. Conspecific competition

Intraspecific competition occurs in Eurasian Pygmy Owls by distinct way, the most striking it is during period of spring mating in first half of April, when neighbouring males match borders of their territories by calls and several mutual conflicts and combats appear (Scherzinger 1970, Schönn 1980, Mikkola 1983). From this point of view is surprising, that despite striking territoriality of the species can two pairs breed as close to one another, as 400 m (Pačenovský 1993, Pačenovský & Kürthy 1992), as it had been found in year 1990, when two simultanously occupied nest holes were observed and each nest was placed in another side of the same mountain ridge.

Conclusion

Accessible data on 78 breedings of the Eurasian Pygmy Owl (*Glaucidium passerinum*) from Slovakia are evaluated in the contribution from the oldest known data on breeding from year 1846 till year 2010. The authors processed their results from field research on breeding biology of the species based on studies of 22 breedings (16 nests, some of which has been occupied repeatedly) and seven finds of fledged families from years 1989–2010 and collected further yet unpublished data from a number of ornithologists active in Slovakia on 31 nests and finds of nine fledged families from years 1983–2010. The outline has been completed also by seven already published, older data on breeding of the species, originated from years 1846–1984.

The results indicate, that breeding of the Eurasian Pygmy Owl has been proved in 24 orographic units, in elevations 450(400)–1450 m a. s. l. in coniferous and mixed forests with distinctive representation of the spruce (*Picea abies*) and the fir (*Abies alba*) from lowest natural distribution of the fir in Slovakia till upper tree limit.

A number of basic habitat types with found nests of Eurasian Pygmy Owls (with percentage of ascertained breeding in individual habitat type): 1. forests with fir in 450–550 m a. s. l. – 11.3%, 2. fir-beech and fir forests in 600–800 (1050) m a. s. l. – 21.1%, 3. beech-spruce-fir forests in 800–1200 m a. s. l. – 21.1%, 4. habitats with distinctive representation of spruce in lower elevations, in production forests (550–1200 m n. m.) – 33.8%, 5. habitats of old, natural montane spruce forests in 1200–1450 m a. s. l. – 7.1%, 6. habitats with prevalent representation of the Scots Pine (*Pinus silvestris*) and the Black Pine (*Pinus nigra*) in 650–850 m a. s. l. (Liptovská kotlina basin and Žiar Mts) – 2.8%, 7. an overgrown pasture-land ecotone with connected forest (Oravská vrchovina Mts) – 1.4%, 8. underflooding spruce forest, (Západné Tatry Mts) – 1.4%. The highest frequency of nests was found thus in spruce forests, in fir-beech forests and in beech--spruce-fir forests.

From structural components of habitat of the Eurasian Pygmy Owl as significant factors were evaluated in Slovakia mainly old coniferous and mixed forests, presence of dry trees with numerous hollow trees and woodpecker cavities, close neighbourhood of small meadows, glades, a number of nests had been placed in forest edge, proximity of water near nest cavity has been also an important factor. From 22 evaluated Slovakian nests of the Eurasian Pygmy Owl as many as 17 (70.8%) was situated not farther than 200 m from water.

High prevalence of nests (72.5%) has been situated in elevations 600–1100 m, 13% over and 14.5% under that span. Average elevation for 70 evaluated nests and fledged families in Slovakia is 840 m a. s. l., what is a lower average, as in the Austrian Alps and slightly higher, as in the Czech Republic. With an exception of Eastern orienation all other directions were found in orientation of slopes in breeding territories of Eurasian Pygmy Owls and no direction has been markedly preferred. As many as 25 nestholes has been 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, from other tree species in one occasion has been found breeding in larch, in dry maple, in black pine and one breeding took place in a nestbox. In more occasions an occupation of the same nest has been found repeatedly, the highest number of such occasions has been found 4× in the same tree in scope of eight years, in three occasions a shift of a nest location within the same territory has been found of 200–350 m farther and two neighbouring nests has been found occupied in the same time by neighbouring pairs as close as 400 m one from another. From 47 evaluated cases of found nestholes 25

has been excavated by *Dendrocopos major*, ten by *Picoides tridactylus*, other cavities were excavated by one of above mentioned woodpecker species, in four occasions breeding took place in a natural cavity (2× beech, 1× larch and 1× partially dry maple). The lowest situated nest has been placed lower than one m above ground level and the highest one has been placed 13 m over the ground, from 44 evaluated nest holes the highest number, 26 has been situated 4–7 m high. Production of young has been evaluated in 56 cases, 34 of those has been successful (69.7%). Proper number of fledglings has been found in 27 occasions of breedings, from which 80 fledglings have been fledged, in average 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 characterised 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 eight 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.

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

On other occasions disturbance due to human activity (felling of trees) was recorded as the reason for an abandoned breeding attempt. 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 a 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 *Pernis apivorus* or *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 of one pair of Eurasian Pygmy Owls in the Žiar Mts has been observed several times in detail and also photo-documented. Nest-showing display has been observed in spring season also in Volovské vrchy Mts and in the same mountain range has been found a little known nest-showing display in autumn season, proved also in the Nízke Tatry Mts. Copulation was observed a total of eleven times in the years 1989–2010, during months February – May with the following frequency: February 1×, March 3×, 1st half of April 5×, 2nd 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 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 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 the unsuccessful breeding/abandoned nest of this pair. Competitive behaviour was observed between the owls and other cavity-breeders such as *Sitta europaea* and *Dendrocopos major* and an occasion of the predation of an owl fledgling by *Strix uralensis* was suspected. On another occasion of an attack by *Aegolius funereus* on a Eurasian Pygmy Owl was observed.

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