# Monitoring owl populations in a natural mountainous forest in the Austrian Alps (Dürrenstein Wilderness Area, IUCN Category I)

## Monitorização de rapinas noturnas numa floresta natural de montanha nos Alpes Austríacos (Área Selvagem da Dürrenstein, IUCN Categoria I)

Thomas Hochebner[1*], Ingrid Kohl[2], Claudia Schütz[1], Gerard Rotheneder[1]

**1** Dürrenstein Wilderness Area Administration, Brandstatt 61, A-3270 Scheibbs, AUSTRIA, Tel./Fax: 0043748243203, web: www.wildnisgebiet.at

**2** REWILD Institute - Research on Ecosystems and Wilderness, AUSTRIA, office@rewild.institute, web: https://rewild.institute

*** Corresponding author:** t.hochebner@aon.at

## ABSTRACT

Between 2015 and 2019 population densities of Boreal Owl (*Aegolius funereus*), Eurasian Pygmy-owl (*Glaucidium passerinum*), Tawny Owl (*Strix aluco*) and Ural Owl (*Strix uralensis*) are being surveyed in the Dürrenstein Wilderness Area (IUCN Category I) in Lower Austria. The study area is located between 720 and 1,500 m a.s.l. and covers 1,650 ha of mixed stands of spruce (*Picea abies*), fir (*Abies alba*) and beech (*Fagus sylvatica*) within the Dürrenstein Wilderness Area (IUCN Category I), including the Rothwald primeval forest (400 ha). This offers unique opportunities to study owls breeding in natural cavities rather than in nest boxes. Each year three standardised surveys are carried out between March and June, using playbacks at 22 monitoring points. Yearly abundances of small mammals as well as seed production of the main tree species are taken into account to assess effects of their fluctuations on the breeding densities of owls. Data from the first three years reveal Boreal and Tawny Owls to be the most common species in the study area. In 2016 a beech mast increased the density of small rodents and in the subsequent breeding season Boreal Owls showed an impressive increase in breeding densities from 11.5 to 20.0 territories/10 km². Breeding success was rather high with at least twelve broods with fledglings confirmed. The species breeds exclusively in natural tree cavities usually provided by Black Woodpeckers (*Dryocopus martius*) that breed at high densities in the area. Tawny Owls showed

a slight increase from 12.1 to 13.3 territories/10 km². Breeding success was rather low in 2017, probably due to heavy snowfalls in April. Eurasian Pygmy-owls showed relatively low densities of 3.0 territories/10 km²; the high density of Tawny Owls may be the main reason for the scarcity of this species. Ural Owls have been reintroduced to the area and have still a low abundance (1.2 territories/10 km²).

**Keywords:** *Aegolius funereus, Glaucidium passerinum,* population dynamics, primeval forest, *Strix aluco*

## RESUMO

Entre 2015 e 2019, as densidades populacionais de mocho-funéreo (*Aegolius funereus*), de mocho-anão (*Glaucidium passerinum*), de coruja-do-mato (*Strix aluco*) e de coruja dos Urales (*Strix uralensis*) estão a ser monitorizadas na Área Selvagem de Dürrenstein (IUCN Categoria I), na Baixa Áustria. A área de estudo está localizada entre 720 e 1500 m a.s.l. e abrange 1650 ha de povoamentos mistos de abeto-falso *(Picea abies*), abeto-branco (*Abies alba*) e faia-europeia (*Fagus sylvatica*), incluindo a floresta primitiva de Rothwald (400 ha). Em cada ano, três censos padronizados são realizados entre março e junho, usando reproduções de vocalizações em 22 pontos de amostragem. Anualmente estão a ser avaliados a abundância de micromamíferos e a produção de sementes pelas principais espécies arbóreas, para aferir os efeitos das suas variações na densidade de rapinas nocturnas nidificantes. Os dados dos primeiros três anos revelam que o mocho-funéreo e a coruja-do-mato são as espécies mais comuns na área de estudo. Em 2016, um tronco de faia contribuiu para aumentar a densidade de pequenos roedores e, na época de reprodução subsequente, foi registado um grande aumento nas densidades de pares reprodutores de mocho-funéreo, de 12,1 para 20,0 territórios/10 km². O sucesso reprodutivo foi bastante elevado, com juvenis voadores em pelo menos doze ninhadas confirmadas. A espécie reproduz-se exclusivamente em cavidades naturais de árvores, geralmente construídas por pica-pau-preto (*Dryocopus martius*). A coruja-do-mato apresentou um ligeiro aumento de 12,1 para 13,3 territórios/10 km². O sucesso reprodutivo foi bastante baixo em 2017, provavelmente devido a fortes nevões em abril. O mocho-anão apresentou densidades relativamente baixas de 3,0 territórios/10 km²; a elevada densidade de coruja-do-mato pode ser a principal razão para a escassez desta espécie. A coruja dos Urales foi reintroduzida na área e ainda apresenta uma reduzida abundância (1,2 territórios/10 km²).

**Palavras-chave:** *Aegolius funereus*, dinâmica populacional, floresta primitiva, *Glaucidium passerinum, Strix aluco*

## Introduction

The Dürrenstein Wilderness Area in Lower Austria includes the primeval forest Rothwald with an area of 400 ha and surrounding woodlands that also have hardly been used. It is the largest remnant of natural virgin forest in the Alps. The area therefore contains many old growth stands with tall trees and abundant natural cavities. It was supposed that this exceptional woodland provides suitable habitat for different owl species but a population survey of this predator group has not been carried out in the past. It was there-

fore a main goal to fill this gap. The population fluctuations caused by beech mast years and the subsequent response of small rodents should also be taken into account. Although there are already many studies dealing with this topic, they mainly focus on owl populations of boreal forest, especially in Finland and mainly on nest box populations (Korpimäki 1986, Korpimäki & Hakkarainen 2012). So far few studies were carried out in the Eastern Alps and even fewer on owl populations breeding in natural cavities. In our study area no nest boxes were mounted for Boreal Owl (*Aegolius funereus*) and Eurasian Pygmy-owls (*Glaucidium passerinum*). Both species are therefore bound to use natural cavities, often provided by woodpecker species.

Since the year 2008 a reintroduction project for the Ural Owl (*Strix uralensis*) is taking place in the Wilderness Area and its surroundings. For supporting and monitoring these owls seven nest boxes have been mounted in the study area. In 2015 a monitoring project on the owl species of the Dürrenstein Wilderness Area was started and will last until 2019. Results of the first three monitoring seasons are presented.

# Methods

## Study area

The Wilderness Area covers an area of 3,500 ha and is strongly protected as Strict Nature Reserve (IUCN Category Ia) and Wilderness Area (IUCN Category Ib). Forestry, hunting and public access are not existing in the area. Furthermore, it is part of the UNESCO World Heritage Site "Primeval Beech Forests of the Carpathians and Other Regions of Europe".

The study area is located between 720 and 1,500 m a.s.l. and covers 1,650 ha of mixed stands of spruce (*Picea abies*), fir (*Abies alba*) and beech (*Fagus sylvatica*). Depending on local abiotic factors like duration of snow cover, exposition, steepness and soil depth deciduous or coniferous trees are prevailing. Geologically it is part of the Northern Limestone Alps with an annual precipitation of 1,700 to 2,400 mm. In wintertime the area is covered by a thick layer of snow up to 2 m deep often lasting until early May.

## Field surveys and data analysis

The monitoring standards for owl species given by Südbeck et al. 2005 were slightly modified due to remoteness, elevation and climate conditions of the study area. Each year three standardised surveys are carried out in March, April and June, using playbacks at 22 monitoring points. In 2017 the first survey took place early April due to heavy snowfall. Buffers of 500 m radius around the monitoring points define an approximate distance of perceptibility per monitoring point and determine a cohesive study area of 1,650 ha. The recording distance was 500 m, as in spring the streams and rivulets carry masses of melting water producing a remarkable noise – a challenge for acoustic monitoring. Two teams consisting of two investigators carry out the survey simultaneously in different parts of the study area for security reasons and for verifying only short or distant calling individuals. Usually snow shoes have to be used until early May. All surveys have been carried out under favourable weather conditions (no or very calm wind and no precipitation) and started about three hours before sunset to record Eurasian Pygmy-owls and lasted about five hours after dusk. Direction and estimated distance of each calling owl was recorded and daily observation maps were drawn using Google Earth. The observations were summarised to territories with a Geographical Information System (ESRI ArcGIS) according to the guidelines of Bibby et al. 1995.

Yearly abundance of small mammals has continuously been monitored using life traps in different parts of the study area since 2002

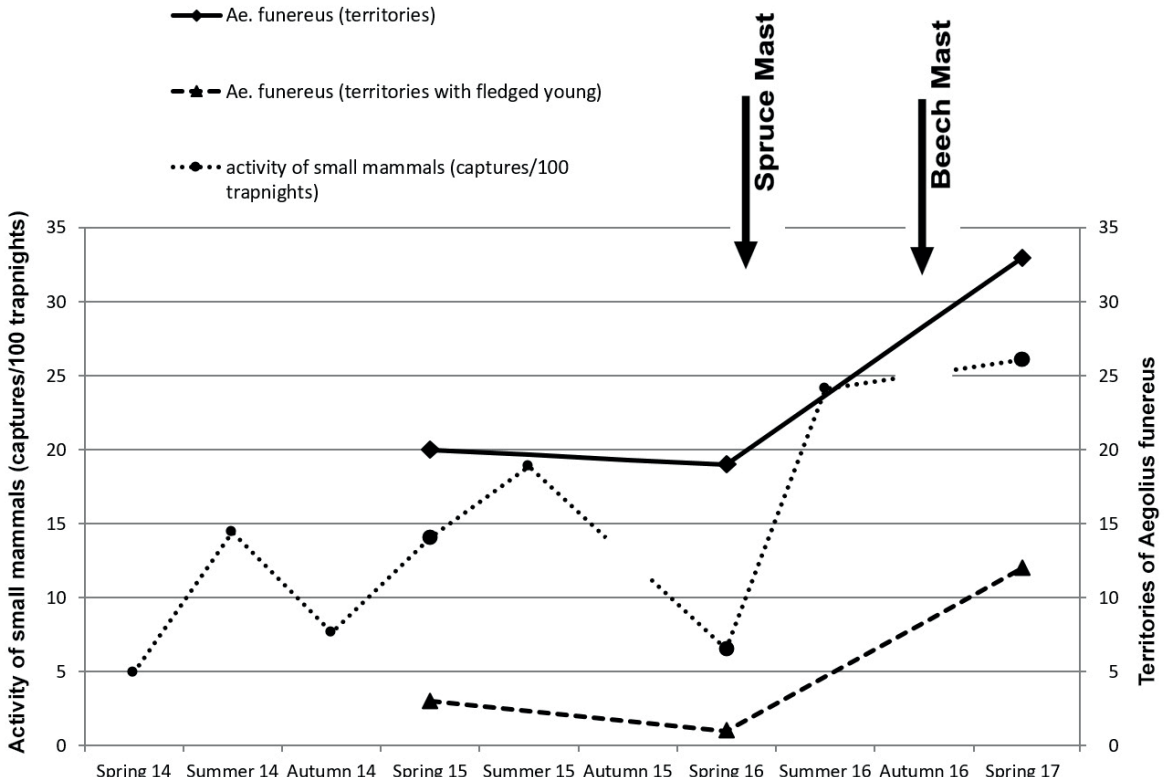
**Table 1** - Recorded population densities (territories/10 km²) of the four owl species breeding in the study area (1,650 ha) during the first three years of the monitoring.

Tabela 1 - Densidade populacional (territórios/10 km²) das quatro espécies de rapinas noturnas reprodutoras na área de estudo (1.650 ha) durante os três primeiros anos de monitorização.

| POPULATION DENSITY (TERR./10 Km²) | 2015 | 2016 | 2017 |
|---|---|---|---|
| Tawny Owl | 11.5 | 12.1 | 13.3 |
| Ural Owl | 1.8 | 1.2 | 1.2 |
| Boreal Owl | 12.1 | 11.5 | 20.0 |
| Eurasian Pygmy-owl | 3.0 | 1.8 | 3.0 |

**Figure 1** - Number of territories and breeding success of Boreal Owl in respect to activity of small mammals (captures/100 trap nights) between spring 2014 and spring 2017.

Figura 1 - Número de territórios e sucesso reprodutivo de mocho-funéreo em relação à atividade de micromamíferos (captura/100 noites de armadilhagem) entre as primaveras de 2014 e de 2017.



(Kempter & Nopp-Mayr 2013, F. Sachser unpubl. data). The two most abundant rodent species in the area are the Bank Vole (*Myodes glareolus*) and the Yellow-necked Mouse (*Apodemus flavicollis*). Moreover, the seed production of the main tree species has been surveyed by other research groups for many years. It was found, that in this area beech masts occur every four to five years (Kempter & Nopp-Mayr 2013).

## Results

So far six species of owls were observed in the Wilderness Area. The four regularly breeding species Tawny Owl (*Strix aluco*), Ural Owl, Boreal Owl and Eurasian Pygmy-owl are the target species of this study. Data from the first three years reveal Boreal and Tawny Owls to be the most common species in the study area (Tab. 1). Eurasian Eagle Owl (*Bubo bubo*) does not occur regularly and does not breed in the area, Long-eared Owl (*Asio otus*) was first discovered as a breeding bird in 2017 in more open parts of the area (1,450 m a.s.l.) outside the study area.

In 2016 a beech mast increased the density of small rodents and in the following breeding season Boreal Owls showed a significant increase in breeding densities from 11.5 to 20.0 territories/10 km² (Fig. 1). The breeding success showed a steep increase too in 2017, covering twelve broods with fledglings confirmed.

Tawny Owls occurred regularly up to an altitude of 1,380 m a.s.l. and showed a slight increase from 12.1 to 13.3 territories/10 km² during the first three years of the study. With only three pairs recorded breeding successfully in 2017, breeding success was remarkably low despite the high activity of rodents, suggesting other limiting factors.

Eurasian Pygmy-owls showed relatively low densities of 1.8 to 3.0 territories/10 km².

Ural Owls have been reintroduced to the area and occur with a density of 1.2 territories/10 km². Three successful broods within the Wilderness Area have been recorded so far, all three in natural tree cavities.

## Discussion

A remarkable feature of the Dürrenstein Wilderness Area with the Primeval forest Rothwald is that Tawny Owls und Boreal Owls occur together with a comparably high density, whereas other studies found avoidance of areas of high Tawny Owl abundance by the smaller species (Pedroli et al. 1975). The diversity of the habitat with old growth forest and a very good supply of natural breeding holes might explain this lower interspecific competition in our area. The Black Woodpecker occurs in an abundance of 0.75 territories/100 ha (Hochebner et al. 2015) and until now 58 cavities have been found in the study area. The density of Black Woodpecker holes in the study area (3.52/100 ha) is much higher than in pristine coniferous woodlands in Finland (Virkkala et al. 1994: 0.5-1.5/100 ha) or in managed coniferous forests in Sweden (Johnsson et al. 1993: 0.3-0.4/100 ha). This is due to the absence of forestry (logging) in the Wilderness Area. Cavities in beech trees can be used as breeding holes for decades, whereas holes in coniferous trees are lost to a much higher extent (Meyer & Meyer 2001).

Tawny Owls were already recorded with several individuals calling in this area back in 1944 (Machura 1944), so it is not a new species. In 2017 a loss of many broods was probably caused by heavy snowfalls on the 19th of April when 2 m of snow fell within 24 hours. At this time, Tawny Owl young already hatched in their nests. Tawny Owls obviously have greater difficulties to cope with high snow cover in early spring compared to Boreal Owls, which breeding period starts later. Despite a large population of

Figure 2 - Number of Boreal Owl territories already occupied during the first survey compared to the number of unique territories initially recorded during the second and third survey for each of the three survey years.

Figura 2 - Número de territórios de mocho-funéreo ocupados durante a primeira amostragem (preto), comparado com o número de territórios inicialmente registado durante a segunda e terceira amostragem (cinzento), em cada um dos três anos de monitorização.

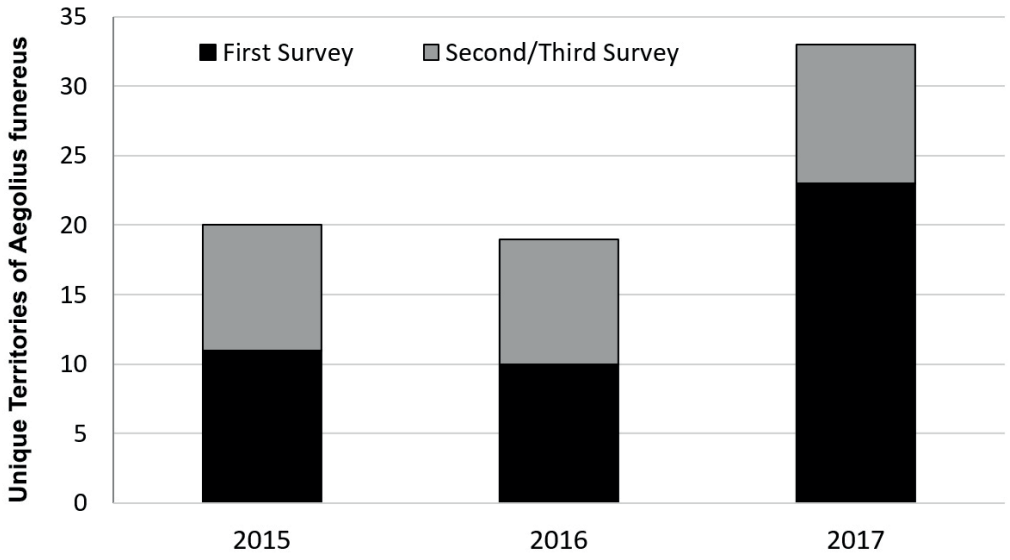



Table 2 - Comparison of the recorded owl population densities between the Wilderness Area and other areas located in the Eastern Austrian Alps.

Tabela 2 - Comparação das densidades populacionais de rapinas noturnas registadas na Área Selvagem e em outras áreas localizadas na região Este dos Alpes Austríacos.

| | NP Kalkalpen, Weißmair et al. (2014) | NP Gesäuse, Teufelbauer et al. (2012) | Ennstal, Styria, Scherzinger (1970) | Dürrenstein Wilderness Area |
|---|---|---|---|---|
| Study area (ha) | 3,242 | 1,522 | 6,000 | 1,650 |
| Elevation (m) | 620 - 1,670 | 480 - 1,780 | 650 - 1,818 | 720 - 1,500 |
| Tawny Owl (terr./10 km²) | 8-9 | 5.3 | - | 11.5 - 13.3 |
| Boreal Owl (terr./10 km²) | 5 | 4.9 - 5.6 | - | 11.5 - 20.0 |
| Eurasian Pygmy-owl (terr./10 km²) | 6-7 | 4.3 - 5.6 | 1.4 | 1.8 - 3.0 |

rodents caused by a preceding beech mast, breeding success of Tawny Owls was very low in 2017.

The Boreal Owl is a species, which shows a quite diverse mating system with polyandry and polygyny occurring quite often. Some males start to display at secondary and even tertial breeding holes after the first brood has been started successfully (Korpimäki & Hakkarainen 2012). Furthermore, a certain percentage of males stay unpaired. Therefore it is difficult to extrapolate from the hooting males to the actual breeding population size. Hence Fig. 2 gives the amount of territories detected in the first survey carried out in March, when males are hooting at their primary hole (Korpimäki & Hakkarainen 2012), combined with the new unique territories as obtained during the second and third survey.

In 2017 more than two thirds of all territories (n = 33) had already been found in the first survey. Hence there may have been at most 30% of the males singing at a second or even tertial breeding cavity. Of these 10 extra territories five have been confirmed with fledglings found in June. That means that for this year with good food supply only five out of 33 claimed territories (15%) might refer to bachelors displaying at secondary or tertial cavities.

Eurasian Pygmy-owls were quite hard to find and rather rare. This may be the result of high population densities of Tawny and Boreal Owls which are not only competing for food, but also bring along some predation risk for the smallest owl species (Mikkola 1983), which is probably increasing when small mammal populations are low. A recently published a remarkably detailed study on the interspecific distribution patterns of Boreal and Eurasian Pygmy-owl in Finland showed that the heterospecific competitor and intraguild predator Boreal Owl did not affect spatial settlement of Eurasian Pygmy-owls, but proximity of the bigger species was associated with low hatching and fledging success of Eurasian Pygmy-owls (Morosinotto et al. 2017). So the dense population of Tawny Owls on the other hand is supposed to be the main reason for the scarcity of Eurasian Pygmy-owls. Further surveys and analyses are necessary to find out more about the interspecific relation of the different owl species in our study area.

Since 2008 a reintroduction project for Ural Owls has been carried out. The species is not very vocal and often does not react well to tape recordings. We found some calling individuals and even fledged young on two occasions. There is a small population establishing in the study area and its surroundings, but the breeding density of the species is still rather low. This also may affect the smaller owl species and probably will bring some change to the intraguild relations.

Compared to surveys in neighbouring areas of the Austrian Eastern Alps, quite high densities of Tawny and Boreal Owl were found in our study area, whereas the population of Eurasian Pygmy-owls was comparably low (Tab. 2). Scherzinger (1970) found a similar value in the Enns valley in Styria (Austria).

Our studies will be continued for at least two more seasons. After finishing field work habitat analyses with respect to the niche selection of different owl species are intended to be made.

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