

Spatial distribution of nocturnal raptor species (Aves: Strigiformes) in the Upper Thracian lowland, Bulgaria

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Abstract. Here we aim to present the recent breeding distribution of the owl species from the Upper Thracian Lowland, Bulgaria, and to compare it with previous studies to highlight distribution changes in the species. Moreover, as a second objective we aim to present the non-breeding distribution (during winter or migration) of the studied species for the first time. The most common species, widely distributed in the study area were the Little owl, the Eurasian Scops owl, the Long-eared owl and the Barn owl. We found new localities for the Short-eared owl and the Eagle owl that are rare breeding species in the study area. The Tawny owl is also rare in the Upper Thracian Lowland and mostly occurs in old preserved forest patches along the Maritsa river valley.

Key words: owls, occurrence, UTM, breeding, wintering.

Introduction

Owls are top predators, occupying a high position on the trophic pyramid (Ciach & Czyzowicz, 2014). The species are sensitive to changes in the environment and are recognized as indicators for assessing the ecological health of the habitats (Apolloni et al., 2018). Thus, their absence act as an indicator of more general changes occurring in the ecosystem (Askew et al., 2007). Their numbers and distribution are affected mainly by food availability, and owls are known to reduce their own numbers in response to changes in their prey (Mikkola, 1983). Other predictors for their population status and numbers are quality and

structure of the habitat, as well as weather conditions during wintering congregations (Dobrev et al., 2021; Ciach & Czyzowicz, 2014).

Currently 10 nocturnal raptor species are registered as breeding in Bulgaria (Iankov 2007, BUNARCO, 2014). Some of the species occur in higher altitudes or they are related to specific habitats - e.g. Eurasian Pygmy owl (*Glaucidium passerinum* Linnaeus, 1758), Boreal owl (*Aegolius funereus* Linnaeus, 1758), Ural owl (*Strix uralensis* Pallas, 1771) while others are widely spread across the country and are even distributed in agricultural areas and in the settlements (Simeonov, 1988). All species of owls in Bulgaria have stable

or slightly increasing populations and the most comprehensive study on their distribution and numbers so far is the Atlas of breeding birds in Bulgaria (Iankov, 2007). The study provides general figures on the distribution, numbers and trends of different owl species in Bulgaria. Additionally, species occupying settlements and agricultural areas close to people, such as the Little owl (*Athene noctua* Scopoli, 1769) and the Barn owl (*Tyto alba* Scopoli, 1769) have been studied in relation to their distribution, nest sites and density. These studies build on the data in the Atlas of breeding birds in Bulgaria and complement the figures for these two species (Ignatov, 2022; Daskalova et al., 2019; Milchev & Gruychev, 2014).

Another species that is very common in settlements is the Scops owl (*Otus scops* Linnaeus, 1758). Its population in Bulgaria is stable, and the species is considered quite common across the country. Moreover, the Scops owl prefers also to breed in sustained parks with old trees in villages and cities (Iankov, 2007).

The Eagle owl (*Bubo bubo* Linnaeus, 1758) is mostly distributed in the mountainous areas in Bulgaria and the hilly plains where cliffs and terrain drops provide proper breeding habitat (Iankov, 2007). Additionally, more detailed information on its distribution and diet is provided from Strandzha mountains and Kazanlak valley (Milchev & Spassov, 2017; Milchev & Gruychev, 2015, 2016; Simeonov, 1983).

The distribution of the Tawny owl (*Strix aluco* Linnaeus, 1758) is defined mostly by the presence of different types of forests. The species is not common in the plains and it is absent in the intensified agricultural areas (Hristov, 2003). Nevertheless, it is widespread in the country and the population seems stable (Iankov, 2007). Likewise, the population of the Long-eared Owl (*Asio otus* Linnaeus, 1758) is stable and the species is common and well-studied in the country (Dobrev et al., 2021; Kodzhabashev et al., 2020; Milchev & Ivanov, 2016; Milchev et al., 2003).

The Short-eared owl (*Asio flammeus* Pontopidan, 1763) is the rarest owl species with small number of registrations during the breeding season, wintering, and most of them recorded in the Thracian lowland (Iankov, 2007; Authors, unpublished). Furthermore, unpublished data during the breeding season from Plovdiv and

Burgas suggests that the species is likely a regular breeder, however, in small numbers (Authors, unpublished).

According to Iankov (2007), the trend in the numbers and distribution of the nocturnal raptor species in Bulgaria is either stable or slightly increasing. Most of the studies are focused on single species (Ignatov, 2022; Dobrev et al., 2021; Milchev & Gruychev, 2014, 2015; Simeonov, 1988) or upland forest species (Nikolov et al., 2001), and none on the changes of recent distribution of species that are common and not related to specific habitats like the upland forest species. There is a gap of detailed information for the Upper Thracian Lowland. Hence, we aim to present the recent breeding distribution of the owl species from the Upper Thracian Lowland, and to compare it with previous studies to highlight distribution changes in the species (Ignatov & Popgeorgiev, 2021; Milchev & Gruychev, 2015, 2016; Iankov, 2007). As a second objective, we aim to present the non-breeding distribution (during winter or migration) of the studied species. The current study can be later used for species-specific studies, which can further assess reasons behind population changes in different species, or factors affecting the distribution and their numbers.

Materials and Methods

Study area

The study was carried out in the Upper Thracian Lowland, which is the most extensive plain in Bulgaria. The lowland covers 6,026 km² (Yordanov & Velez, 1956). The Upper Thracian lowland extends from the Sredna Gora Mountain (Sushtinska Sredna Gora and the Surnena Gora ranges) and Karnobatski Hisar on the North to Belovo on its west boundaries. To the South it reaches the towns of Haskovo and Harmanly, bordered entirely by the Rhodope Mountains, and to the East – by Manastirski heights.

The largest water body in the plain is the Maritsa River. The relief is plain with mean elevation of 202 m (133-331 m a.s.l.). The climate is transitional continental.

According to the species composition, the forests fragments consist predominantly of different oak species (*Quercus robur*, *Quercus patraea*, *Quercus frainetto*, *Quercus cerris*, *Quercus pubescens*), Wych elm (*Ulmus minor*), Narrow-leaved ash (*Fraxinus angustifolia*), Field maple

(*Acer campestre*), False acacia (*Robinia pseudoacacia*), European hornbeam (*Carpinus betulus*), Silver poplar (*Populus alba*), White willow (*Salix alba*), Common alder (*Alnus glutinosa*). The forest landscape is mainly affected by human activities related to silviculture and creation of complex of mosaic forest patches with different size (Koprarev, 2002).

The Thracian lowland is intensively cultivated with dense settlements network and population. The arable land is more than 75% of the total lowland area.

Data and Information Sources

The study concerns nocturnal raptor species (Aves: Strigiformes), including Little Owl, Long-eared owl, Short-eared owl, Tawny owl, Eurasian scops owl, Eurasian eagle owl, and Barn owl.

The study analyses data on the spatial distribution of the target species between 2006 and 2023. The data is derived from publicly accessible data at GBIF public repository (GBIF.org, 2023), more recent unpublished data collected with SmartBirdsPro by different observers, and data collected in forest fragments in the western Upper Thracian Lowland in the frames of a PhD study between 2021 and 2022 (Popgeorgiev et al., 2015).

In general, the data on the spatial distribution of target nocturnal raptor species is based on observations of individuals in two seasons:

1) breeding season – April-June (January-February in case of the Eagle owl and October-March in case of Tawny owl), when the birds vocalize actively

2) non-breeding season (Penteriani, 2002; Snow, 1998).

The distribution of the Eurasian scops owl during breeding season is based on occurrence data from 20 April to 30 June, in order to minimize the accounts of migrating individuals in the analysis (Cramp, 1985). To map the distribution of the Little owl we used data collected during and after the breeding season from 2016 onward (Ignatov & Popgeorgiev, 2021).

Data analyses

We analyzed the distribution of the owl species in the study area and compared the records extracted from 6996 observations in the current study with the data from The Atlas of breeding birds in Bulgaria (hereafter the Atlas)

(Iankov, 2007). Hence, we therefore use the following categories to account for the distribution of the species during the breeding season in the UTM squares:

- confirmed (the species was registered in both the Atlas and the current study),
- unconfirmed (the species was registered in the Atlas but not in the current study),
- new (the species was registered only in the current study).

For the non-breeding season, we present data for the distribution that has not been presented before in this manner and could be used for a baseline for future studies.

The records of identified individuals are plotted in 115 standard 10x10 km UTM grid squares as in the Atlas. All locations of identified individuals from different sources of data we used were intersected with the UTM grid (10 km) and plotted using ArcGIS 10 (ESRI 2014) to account for new, confirmed or unconfirmed locality of the studied species.

Results and Discussion

Little owl

The Little owl was confirmed in 70 out of 115 UTM grid squares and no new localities were found during the breeding season (Fig. 1a) (Ignatov & Popgeorgiev, 2021; Iankov 2007). During the non-breeding season, the species was recorded in 74 UTM squares that overlap with the distribution during the breeding season (Fig. 1b).

As previously described, the Little owl distribution is related to lowlands with temperate conditions and a wide variety of habitats including settlements and proper nesting habitat such as old buildings and single buildings nearby agricultural lands (Ignatov, 2022). Our results confirm these findings and the Little owl seems to be the most abundant and common species of all seven species that we have recorded in the Upper Thracian Lowland.

The abundance of agricultural lands and settlements support the optimal conditions for the breeding and the distribution of the species. The distribution of the Little owl that we have found in the non-breeding season overlaps to a large extent with the breeding distribution; it is wide and covers 74 UTM squares and a significant part of the study area.

Eurasian Scops owl

The Eurasian Scops owl was confirmed in 24 out of 115 UTM grid squares and 19 new localities were found during the breeding season, in 33 UTM squares the species remained not confirmed (Fig. 2a). During the non-breeding season, the species was recorded in 43 UTM squares mostly along the Maritsa River and its main tributaries (Fig. 2b).

A species that we found widely distributed in the study area during the breeding season was the Eurasian Scops owl, which was confirmed in 24 and recorded in another 19 of the 115 UTM squares where the study was carried out. The population of the species in Bulgaria is stable and it is distributed across all regions of the country, very common in parks in the villages and the towns (Iankov, 2007). Our results demonstrate that the species was recorded in 19 new squares during the breeding season. Nevertheless, it was not confirmed in another 33 UTM squares, which is most likely due to the lack of data collection in these particular UTM squares. Regarding the nonbreeding season, all observations cover 43 squares that overlap with those from the breeding season almost entirely.

Probably the wide distribution of the species in the study area can be explained with the settlements and agricultural systems with abundant food resources around, and the presence of parks with trees and cracks and holes in the buildings where the Eurasian Scops owl can breed or stop during migration (Marchesi & Sergio, 2004).

Long-eared owl

The Long-eared owl was confirmed in 31 out of 115 UTM grid squares and it was registered in 19 new squares during the breeding season, in 36 UTM squares the species remained not confirmed (Fig. 3a). During the nonbreeding season, the species was recorded in 36 UTM squares. The species is widely distributed throughout the study area (Fig. 3b).

The Long-eared owl was confirmed and recorded in 50 UTM squares in the breeding season in total, and in another 36 in the non-breeding season. The species prefers parks in the towns and the villages to breed, also different lines of trees and forest fragments in the agricultural lands that are dominant in the study area (Iankov,

2007). Furthermore, the area of Plovdiv is well known with the largest wintering congregation site for the species in the country and harbors hundreds of birds during the winter (Dobrev et al., 2021).

Our results show that there are still a number of UTM squares where the species was not confirmed during breeding season but this is most likely due to the imperfections of the methods that we used to collect data rather than a shrink in the breeding distribution of the species.

Short-eared owl

The Short-eared owl is rare and it was recorded in 11 new UTM squares along the Maritsa river during the breeding season (Fig. 4a). The species was not confirmed in the four former UTM squares. During the non-breeding season, the species was recorded in six UTM squares, and only two of them overlap with squares where the species was registered breeding (Fig. 4b).

In contrast to the Long-eared owl, the Short-eared owl has a limited distribution and it was found during the breeding season in 11 UTM squares. Nevertheless, formerly, the species was considered as very rare breeder with scarce data for its distribution in the breeding season (Iankov, 2007). This is likely because Bulgaria and the Upper Thracian lowland are in the periphery of the breeding distribution of the species and usually there are more records of wintering birds than records of breeding (BirdLife International, 2021).

Our study provides new data on the breeding of the species, extending its former breeding distribution to new localities mostly along the Maritsa River and the region of Plovdiv.

Barn owl

The Barn owl is distributed widely in the Upper Thracian lowland and it was confirmed in 25 UTM squares and recorded in another 22 new UTM squares (Fig. 5a). The species was not confirmed in 17 of the UTM squares where it has been registered before. During the non-breeding season, the species was recorded in 39 UTM squares, most of them in the west of the Upper Thracian lowland (Fig. 5b).

One of the species common for settlements and agricultural systems was confirmed as widely distributed in the study area – the Barn owl

(Iankov, 2007). The species was confirmed in 25 UTM squares in total across the whole study area, and in 22 of the squares it was newly recorded during the breeding season.

The Barn owl is associated with open habitats of agricultural landscape that is dominating the Upper Thracian Lowland (Cramp, 1985). Furthermore, the population density and distribution as noted in other studies from southern Bulgaria seems to be around the average for Europe (5 breeding pairs/100 km²) which can also explain the number of UTM squares where the species has been confirmed (Daskalova et al., 2019; Milchev & Gruychev, 2014). The species nonbreeding distribution covers 39 UTM squares and overlaps almost entirely with the breeding distribution and is probably defined by the high density of the species and the fact that this species is easily registered in the settlements and elsewhere compared to others.

Tawny owl

The Tawny owl was found in six UTM squares along the Maritsa river where it has not been registered before, and it was confirmed in another square in the lowland (Fig. 6a). In 24 of the UTM squares that cover mostly the footsteps of the surrounding mountain ranges the species was not confirmed during the breeding season within the current study. During the non-breeding season, the species was recorded in seven UTM squares, all of which different from the squares where the species was confirmed or newly recorded during breeding (Fig. 6b). However, some of those might be breeding sites too as the species is mainly sedentary (Cramp, 1985).

A typical forest species, the Tawny owl prefers forests and forest patches with older trees, lines of trees and is generally not common in the lowlands and the agricultural systems in Bulgaria (Iankov, 2007; Cramp, 1985). Hence, the Tawny

owl was registered in only seven UTM squares, six of them new for the species from this study and only one confirmed from the Atlas (Iankov, 2007). Probably this is because the study was not carried out following species-specific methodologies and since not each UTM square was visited to detect its presence, the Tawny owl was not confirmed in 24 of the UTM squares that has been registered before.

Eagle owl

The Eagle owl was recorded in six new UTM squares along the Maritsa river where it has not been registered before (Fig. 7a). In 17 of the UTM squares, the species was not confirmed during the breeding season within the current study. During the non-breeding season, the species was recorded in two UTM squares (Fig. 7b).

The Eagle owl is a species with limited distribution and it was recorded in only 4 UTM squares. The species breeds in cliffs or slopes, caves that are very rare in most of the study area, which can explain the rare observations of the species (Iankov, 2007). Furthermore, the landscape is dominated by intensive agricultural fields and many settlements further limiting the breeding habitat preferences of the species (Schuchmann, 1999). In 17 of the UTM squares where the species has been registered before it was not confirmed in the current study. This could probably be explained by the insufficient data collection in these squares and the illusiveness of the Eagle owl, and the need of specific methodology to detect its presence (e.g. vocal stimulation and detection in January-February in specific habitats). This can be well observed in Fig. 7a where we can see that the Eagle owl is occupying mostly the footsteps of the mountains around and not the lowland, and most of the squares where it was reported in the Atlas remain unconfirmed in the current study.

Spatial distribution of nocturnal raptor species (Aves: Strigiformes) in the Upper Thracian lowland, Bulgaria

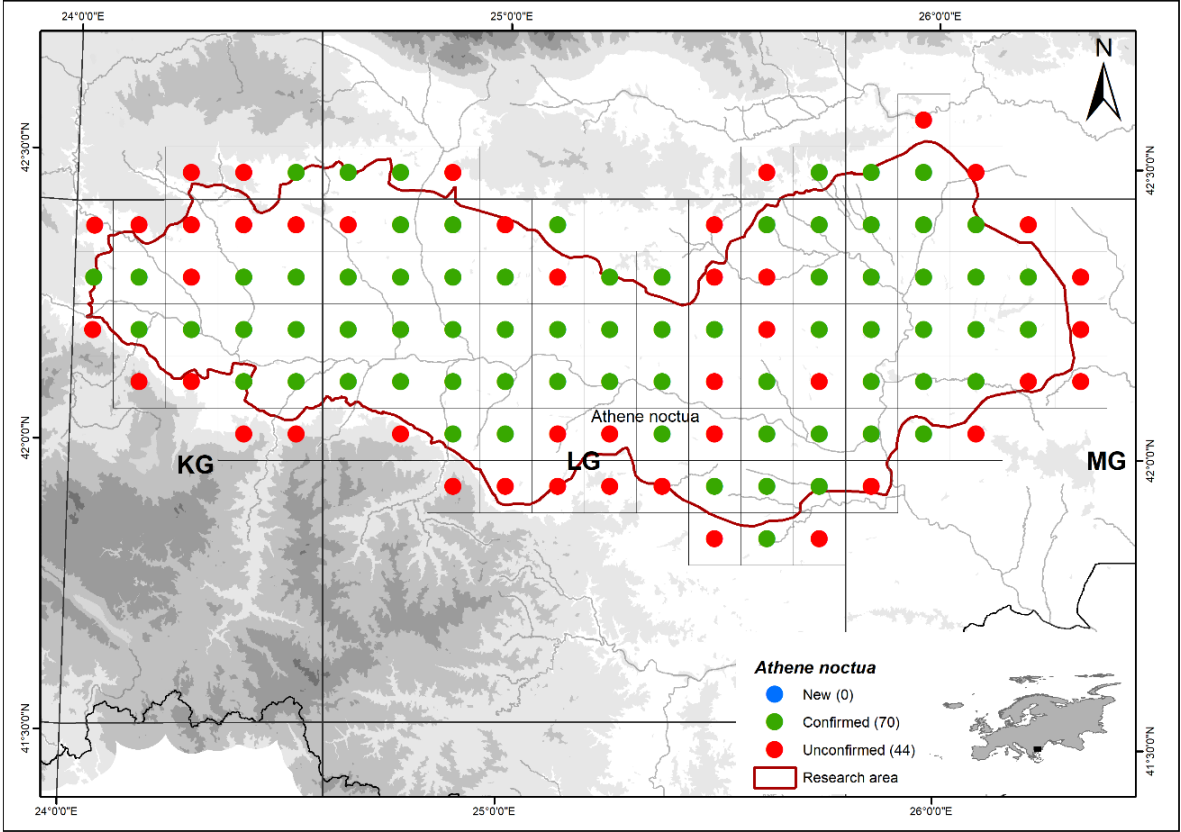


Fig. 1a. Breeding distribution of the Little owl (*Athene noctua*)

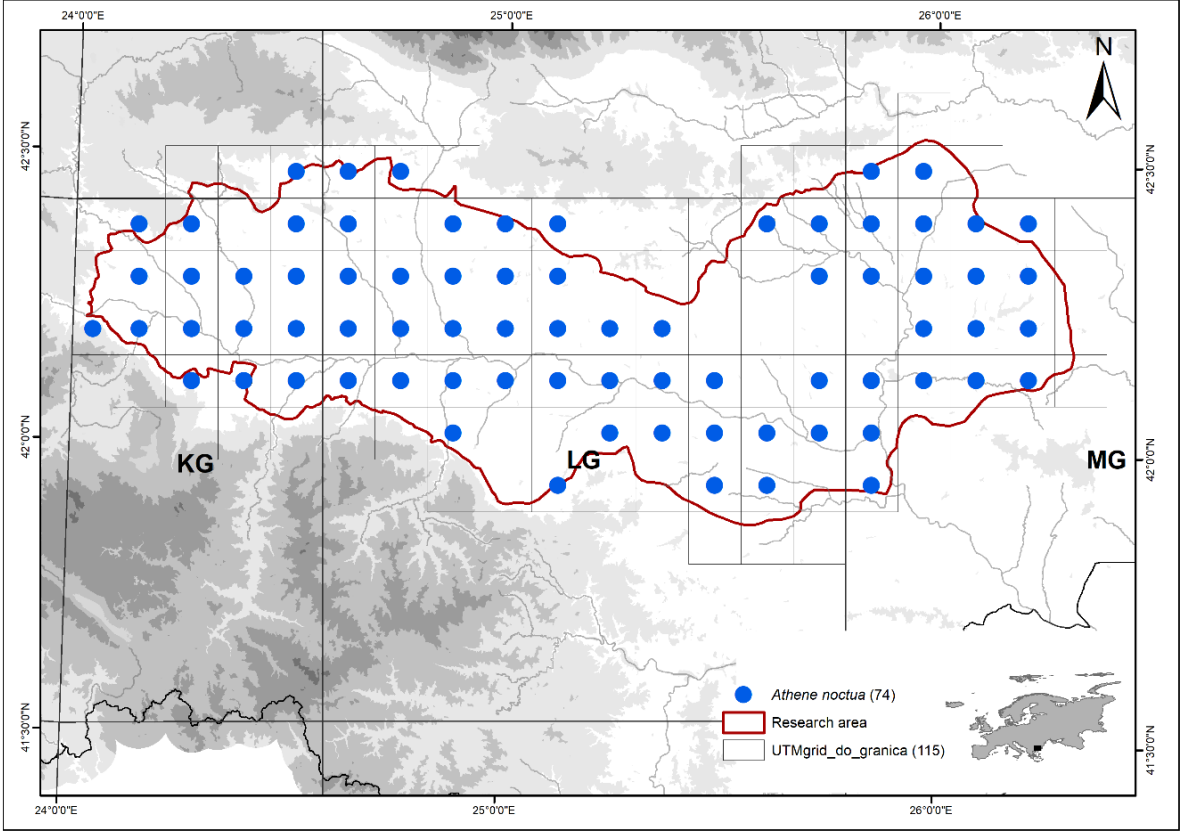


Fig. 1b. Non-breeding distribution of the Little owl (*Athene noctua*)

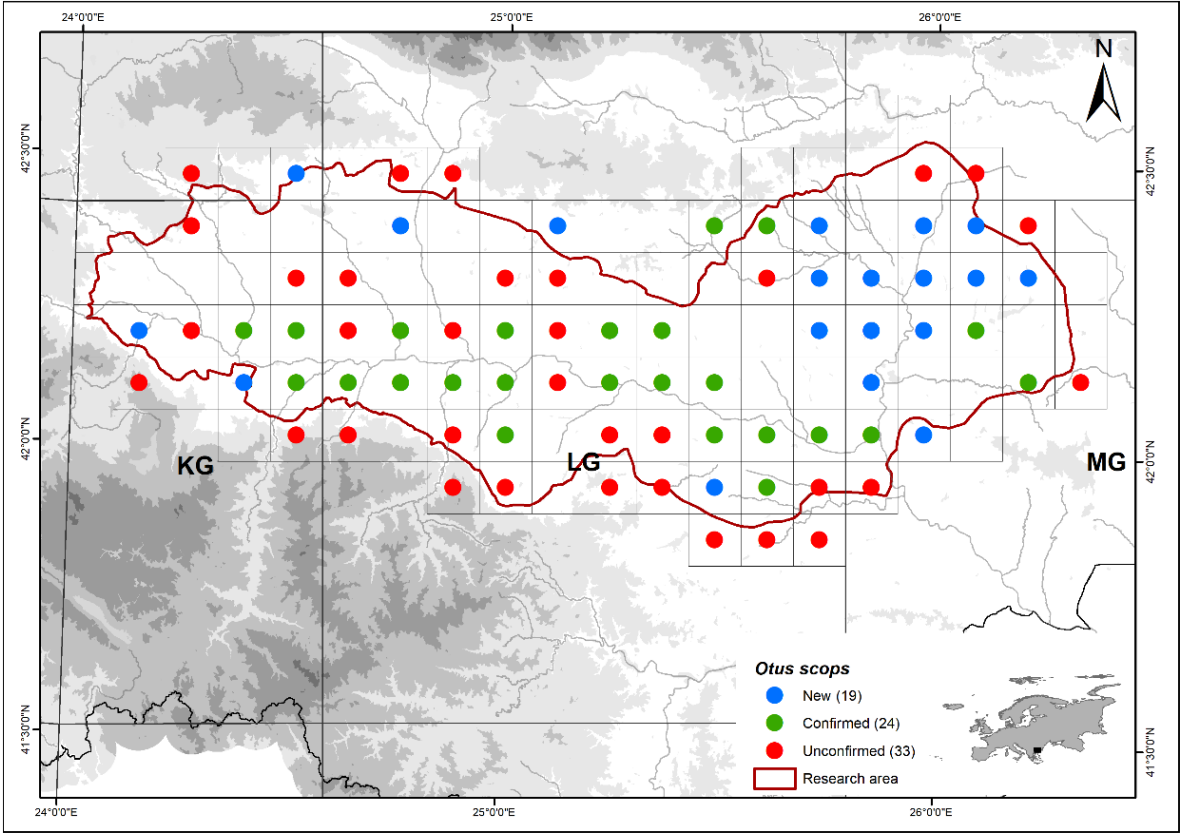


Fig. 2a. Breeding distribution of the Eurasian Scops owl (*Otus scops*)

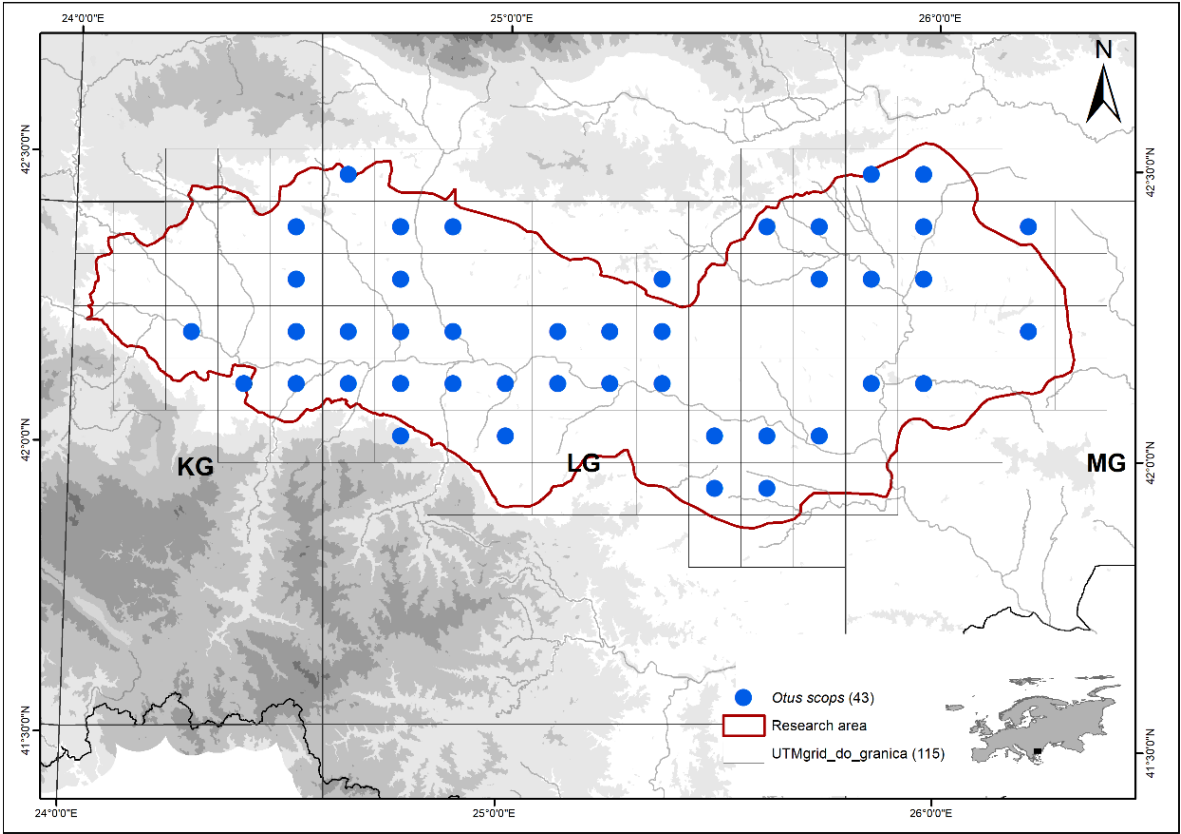


Fig. 2b. Non-breeding distribution of the Eurasian Scops owl (*Otus scops*)

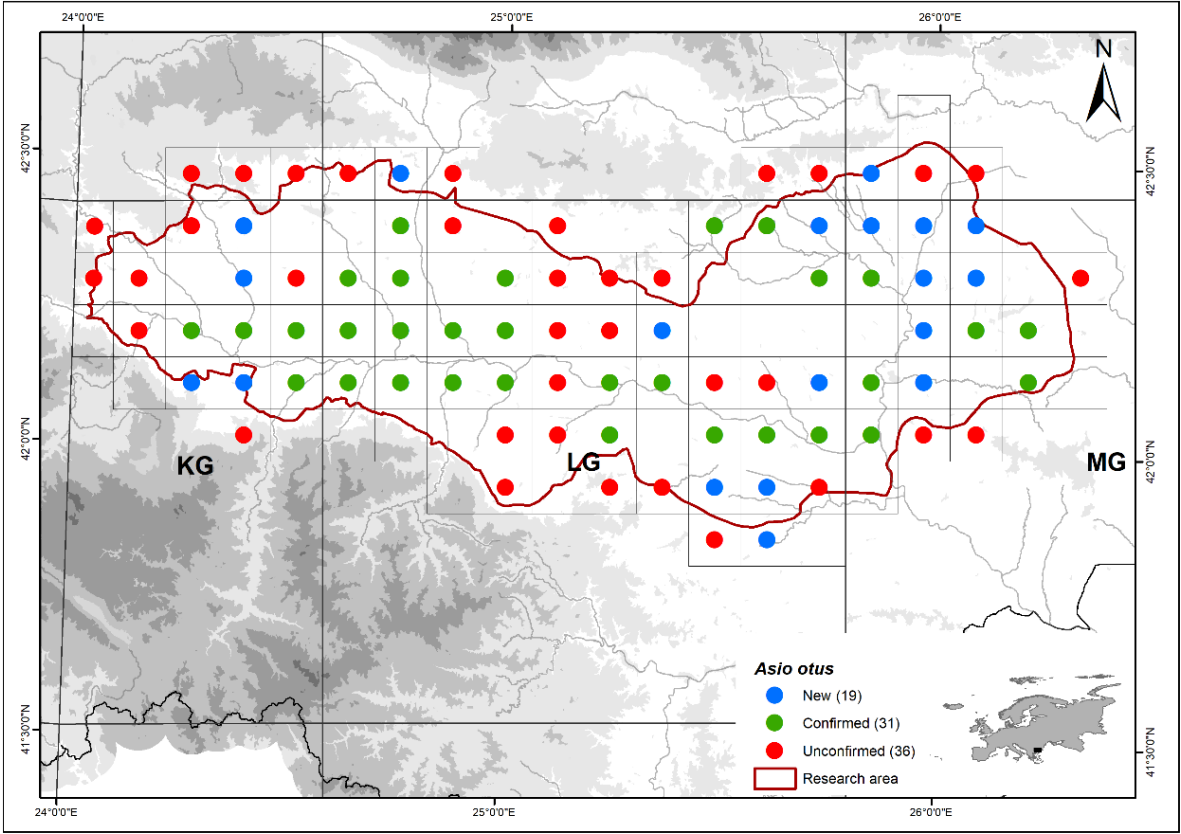


Fig. 3a. Breeding distribution of the Long-eared owl (*Asio otus*)

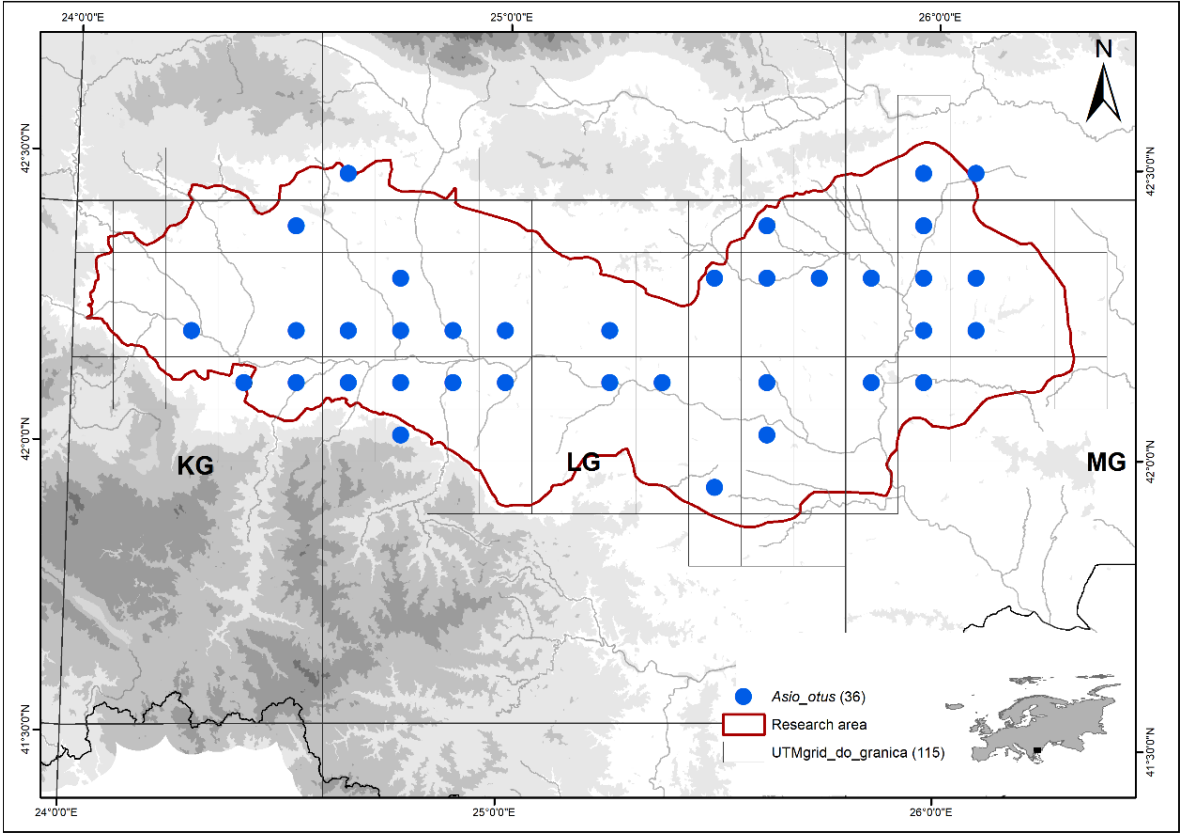


Fig. 3b. Non-breeding distribution of the Long-eared owl (*Asio otus*)

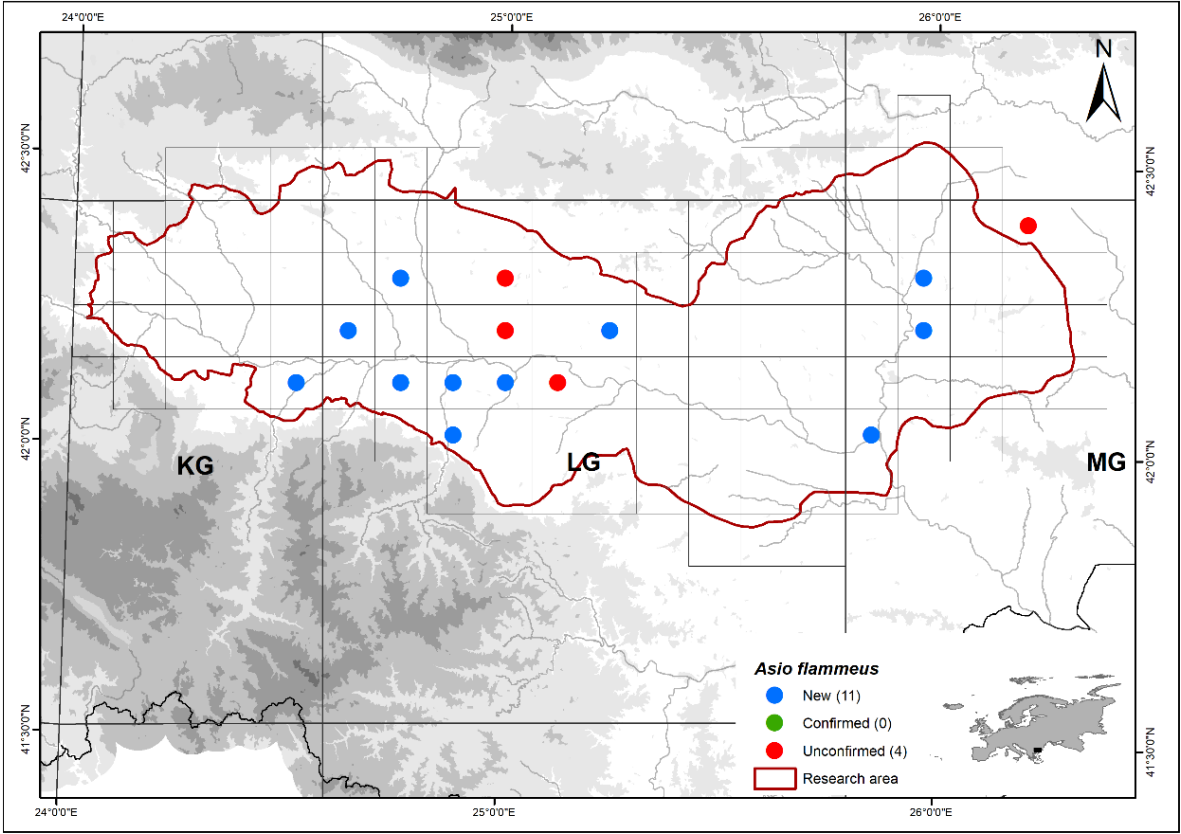


Fig. 4a. Breeding distribution of the Short-eared owl (*Asio flammeus*)

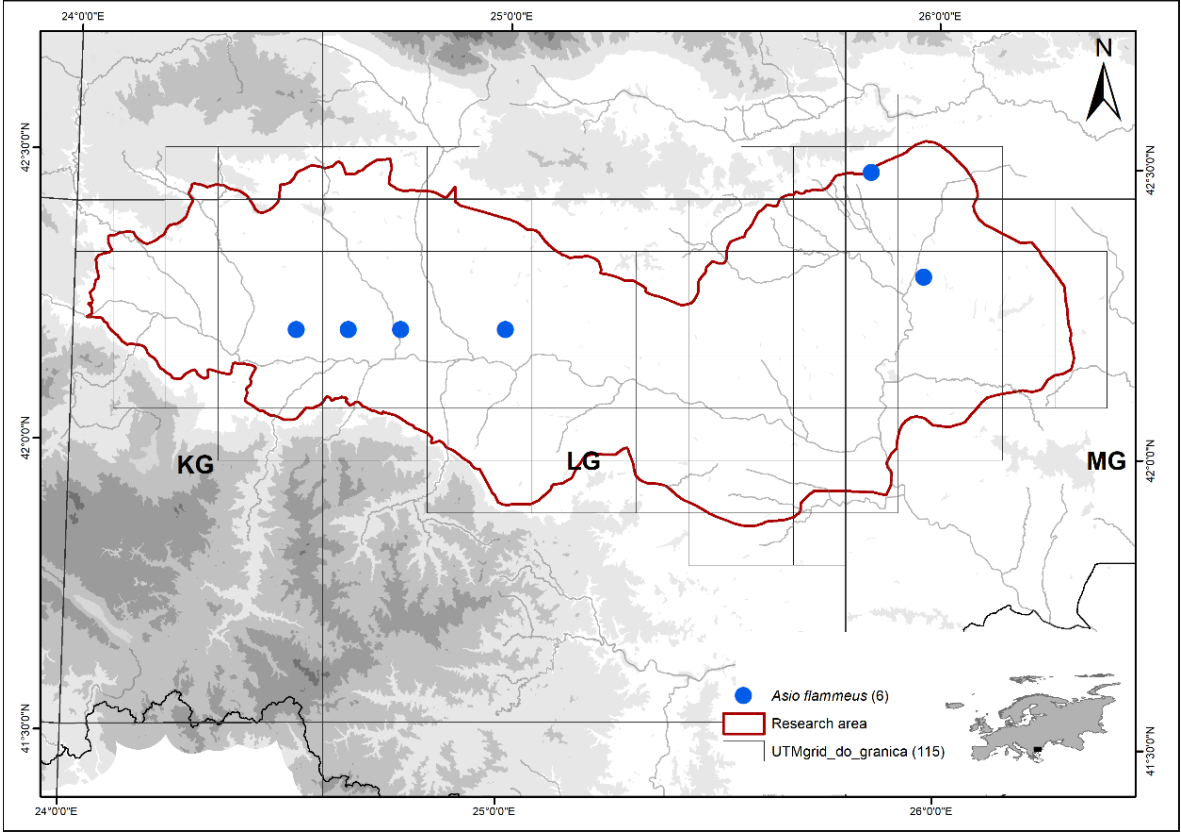


Fig. 4b. Non-breeding distribution of the Short-eared owl (*Asio flammeus*)

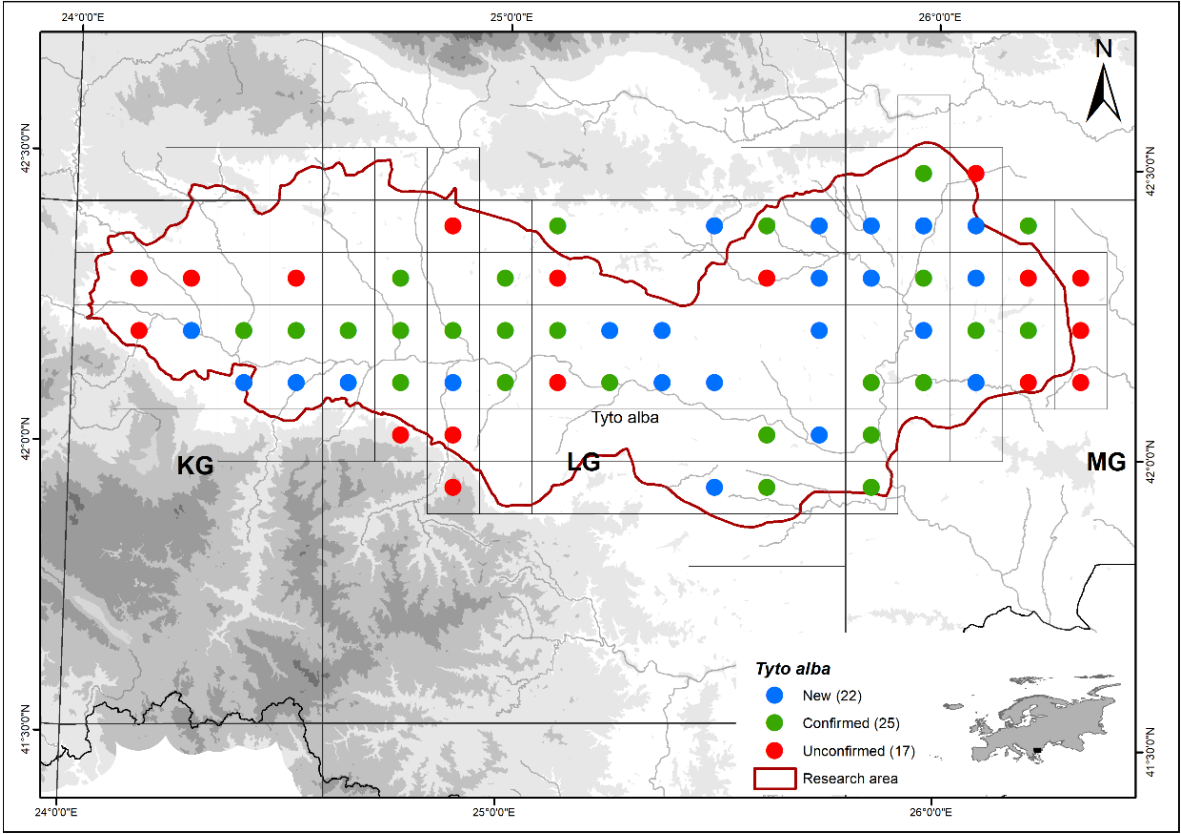


Fig. 5a. Breeding distribution of the Barn owl (*Tyto alba*)

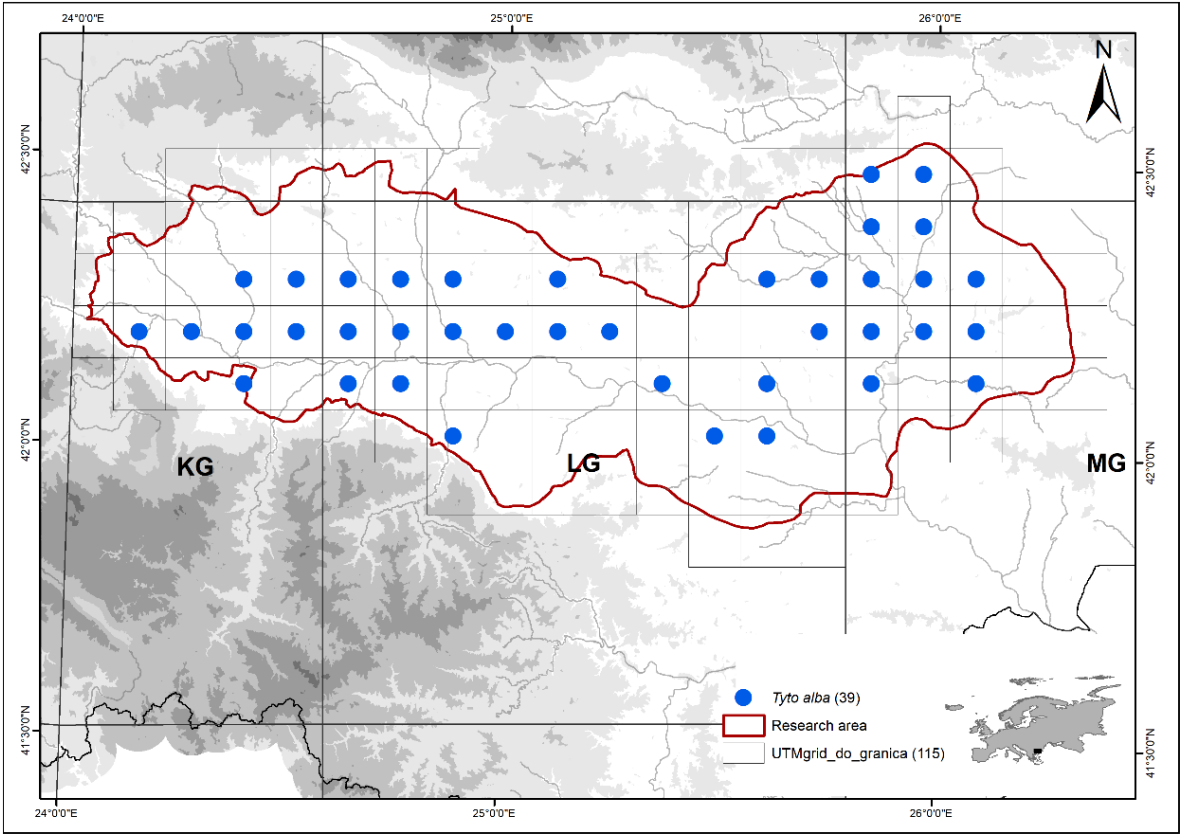


Fig. 5b. Non-breeding distribution of the Barn owl (*Tyto alba*)

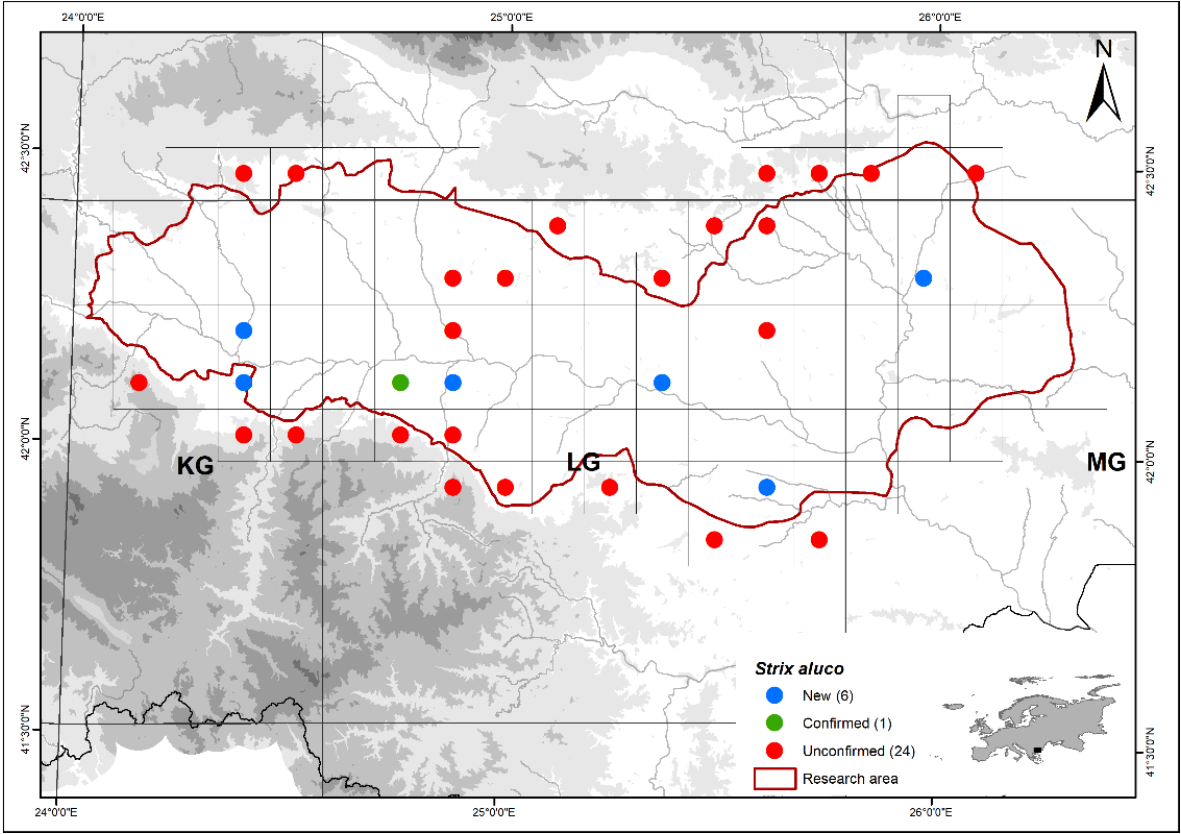


Fig. 6a. Breeding distribution of the Tawny owl (*Strix aluco*)

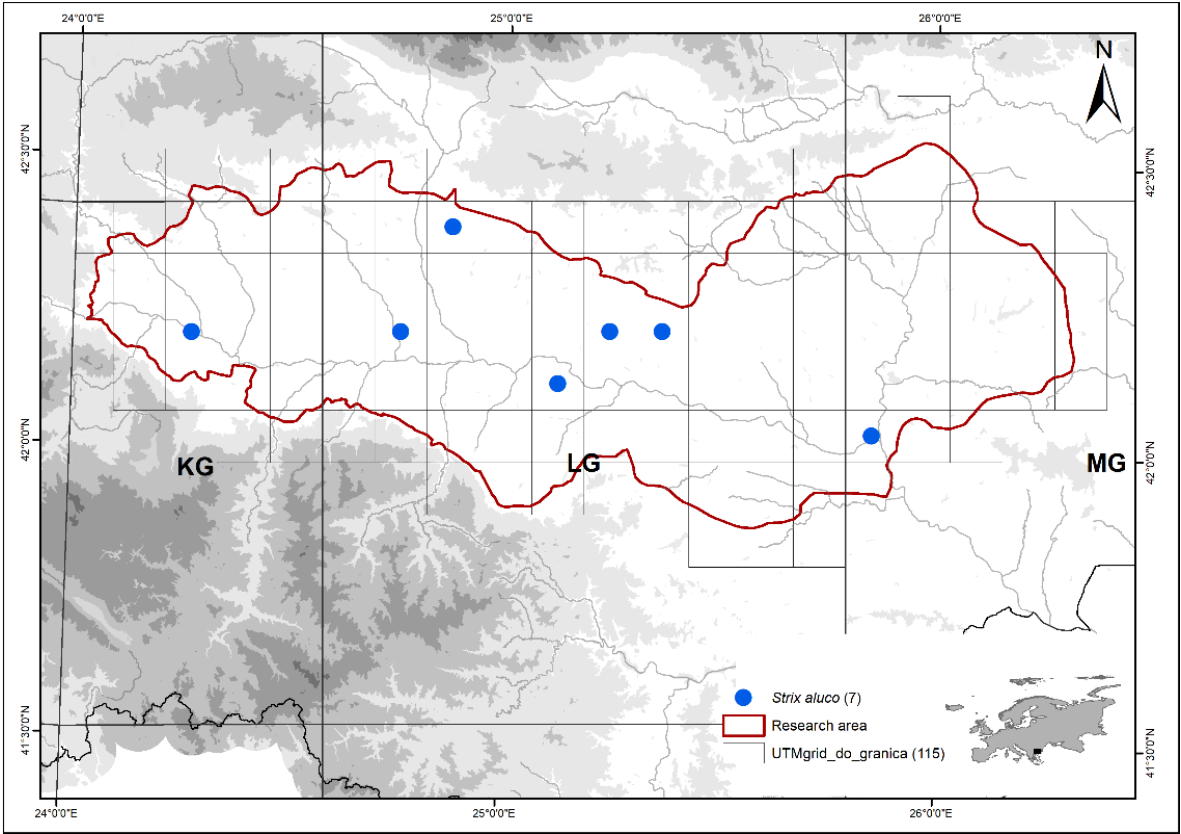


Fig. 6b. Non-breeding distribution of the Tawny owl (*Strix aluco*)

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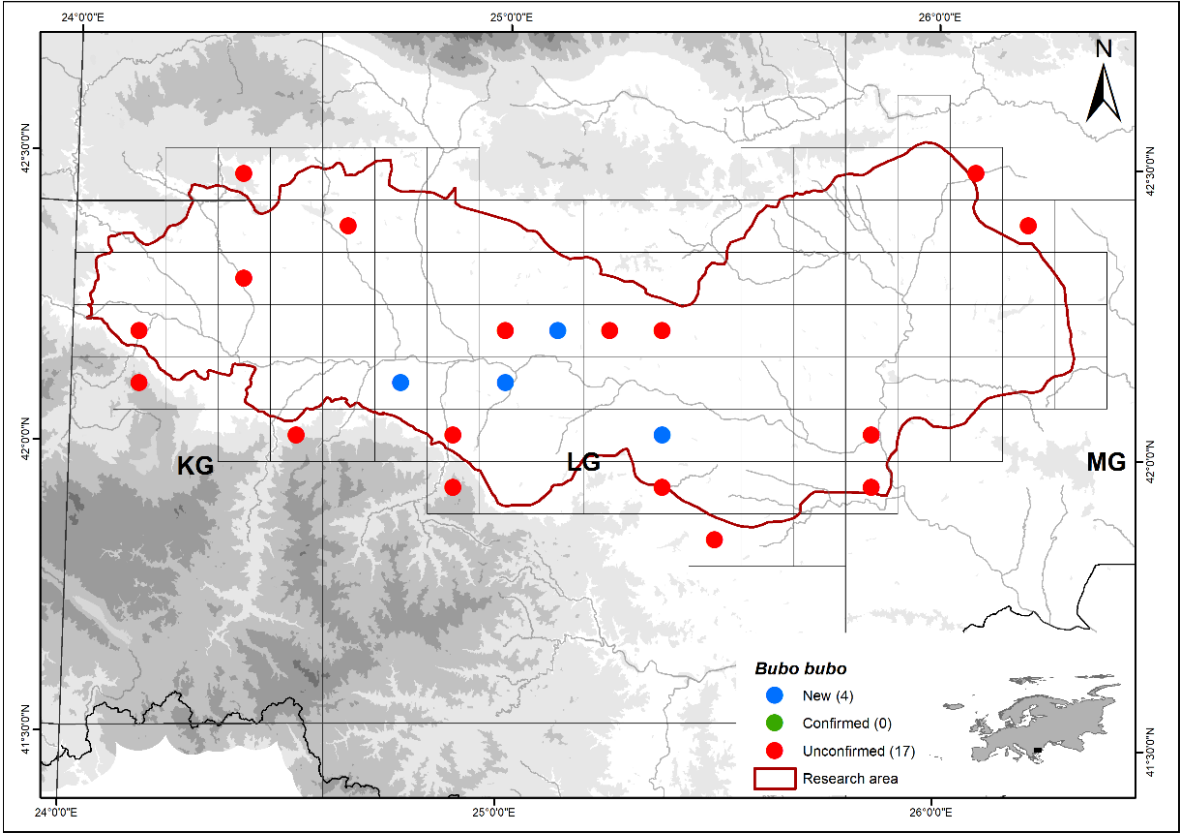


Fig. 7a. Breeding distribution of the Eagle owl (*Bubo bubo*)

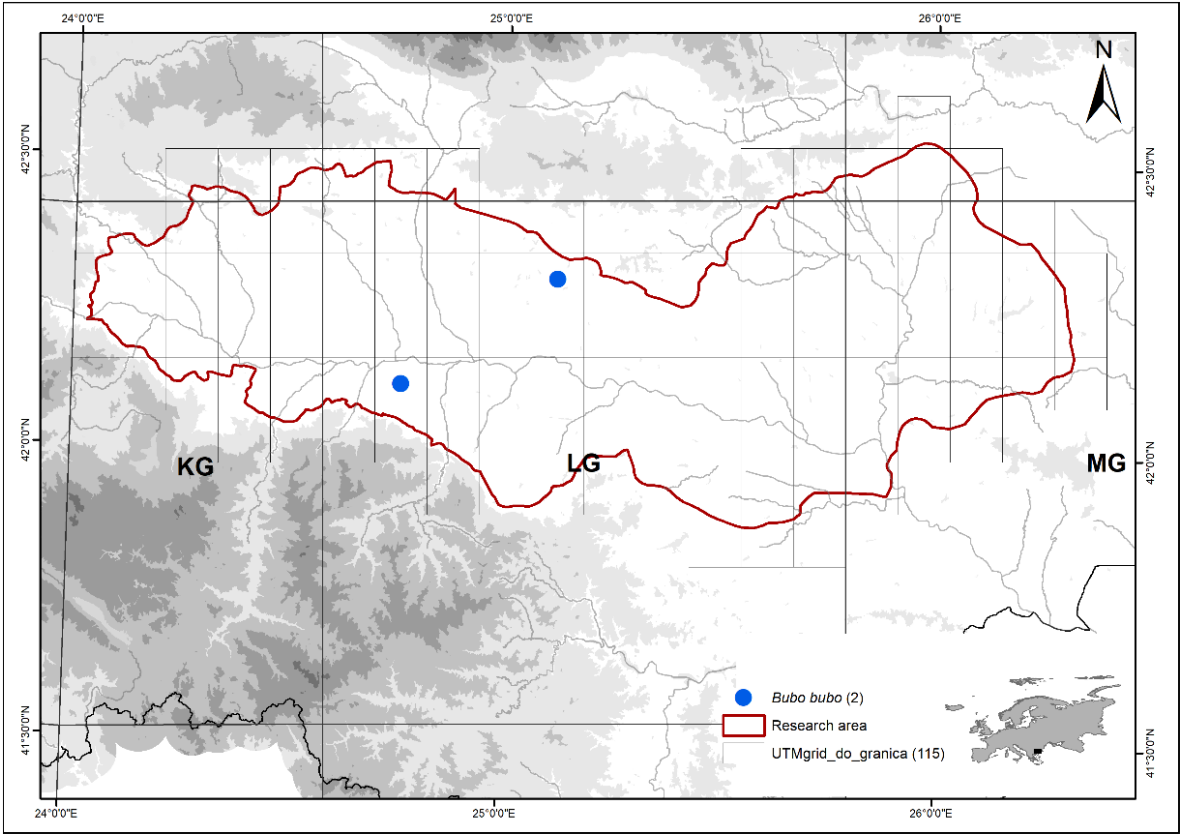


Fig. 7b. Non-breeding distribution of the Eagle owl (*Bubo bubo*)

Conclusions

The most widely distributed owl species in the study area and confirming the data from former assessment in the Atlas of breeding birds are the Little owl, the Eurasian Scops owl, the Long-eared owl and the Barn owl. All four species prefer agricultural systems and settlements where they find food and breed and it seems that their distribution hasn't changed since the last assessments, or it might have even improved. We found new localities for the Short-eared owl during the breeding season, complementing the existing data on breeding and underlining the area around Plovdiv as important breeding habitat for the species. The Eagle owl as expected is rare in the Upper Thracian lowland and it rarely occurs along the Maritsa river valley as none of the former records were confirmed. Nevertheless, historically the breeding distribution of this species was attributed to the foothills of the mountain ranges nearby. The Tawny owl is also rare in the Upper Thracian Lowland and mostly occurs in old preserved forest patches along the Maritsa river valley.

The current study can be further used to study distribution *and* abundance of the species and factors affecting them.

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