

Population density and distribution of the Eurasian Eagle-Owl (*Bubo bubo*) in the Republic of Mordovia (Middle Volga)

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Abstract We determined the population density and number of Eurasian Eagle-Owl in one of the regions of Russia (Republic of Mordovia). The work was carried out over sixteen years (2009–2024). The studies were conducted using methods of direction finding of vocalizing birds with subsequent search for nests and with the use of digital voice recorders. The Eurasian Eagle-Owl reliably lives in 16 out of 22 districts (72.7%). During our research, we built more than 60 artificial nests, in which Eurasian Eagle-Owls subsequently settled. In total, during the research period, 89 Eurasian Eagle-Owl habitats (of which 38 in four stationary sites), 125 nesting cases, and 214 chicks were identified. Over the entire period, the birds laid 282 eggs. Productivity for couples was 76%. The most successful years in terms of the number of eggs and chicks in nests were 2014, 2018, 2022, 2023. The density of the Eurasian Eagle-Owl population ranges from 3.1 to 5 pairs per 100 km². The total population density in the open spaces of the region can reach 583 habitats. The presence of a large number of ravines with stands determines the high population density of Eurasian Eagle-Owl in Mordovia. Making artificial nesting boxes in ravines improves the suitability of breeding sites and promotes better survival of young individuals.

Keywords: *Bubo bubo*, Strigidae, density, reproduction, forest-steppe area, Russia

Összefoglalás Oroszország egyik régiójában (Mordvin Köztársaság) meghatároztuk az uhu állománysűrűségét és számát. A munkát tizenhat éven keresztül végeztük (2009–2024). A vizsgálatokat a hangoskodó madarak irány-meghatározásának módszereivel, a fészkek későbbi felkutatásával és digitális hangrögzítők alkalmazásával végeztük. Az uhu a 22 körzetből 16-ban (72,7%) megbízhatóan él. Kutatásaink során több mint 60 mesterséges fészket építettünk, amelyekben az uhu később megtelepedett. Összesen a kutatási időszak alatt 89 uhu élőhelyet (ebből 38-at négy helyhez kötött helyszínen), 125 fészkelést és 214 fiókát azonosítottunk. A teljes időszak alatt a madarak 282 tojást költöttek. A párok termelékenysége 76%-os volt. A fészekben lévő tojások és fiókák számát tekintve a legsikeresebb évek a következők voltak: 2014, 2018, 2022, 2023. Az uhu populáció sűrűsége 3,1–5 pár/100 km² között mozog. A régió nyílt területein a teljes populáció sűrűsége elérheti az 583 élőhelyet. A nagyszámú, állományokkal rendelkező szurdok jelenléte határozza meg az uhu nagy populációs sűrűségét Mordvin-földön. A szurdokokban mesterséges fészkelőhelyek kialakítása javítja a költőhelyek alkalmasságát és elősegíti a fiatal egyedek jobb túlélését.

Kulcsszavak: *Bubo bubo*, Strigidae, sűrűség, szaporodás, erdő-sztyepp terület, Oroszország

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Introduction

The vulnerability of the Eurasian Eagle-Owl (*Bubo bubo*) and the influence of humans on it (poaching, disturbance during nesting period) in many European countries: Germany (Brauneis & Hormann 2005, Rockenbach 2005), Austria (Liditznig 2005), Spain (Delgado & Penteriani 2005) is of ongoing research interest. The current number of the species in Europe, including the European part of Russia, ranges from 20,130 to 28,952 pairs and represents a relative estimate of the size of the European population (Penteriani & Delgado 2019). Moreover, in the latest monograph on the Eurasian Eagle-Owl (hereafter, Eagle-Owl), the above estimate has some subjectivity, since, as its authors themselves admit, there is no reliable data on the number of Eagle-Owls in Russia and Central Asia. The range of the Eagle-Owl is estimated at 32 million km². Territory of Russia (without the Arctic regions), where the Eagle-Owl lives, accounts for more than one third of the entire range. Based on this, the ratio is 17,630–23,452 pairs for European countries (less than 1/5 of the range) and 2,500–5,500 pairs only for the European part of Russia looks very underestimated. In addition, the Eagle-Owl population status is currently unknown in 39% of the countries, where the species occurs (Penteriani & Delgado 2019). An increase in population size is observed in 30.2%, a decrease in 21%, and stabilization in 4% of the countries. The share of the declining Eagle-Owl population in Europe is lower than in the late 1990s (Hagemeijer & Blair 1997). Colleagues report positive trends in the increase in the number of Eagle-Owls in Germany, France and Spain. At the same time, it is reported that in the European part of Russia and the northernmost countries of Scandinavia (Norway, Finland) the number of Eagle-Owls is decreasing. Difficulties in objectively assessing the number of Eagle-Owls in Russia by ornithologists can be explained by the small number of publications on vast territory of Russia. Indeed, despite the significance and priority of studying the ecology and biology of the Eagle-Owl, there are very few works devoted to its study in Russia. As a rule, the authors only indicate individual cases of records of the Eagle-Owl in certain regions (Pukinsky 1993, Karyakin 1998). Unfortunately, in Russia there has still been no targeted work to identify the number and population density of the species by area of individual plots, as was done in other countries (Penteriani & Delgado 2019). There are few Russian ornithologists, who specifically study the Eagle-Owl, and detailed data on individual regions is of great importance. According to molecular genetic data, 13–14 subspecies are distinguished (Wink *et al.* 2009). More data were known for the subspecies *B. b. ruthenus* (1,271 to 1,505 pairs) and *B. b. interpositus* (from 241 to 376 pairs) (Penteriani & Delgado 2019). The largest number of Eagle-Owl subspecies have been recorded exactly in Russia (*B. b. bubo* L., 1758; *B. b. ruthenus* Zhitzkov and Buturlin, 1906; *B. b. interpositus* Rothschild and Hartert, 1910; *B. b. sibiricus* Gloger, 1833; *B. b. yenisseeensis* Buturlin, 1915). Therefore, research of the Eagle-Owl in different regions of Russia should be conducted to assess the total number in the country. In most regions, abundance estimates are based on extrapolation and are relatively subjective, which indicates insufficient knowledge of local populations of the species.

A lot of work has been devoted to studying the dependence of population density and productivity of the Eagle-Owl on various factors, including diet (Brambilla & Bionda 2013, Andreychev *et al.* 2016, Harms 2017, León-Ortega *et al.* 2017, Milchev & Spassov 2017,

Milchev & Georgiev 2020, Obuch 2021, Pearson & Husby 2021, Tobajas *et al.* 2021, Hadad *et al.* 2022, Husby & Pearson 2022), however, it is not always possible to establish the main reason for the higher numbers in some territories or lower numbers in others. Therefore, it is important to identify the population density of the Eagle-Owl in individual areas in different parts of the range. Each study aimed at this deserves attention for a comprehensive assessment of the state of the species.

Along with the great influence of the availability of food, the success of Eagle-Owl breeding is also affected by the presence of nesting sites that can be improved artificially. It is widely known that for the Eagle-Owl, artificial nests, caves, and cornices on rocks and cliffs of ravines are arranged, or natural nest sites are cleared and improved (Olsson 1979, Gorner 1983). However, until now, not enough attention has been paid to comparing the success of Eagle-Owl reproduction in natural and artificial nests. It is especially important whether this affects the population density.

The aim of our research is to determine the population density and number of Eagle-Owls in one of the regions of central Russia. Targeted work to achieve this goal has begun in 2009 and is ongoing. In total, observations covered most districts of the region. A separate task was to compare the success of reproduction in natural and artificial nests. One of the important objectives of the study was to assess possible positive and negative factors influencing population density and reproduction of Eagle-Owl in the region.

Material and Methods

Study site

The studies were carried out from 2009 to 2024 in the Republic of Mordovia. The region is located in the center of the East European Plain (53°38' – 55°11'N and 42°11' – 46°45'E). The length from west to east is 298 and from north to south is from 57 to 140 km. The area of Mordovia is 26,200 km², which is comparable to the territories of individual European countries (Belgium, Slovenia, Macedonia, Albania). Most of Mordovia is located in the northwestern part of the layered Volga Upland, which in the west turns into the layered Oka-Don lowland. This geographical location of the region causes a decrease in the activity of erosion-denudation processes from the southeast to the northwest. The republic is located in the interfluvium of rivers Moksha and Sura (the right tributary of the Volga), on the southwestern periphery of the Volga. The study area is characterized by a temperate climate. The average annual temperature is about 15 °C, the average annual precipitation is from 700 to 800 mm. The warmest months are July and August (average temperature 24–26 °C), the coldest months are January and February (average temperature 7–9 °C). Mordovia is located on the border of broad-leaved, mixed and forest-steppe zones. Most of Mordovia is occupied by the forest-steppe zone. Natural vegetation is dominated by oak forests and meadow steppes. Three stationary sites in the southeastern and central parts of the region were selected as the main ones. The southeastern and southern part of Mordovia is occupied by an erosion-denudation plain, characterized by high erosional dissection. As a result of

erosion, linearly elongated relief forms – ravines and gullies – were formed. The ravines often have a V-shape with slope heights of up to 40 m. The watershed areas of this plain in the territory of Mordovia can reach significant heights above sea level (from 280 to 320 m), the depth of the erosion incision is from 100 to 120 m. The density of linear erosion forms on in some areas exceeds 1 km/km².

The main studies took place at four stationary sites: Prisursky, Kochkurovsky, Chamzinsky, and Kovylninsky (Figure 1). Prisursky stationary site is located in the southeastern part of the region. Its area is 900 km². The territory of the stationary site is limited to the north by the highway from the village of Chamzinka (54°23.553 N, 45°47.858 E) through the villages Kochkurovo, Dubenki, and Morga to the border of Mordovia with the Ulyanovsk oblast (54°25.035 N, 45°31.477 E). The border from the southeast runs along the edge of the Prisursky forest (54°25.035 N, 45°31.477 E) to Bol'shie Berezniki (54°11.289 N, 45°59.468 E). The border from the west runs along the road from the village of Bol'shiye Berezniki through the villages Mariupol, Elizavetinka, Petrovka, Penkozavod, Picheury, Ivanova Polyana to Chamzinka. The stationary site is a complex of field-type agricultural land with a small amount of island forests.



Figure 1. Map of the Republic of Mordovia with habitats (red circle) of Eagle-Owl at four stationary sites (A – Prisursky, B – Kochkurovsky, C – Chamzinsky, D – Kovylninsky)

1. ábra A Mordvin Köztársaság térképe az uhu élőhelyeivel (piros kör) négy állandó helyen (A – Prisursky, B – Kochkurovsky, C – Chamzinsky, D – Kovylninsky)

Kochkurovsky stationary site is located in the southern part of the region. The area of the hospital is 450 km². The territory of the stationary site is limited from the north by a straight horizontal line running from the village of Yalga (54°06.456 N, 45°09.089 E) through the village Goryainovka to the village Podlesnaya Tavla (54°06.401 N, 45°27.408 E), from the east – a straight line running from the Podlesnaya Tavla through the villages Kochkurovo, Novaya Pyrma, Staraya Pyrma, Starye Turdaki to the border of Mordovia with the Penza oblast, from the south – along the border of Mordovia, from the west – a vertical line passing from the border of Mordovia (Ovechkin forest) (53°57.853 N, 45°09.013 E) to village of Yalga (54°06.456 N, 45°09.089 E). The stationary site is a complex of agricultural land alternating with shallow ravines and gullies.

Chamzinsky stationary site is located in the central part of the region. The area of the hospital is 100 km². The territory of the stationary site is limited from the north by a straight horizontal line running from the village Kurilovo (54°27.113 N, 45°29.899 E) to the village Kochkushi (54°27.104 N, 45°39.159 E), from the east – a straight vertical line passing from the Kochkushi through the villages Otradnoye, Syryatino, Bolshoye Maresevo (54°21.727 N, 45°39.142 E), from the south – a straight vertical line running from the Bolshoye Maresevo to the Pyatina (54°21.732 N, 45°29.908 E), from the west – along a vertical line running from the Pyatina to the Kurilovo. The stationary site is a complex of predominantly open slopes and gullies on the right bank of the Amorda River.

Kovylkinsky stationary site is located in the western part of the region. The area of the hospital is 200 km². The territory of the stationary site is limited from the north by a straight horizontal line running from the village Matveevka (54°16.005 N, 45°34.981 E) through the villages Staraya Potma, Zaitsevo, Vorona (54°16.008 N, 45°43.994 E), from the east – a straight vertical line passing from the Vorona through the villages Malyj Azyas, Izosimovka, Potma (54°05.012 N, 43°44.007 E), from the south – along a straight horizontal line passing from the Potma through the Ezhovka to the Pokrovsk (54°05.009 N, 43°34.998 E), from the west – a vertical line running from the Pokrovsk through the Mikhailovskoe to the Matveevka. The stationary site is a complex of agricultural land with a small number of forested ravines.

Stationary sites included the territories of several municipal districts (Bolshebereznikovsky, Dubensky, Chamzinsky, Kochkurovsky, Ruzaevsky, Romodanovsky, Kovylkinsky and suburbs of the city of Saransk). In addition to stationary sites, research was carried out in the territories of other districts of the northwestern, central and eastern parts of Mordovia (Temnikovsky, Krasnoslobodsky, Insarsky, Kadoshkinsky, Ardatovsky, Ichalkovsky, Atyashevsky, Lyambirsky), where separate habitats of Eagle-Owls were found. Thus, in Mordovia the Eagle-Owl reliably lives in 16 out of 22 districts (72.7%).

Artificial nests sites in the amount of 60 were arranged in Bolshebereznikovsky, Chamzinsky, Dubensky, Kochkurovsky, Ardatovsky districts. The analysis was conducted from them on 17 nests in which reproduction was detected. Artificial nests with a roof, and with a roof and walls were used by the Eagle-Owl equally. Artificial nests dug in the ground were used to a lesser extent.

Data collection

Initially, the identification of Eagle-Owl habitats was carried out by direction finding of vocalizing birds, followed by a search for nests. Then the method was applied using portable digital voice recorders Olympus VN-416PC, VN-406PC, VN-712PC (Andreychev *et al.* 2017, Lapshin *et al.* 2018). The detection radius of Eagle-Owl calls in open areas was 1–3 km, depending on the wind direction. More than 10,000 h of audio recordings were processed each year. Most of them were made during the spring-summer period (more than 7,000 h/year). The Eagle-Owl nests found on the ground were marked with dots when using a GPS navigator.

To increase the population density of Eagle-Owls, we carried out biotechnical measures in suitable areas. We arranged more than 60 artificial nests, which were subsequently occupied by Eagle-Owls (Lapshin *et al.* 2022, 2023). We studied the productivity of the Eagle-Owl in natural nest sites (1) and three types of artificial nest sites: with a roof (2), with a roof and walls (3), dug in the ground without a roof and walls (4). Since the last three types of artificial nest sites had similar significance for birds, the analysis of the results is given for a combined sample of them.

Population productivity

The productivity of Eagle-Owl pairs was assessed by the generally accepted method as the definition is number of fledgling/all breeding attempts (including failed ones). We also determined the ratio of the number of nesting events, max number of eggs/chicks per pair/year, mean number of chicks per successful pair, number of chicks for all years. Nesting event was taken as a reproduction resulting in the laying of at least one egg. Breeding is considered successful, if at least one young fledged.

Data analysis

The distance between the nearest nests, between the Eagle-Owl nest and the nearest settlement, automobile field dirt roads, paved roads, an agricultural land was set using the OziExplorer software. The calculation of the population density of Eagle-Owl on the area was carried out using the observed distance to the nearest neighbor (a statistical method used in GIS, Sergio *et al.* 2004). Data analysis was performed using MS Excel (Microsoft Corporation, Redmond, Washington, DA, USA). For proportions, 95% confidence interval (CI) was calculated using Quantitative Parasitology software, Qpweb version 1.0.15 (<https://www2.univet.hu/qpweb/qp10/index.php>).

Results

Results of studying the Eagle-Owl population for individual periods

In the study of the number and distribution of Eagle-Owl from the territory belonging to Mordovia, several periods can be distinguished:

I. period – end of the 19th century – information was given that the Eagle-Owl was a common species in the coniferous and mixed forests of the eastern part of the region. Eagle Owl calls were often recorded in the river valley Alatyr. Zhitkov and Buturlin (1906) reported that the Eagle-Owls were numerous in the southwestern corner of Ardatovsky district, in deciduous dachas near the villages of Syryatino and Maresevo (currently Chamzinsky district), where they nested in remote forest ravines. In the deciduous forests of the steppe north of the Alatyr valley, the Eagle-Owl was found much less frequently, and was not found at all in the steppe ravines and gullies. The Eagle-Owl was a common species in the forests of the river valley Sura. However, the number of breeding pairs was not known, the approximate number was not estimated, and the nests were not described.

II. period – 20th century. Until the 1960s, the number of Eagle-Owls in Mordovia was relatively high. By the middle of the second half of the 20th century, the Eagle-Owl has become rare in the republic, which was facilitated by several factors: direct persecution by humans and a reduction in the number of hare (Lugovoy 1975). The Eagle-Owl was a common species on the territory of the Mordovian Nature Reserve, where the bird mostly stayed in coniferous areas, especially where spruce grows (Ptushenko 1938). At that time, there was no data on the discovery of Eagle-Owl nests in Mordovia (Lugovoy 1975). The only nest was discovered on July 18, 1982, in the area of the village. Redkodubye (Ardatovsky district). It was located on the edge of a pine forest in a bend of the river Alatyr. There were three well-feathered chicks in the nest (Lysenkov 1994). In the 1990s, the Eagle-Owl population started to recover.

III. period – beginning of the 21st century (2000–2014). By 2005, it was known from game managers, foresters and the local inhabitants about 25 Eagle-Owl territories in the regions of Mordovia. As our subsequent surveys using voice recorders in these areas showed, Eagle-Owls were not present in all reported areas. The reason for this was that many people confused the Eagle-Owl with the Long-eared Owl (*Asio otus*), Ural Owl (*Strix uralensis*) and other owl species. However, breeding territories were already known in the vicinity of the villages Redkodubye and Lunga in the Ardatovsky district, village Nikolaevka in the Dubensky district and village Papulevo in the Ichalkovsky district (Barakhmanovskoye forestry in the Smolny National Park). New nests were discovered in the vicinity of the villages of Simkino and Engalychevo. In subsequent years, dead individuals were found, or mating calls were heard, therefore, we suppose that new territories were established in the vicinity of the villages of Supodeevka, Krasnaya Polyana, Ekonomicheskije Polyanki, and Sarast. Thus, using classical methods of counting owls until 2014, six nests and four territories of Eagle-Owls were known. These territories were subsequently subject to annual observations to study the biology and ecology of Eagle-Owls.

IV. period – first quarter of the 21st century (2015–2024). Detection of Eagle-Owl territories in Mordovia using digital portable voice recorders began in 2015 (Andreychev *et al.* 2017,

Lapshin *et al.* 2018) and by 2024, nine times more habitats were identified in the region with this method than with previously used traditional methods. By using the acoustic method, it was possible to identify the distribution and population density of the Eagle-Owl more effectively.

Results of studying the Eagle-Owl population using acoustic method

During the research period (2015–2024), 640 expeditions were carried out, 920 sound recordings were obtained and processed, with a total length of more than 84,500 hours. In total, during the research period, 89 Eagle-Owl territories, 125 nesting events, and 214 chicks were identified. Over the entire period, the birds laid 282 eggs. The most successful years in terms of the number of eggs and chicks in nests were 2014, 2018, 2022, and 2023 (*Figure 2*).

Three types of biotopes were identified, in which Eagle Owls in Mordovia live: 1) ravine-gully complexes, 2) slopes of river terraces, 3) abandoned quarries. In most cases, Eagle-Owls prefer to inhabit ravine-gully complexes (*Figure 3*), and, to a lesser extent, the slopes of river terraces and undeveloped quarries. Most of the nests were located in the spurs of the upper part of ravines, which have steeper slopes. In almost all cases, the Eagle-Owl chose the upper part of the slopes for nesting; less often, its nests were found in the middle part. The steepness of the slopes of the ravines on which the nests were located varied from 35 to 80°. The nests themselves were located on the steeper part of slopes, which were about 70–80° steep. Of the atypical ones, noteworthy is the nest located in the vicinity of the village Starye Naimany (Bolshebereznykovsky district), which was located on a flat surface 20 m from the edge of the ravine. Many nests were found in ravines overgrown with woody

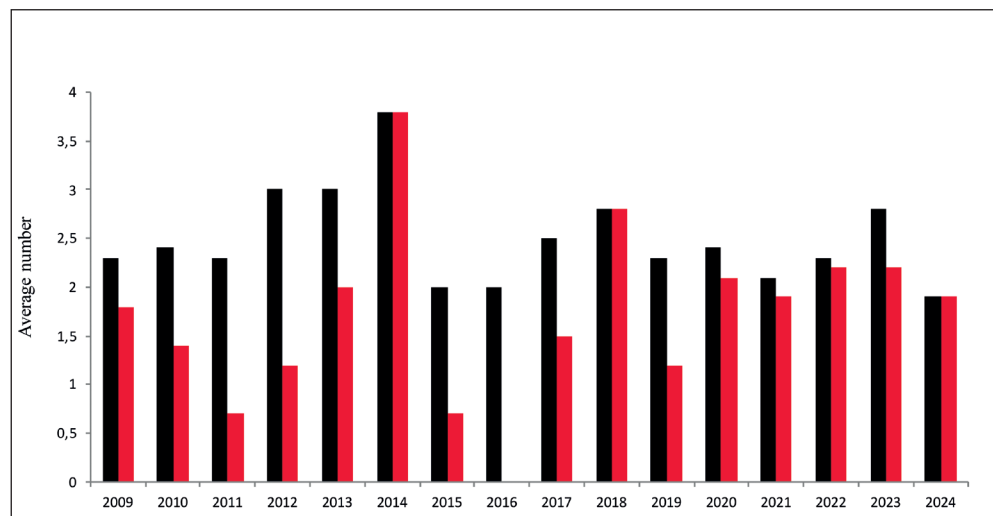


Figure 2. Average number of eggs (black bar) and fledglings (red bar) of the Eagle-Owl in Mordovia in different years (2009–2024)

2. ábra Az uhu tojásainak (fekete) és fiókáinak (piros) átlagos száma a különböző években Mordvinföldön (2009–2024)



A. Typical habitat of an Eagle-Owl in the vicinity of the village of Tazino

A. Az uhu tipikus élőhelye Tazino község környékén



B. Female at a nest in the vicinity of the village of Makolovo

B. Egy tojó a Makolovo falu közelében lévő fészkenél



C. Natural nest in the vicinity of the village of Bulgakovo

C. Természetes fészkek Bulgakovo falu közelében



D. Artificial nest box in the vicinity of the village of Cheberchino

D. Mesterséges fészkek (költőláda) Cheberchino falu közelében

Figure 3. Habitats and nests of the Eagle-Owl in Mordovia

3. ábra Az uhu élőhelyei és fészkei Mordvinföldön

vegetation. The ravines were surrounded by pine or birch plantings. In a single case, a nest was located in open ravine. In most cases, Eagle-Owls tried to settle on slopes with a southern exposure, and only in one with a northern exposure.

In the Prisursky stationary area, 38 Eagle-Owl territories were identified, in Kochkurovsky – 14, in Chamzinsky – 5, in Kovylkinsky – 7. Outside the stationary areas, habitats were noted in 25 cases, most of them were located in the Ichalkovsky, Ardatovsky and Atyashevsky districts. Productivity for couples was 76%. In 51% of nesting events, pairs laid three eggs, compared to two eggs in 43% or four eggs or one egg each in 3%. The average clutch size was 2.54 ± 0.08 ($\mu \pm \text{SE}$; $n = 125$) eggs. Over the years, the study pairs in Mordovia raised one (13.6%), two (36.4%), or three chicks (50%). The number of chicks per successful nest averaged 2.36 ± 0.11 . The mortality rate in nests was lower in artificial nesting sites (30%) ($n = 17$) than in natural ones (40.6%) ($n = 21$). The average nesting success on artificial and natural nesting sites in different periods of research in Mordovia was comparable (*Figure 4*).

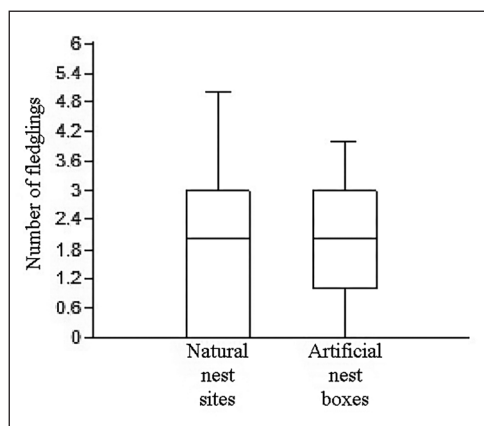


Figure 4. Number of fledglings the Eagle-Owl from natural and artificial nesting sites in Mordovia for the period of 2009–2024. Note: 'strip on box' is the median, the boundaries of the box are 25–75% quantiles, whiskers – minimum and maximum values

4. ábra Mordvinföld természetes és mesterséges fészkelőhelyeiről származó fiókák száma a 2009–2024-es időszakban

Forty-one breeding pairs were identified. At the Prisursky stationary site, 19 breeding pairs were registered, at Kochkurovsky – 9, at Chamzinsky – 3, at Kovylkinsky – 1 (Table 1).

The Eagle-Owl population density at the Prisursky station ranges from 4.3 pairs per 100 km² (1 pair/23.1 km²). The distance between neighboring nesting sites ranges from 1.2 to 9.2 km, the average is 3.2 km. The Eagle-Owl population density at the Kochkurovsky station is 3.1 pairs/100 km² (1 pair/32.1 km²). The distance between neighboring nesting sites ranges from 1.8 to 3.2 km, the average is 2.6 km. The Eagle-Owl population density at the Kovylkinsky station is 3.5 pairs/100 km² (1 pair/28.6 km²). The Eagle-Owl population density at the Chamzinsky station is 5 pairs / 100 km² (1 pair/20 km²). The distance between neighboring nesting sites ranges from 1.3 to 4.8 km, the average is 2.7 km.

Based on the degree of cover, nests were well, partially and completely covered. The degree of cover of the nest was determined by the distance from which the nest could be seen during the nesting period. Three nests had good cover, which could only be seen from several meters. Five nests had partial cover, visible from one side from 10–20 m. Most of the nests were built openly, were not covered by trees and shrubs and were clearly visible from the opposite side of the ravine, in some cases from more than 100 m.

In Mordovia, Eagle-Owl nests were located in relative proximity to populated areas. The average distance from nests to settlements was 1,550 m. The greatest distance from a nest to a settlement was 3,700 m (Engalychevo). The nests closest to populated areas were located in the vicinity of the villages of Veyse and Yanguzhinskiy Maydan (400 m).

The average distance from nests to automobile field dirt roads was 436 m. The shortest distance between a nest in the vicinity of Griboedovo and the road was 40 m. The greatest distance between a nest in the vicinity of Yanguzhinskiy Maydan and the road was 1,370 m. There were no nests located within 1 km of paved roads.

Eagle-Owl nests were located near cultivated agricultural lands. The average distance from the nest to the field was 627 m. The greatest distances from nests to agricultural land were 3 nests located in the north-eastern part of Mordovia, on the slope of the Alatyr River valley – the average distance was 1,936 m. The shortest distance from nests to fields was in the vicinity of villages Novye Turdaki (48 m), Nikolaevka (50 m), Kaybichevo (71 m), Tazino (73 m), Sosnovyj Gart (100 m).

Table 1. Breeding parameters of an Eagle-Owl population in Mordovia monitored from 2009 to 2024
 1. táblázat A mordvinföldi uhu populáció költési paraméterei 2009 és 2024 között

Nº	Nearest town	Year of first record of the territory	Number of nesting events	Number of successful nesting	Breeding success (%) as of successful / all nesting attempts	Total number of young	Mean number of young / successful pairs	Mean productivity (young / all breeding attempts)
Prisursky stationary site								
1	Simkino	2005	7	5	67	8	1.6	1.1
2	Tazino	2015	9	7	76	16	2.3	1.8
3	Chernaya Promza (north)	2015	1	0	0	0	0	0
4	Veyse	2016	3	3	100	6	2	2
5	Sosnovyj Gart	2015	3	3	100	8	2.7	2.7
6	Starye Najmany (west)	2017	3	3	100	6	2	2
7	Bol'shie Berezniki	2016	2	1	50	3	3	1.5
8	Parakino	2016	2	2	100	4	2	2
9	Starye Najmany (east)	2016	0	0	0	0	0	0
10	Chernaya Promza (west)	2016	0	0	0	0	0	0
11	Shugurovo (north)	2016	0	0	0	0	0	0
12	Chernaya Promza (north-east)	2016	0	0	0	0	0	0
13	Chernaya Promza (south)	2017	0	0	0	0	0	0
14	Starye Najmany (south-west)	2016	0	0	0	0	0	0
15	Kosogory	2016	0	0	0	0	0	0
16	Engalychevo (east)	2010	5	3	60	12	4	2.4
17	Nikolaevka (north-east) – ravine Mishin	2010	9	5	55.56	16	3.2	1.8
18	Kaybichevo (north-east)	2016	4	3	75	5	1.3	1.3
19	Engalychevo (north)	2016	3	1	33.34	2	1	0.7
20	Krasnoe Pol'co	2017	2	0	0	0	0	0
21	Cheberchino (north-east)	2016	6	6	100	14	2.3	2.3
22	Nikolaevka (near the village)	2017	4	4	100	9	2.3	2.3
23	Nikolaevka (north) – ravine Gorodok	2018	1	1	100	3	3	3
24	Purkaevo (north-west) – ravine Markov	2016	1	1	100	2	2	2
25	Yavlejka	2018	1	0	0	0	0	0
26	Krasino	2016	0	0	0	0	0	0
27	Morga	2016	0	0	0	0	0	0
28	Kaybichevo (north) – Urochishche Babrenkin	2016	0	0	0	0	0	0
29	Kaybichevo (east)	2015	0	0	0	0	0	0

№	Nearest town	Year of first record of the territory	Number of nesting events	Number of successful nesting	Breeding success (%) as of successful / all nesting attempts	Total number of young	Mean number of young / successful pairs	Mean productivity (young / all breeding attempts)
30	Engalychevo (south)	2016	0	0	0	0	0	0
31	Purkaevo (south-west) – ravine Ramzinskij	2017	0	0	0	0	0	0
32	Purkaevo (north) – river Ashnya	2017	1	0	0	0	0	0
33	Nikolaevka (north-west) – ravine Izvestnyj	2018	0	0	0	0	0	0
34	Machkazerovo (east)	2016	0	0	0	0	0	0
35	Picheury	2018	0	0	0	0	0	0
36	Ivanova Polyana	2016	0	0	0	0	0	0
37	Machkazerovo (west)	2017	0	0	0	0	0	0
38	Medaevo	2024	0	0	0	0	0	0
Kochkurovsky stationary site								
39	Bulgakovo (west)	2017	6	6	100	12	2	2
40	Novye Turdaki (east)	2017	2	2	100	4	2	2
41	Novye Turdaki (west)	2017	1	1	100	2	2	2
42	Bulgakovo (east)	2020	2	2	100	6	3	3
43	Vnukovka	2020	1	1	100	3	3	3
44	Semilej	2021	0	0	0	0	0	0
45	Novotyaglovka	2021	0	0	0	0	0	0
46	Karnaj	2021	0	0	0	0	0	0
47	Starye Turdaki (west) – ravine Zhivyarki	2021	0	0	0	0	0	0
48	Starye Turdaki (south)	2022	0	0	0	0	0	0
49	Monastyrscoe	2018	4	4	100	10	2.5	2.5
50	Kulikovka	2017	1	1	100	2	2	2
51	Griboedovo	2019	2	1	50	2	2	1
52	Akshenas	2021	1	1	100	2	2	1
Chamzinsky stationary site								
53	Makolovo	2017	4	3	75	5	1.7	1.3
54	Bol'shie Remezenki	2020	1	1	100	2	2	2
55	Kul'mino	2020	1	1	100	2	2	1
56	Ogaryovka	2020	0	0	0	0	0	0
57	Bol'shoe Chufarovo	2020	0	0	0	0	0	0
Kovylninsky stationary site								
58	Ezhovka	2017	4	4	100	8	2	2

№	Nearest town	Year of first record of the territory	Number of nesting events	Number of successful nesting	Breeding success (%) as of successful / all nesting attempts	Total number of young	Mean number of young / successful pairs	Mean productivity (young / all breeding attempts)
59	Izosimovka	2018	0	0	0	0	0	0
60	Staraya Samaevka	2018	0	0	0	0	0	0
61	Sejtyanovka	2018	0	0	0	0	0	0
62	Novaya Sazonovka	2018	0	0	0	0	0	0
63	Vysokoe	2018	0	0	0	0	0	0
64	Staraya Derganovka	2018	0	0	0	0	0	0
Habitat areas outside stationary sites								
65	Gart	2017	0	0	0	0	0	0
66	Krasnyj Poselok	2012	0	0	0	0	0	0
67	Tarhanovo	2017	2	2	100	4	2	2
68	Vedyancy	2020	1	1	100	2	2	1
69	Petrovka	2020	1	0	0	0	0	0
70	Bol'shaya Pestrovka	2020	3	3	100	5	1.7	1.7
71	Permeevo	2020	0	0	0	0	0	0
72	Lada	2020	0	0	0	0	0	0
73	Barahmanovskoe lesnichestvo	2002	7	2	28.57	5	2.5	0.7
74	Redkodubye	1982	5	5	100	8	1.6	1.6
75	Lun'ga	2005	6	5	83.34	11	2.2	1.8
76	Supodeevka	2008	0	0	0	0	0	0
77	Krasnaya Polyana	2008	0	0	0	0	0	0
78	Oktyabr'skij	2010	0	0	0	0	0	0
79	Yanguzhinskiy Maydan	2016	2	1	50	3	3	1.5
80	Payovo	2015	0	0	0	0	0	0
81	Ekonomicheskie Polyanki	2006	0	0	0	0	0	0
82	Dyurki	2015	0	0	0	0	0	0
83	Alovo	2013	0	0	0	0	0	0
84	Chukaly na Vezhne	2021	1	1	100	2	2	2
85	Sarast	2009	0	0	0	0	0	0
86	Staryj Gorod	2015	0	0	0	0	0	0
87	Srednee Pole	2015	0	0	0	0	0	0
88	Novye Verhissy	2015	0	0	0	0	0	0
89	Novaya Uda	2024	0	0	0	0	0	0
	Total	1982–2024	125	97	77.6	214	2.2	1.8

Discussion

The average number of nestlings of Eagle-Owl in Mordovia slightly less than in southeast Spain (2.84 ± 1.17 , Pérez-García *et al.* 2012) and in Israel (2.67 ± 0.13 , Hadad *et al.* 2022), but more than in France (1.69 ± 0.76 , Penteriani *et al.* 2004) and in Belarus (2, Gritschik & Tishechkin 2002). In this regard, it should be recognized that the quantitative characteristics of Eagle-Owl reproduction are quite stable across regions.

High rate of association of Eagle-Owl with ravines in Mordovia is explained by their high density of ravines – more than 1 km of ravines per 1 km² in the study area and the relatively large number of nesting sites in them. Such selectivity when choosing a place to occupy nest site a nest may be due to the inaccessibility of Eagle-Owl nests to humans and the presence of forest cover in ravines. The presence of a large number of ravines with stands determines the high population density of Eagle-Owl in Mordovia. The influence of local conditions on the population density of Eagle-Owl has been shown for other regions as well. In southeast Spain, a high-density population of the Eagle-Owl in Alicante (100–120 pairs, approximately 2.03 pairs/100 km², Martínez & Zuberogoitia 2003) and Murcia (182–220 pairs, approximately 1.78 pairs/100 km², Sánchez-Zapata *et al.* 1995) has been reported. Somewhat later, an even higher population density (22.01 territories/100 km²) was revealed for the southeast of Spain across 99 different Eagle-Owl territories (Pérez-García *et al.* 2012).

Given the population density of the Eagle-Owl on stationary sites in Mordovia, it can be determined that one pair account for from 20 to 32.1 km² of territory. These results are consistent with those obtained by researchers using different methods in other parts of the range. Based on the satellite-tracking data in Hungary, the habitat of one Eagle-Owl can cover an area of about 18 km² (Prommer *et al.* 2018). According to other researchers in the Caucasian Mineral Waters region in the Stavropol oblast (Russia), the habitats in some cases can be 60–80 km² (Ilyukh 2017).

The high density of the Eagle-Owl population in Mordovia in stationary sites can be explained by the fact that previously artificial nest sites were established here in suitable areas. We know that the dispersal distance of juveniles is usually between 4 and 8 km from the natal site, although some data suggest that it may be much greater (13 to 72 km) (Nygård *et al.* 2023). A study of Eagle-Owls radio-tagged in the Sierra Morena, 20 km north of Seville, Spain, showed that young Eagle-Owls remained in their parents' range until the end of August, and then dispersed over distances ranging from 1.6 to 34.9 km (average 9.1 km) (Delgado & Penteriani 2005). Therefore, we believe that the presence of conditions for nesting in the nearest ravines determines a shorter distance for the settlement of young individuals and, accordingly, the optimal population density at stationary sites.

Considering that on a total area of four stations of 1,650 km², 64 habitats of the Eagle-Owl were registered, by extrapolating this number, up to 1,032 habitats can be located on the entire area of Mordovia of 26,200 km². However, we understand that this number is not achievable, since when choosing stations for surveys, we were guided by optimal conditions for the Eagle-Owl. The Eagle-Owl population density in habitats outside of stationary sites is somewhat lower. In addition, we identified most of the Eagle-Owl's habitats in open spaces that surround populated areas, agricultural lands, or on the edges of forests. The

Eagle-Owl settles in the forests of Mordovia much less frequently than in open landscapes. Taking into account the fact that the area of open spaces in Mordovia is 18,800 km², and research was carried out on an area of open spaces of 4,000 km² (89 sites were identified), the possible population density in the open spaces of the region can reach 583 habitat sites.

We can conclude that by analyzing literature sources on other regions of Russia, the population density of the Eagle-Owl in Mordovia is one of the highest of the surveyed populations. In particular, in Kalmykia, 36 habitats of the Eagle-Owl are known (the possible number in the region could be 293 pairs), which corresponds to 1.29 pairs/100 km² (Abushin 2021). The total number of Eagle-Owls in the Stavropol oblast is estimated at 150–180 breeding pairs (Fedosov 2019), in the Rostov oblast up to 200–300 pairs (Belik 2014) in the Volgograd oblast

Table 2. Population estimates (number of pairs) of Eagle-Owls in different countries

2. táblázat Az uhupopulációk becslése (párok száma) a különböző országokban

Country	Area, km ²	Number of pairs	References
Macedonia	25,333	100–300	Velevski <i>et al.</i> 2010
Albania	28,748	50–100	Penteriani & Delgado 2019
Slovenia	20,253	120–140	Mihelič & Marčeta 2000
Montenegro	14,026	225–300	Cochet 2006
Turkey	23,900	3000–6000	Penteriani & Delgado 2019
Moldova	33,843	5–10	Cochet 2006
Belgium	32,528	80–85	Vangeluwe <i>et al.</i> 2010
Slovakia	48,845	300–400	Danko & Karaska 2002, Dravecky & Guziová 2012
Bosnia and Herzegovina	51,129	400–500	Kotrošan & Hatibović 2012
Poland	312,685	250–280	Wójciak <i>et al.</i> 2008
Italy	301,340	250–340	Brichetti & Fracasso 2006
Bulgaria	110,910	420–490	Hristov <i>et al.</i> 2007
Greece	131,940	200–500	Penteriani & Delgado 2019
Portugal	92,082	250–580	Cabral <i>et al.</i> 2005, Lourenço <i>et al.</i> 2015
Serbia	88,361	330–450	Penteriani & Delgado 2019
Spain	498,508	2350	Martínez & Zuberogoitia 2003
France	547,030	1649 950–1500	Cochet 2006 Martin 2010
Romania	237,500	1000–1500	Penteriani & Delgado 2019
Germany Schleswig-Holstein	357,021 1900	1100 58	Lanz & Mammen 2005 Klose & Koop 2007
Croatia	56,542	800–1200	Barišić <i>et al.</i> 2016
Czech Republic	78,866	600–900	Štastný <i>et al.</i> 2006, Hora <i>et al.</i> 2010
Belarus	207,600	400–500	Gritschik & Tishechkin 2002
Norway	385,186	451–681	Øien <i>et al.</i> 2014
Sweden	449,964	474	Hellström & Helander 2012

up to 200–300 pairs (Gugueva & Belik 2013). The number of Eagle-Owl for the Sverdlovsk oblast – 850 pairs (147 nesting territories identified), the Chelyabinsk oblast – 150 pairs (135 nesting territories identified) (Karyakin 1998). In the regions of the Volga, the population differs significantly. The region with a known high number of Eagle-Owls is the Republic of Bashkiria – 850 pairs (identified 374 nesting territories). A slightly smaller number is known for the Perm kray. According to one estimate, 500 pairs may live here (225 nesting territories have been identified (Karyakin 1998). According to other estimates, the number varied in different years from 120 to 330 pairs (Shepel 2011). In the Saratov oblast, there were 125–140 pairs of Eagle-Owl (Zavyalov & Tabachishin 2006). A relatively small number (up to 15 pairs) is known for the Chuvash Republic and the Mariy El Republic (Shepel 2011).

In countries with similar territorial areas, the number of Eagle-Owls is comparable to Mordovia, for example, in Macedonia (25,333 km²) from 100 to 300 pairs (Velevski *et al.* 2010), Albania (28,748 km²) from 50 to 100 pairs (Penteriani & Delgado 2019), in Slovenia (20,253 km²) from 120 to 140 pairs (Mihelič & Marčeta 2000), in Montenegro (14,026 km²) from 225 to 300 pairs (Cochet 2006). The various data can be seen in *Table 2*. High Eagle-Owl population (3–6 thousand pairs) is typical for Turkey (23,900 km²) (Penteriani & Delgado 2019). Lower numbers in relation to area are noted for Moldova (from 5 to 10 pairs on an area of 33,843 km²) (Cochet 2006) and Belgium (from 80 to 85 pairs on an area of 32,528 km²) (Vangeluwe *et al.* 2010).

Assessing not only the factors that have a positive impact, but also the negative impact, it is necessary to characterize the relationship of the Eagle-Owl with other species in the region. Considering our previous results in the region, based on studies of co-vocalization (Andreychev 2023, Andreychev *et al.* 2023) and the diet of competitive owl species (Andreychev & Lapshin 2017), we can conclude that the Eagle-Owl has no enemies. The large owl, the Ural Owl, is found in the Eagle-Owl's diet, but Eagle-Owl remains are not found in its diet. This is also indirectly evidenced by the fact that the Eagle-Owl vocalizations are recorded during the vocalizations of predatory mammals in the family Canidae.

Thus, the abundance of Eagle-Owl in Mordovia has been determined. This can be used to estimate the total number of the subspecies *B. b. ruthenus* throughout its range. This study provides data on the density of the Eagle-Owl in Mordovia, but further research is needed to obtain more information on the ecology of the species in the Middle Volga region. For example, it would be particularly interesting to test whether Eagle-Owl population densities are comparable in other regions during the same study years. Each study on monitoring the status of the Eagle-Owl population is important, as it contributes to the general knowledge of the species and allows us to evaluate the effectiveness of conservation measures.

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References

- Abushin, A. A. 2021. Distribution and number of the Eagle Owl in the Republic of Kalmykia, Russia. – *Raptors Conservation* 42: 9–33. DOI: 10.19074/1814-8654-2021-42-9-33
- Andreychev, A. 2023. Vocal interaction between Eagle Owl (*Bubo bubo*) and canines (Carnivora, Canidae). – *Ornis Hungarica* 31(2): 61–73. DOI: 10.2478/orhu-2023-0019
- Andreychev, A. V., Kuznetsov, V. A., Alpeev, M. A. & Lapshin, A. S. 2023. Co-vocalisation of Eagle Owl and other owls in the natural and climatic conditions of the Middle Volga region. – *IOP Conference Series: Earth and Environmental Science* 1229: 012007IOP. DOI: 10.1088/1755-1315/1229/1/012007
- Andreychev, A. V., Lapshin, A. S. & Kuznetsov, V. A. 2016. Breeding success of the Eurasian Eagle Owl (*Bubo bubo*) and rodent population dynamics. – *Biology Bulletin* 43(8): 851–861. DOI: 10.1134/S1062359016080045
- Andreychev, A. V., Lapshin, A. S. & Kuznetsov, V. A. 2017. Методика регистрации филина (*Bubo bubo*) по голосовой активности [Techniques for recording the Eagle Owl (*Bubo bubo*) based on vocal activity]. – *Zoologicheskii Zhurnal* 96(5): 601–605. DOI: 10.7868/S004451341705004X (in Russian with English Summary)
- Andreychev, A. & Lapshin, A. 2017. Quantitative and qualitative composition of diet of the Ural Owl, *Strix uralensis* (Strigidae, Strigiformes), in the Central Part of European Russia (the example of the Republic of Mordovia). – *Vestnik Zoologii* 51(5): 421–428. DOI: 10.1515/vzoo-2017-0050
- Barišić, S., Tutiš, V., Ćiković, D., Kralj, J. & Ružanović, Z. 2016. The Eagle Owl *Bubo bubo* (Aves: Strigidae) in the Eastern Adriatic (Croatia): the study case of a high-density insular population. – *Italian Journal of Zoology* 83(2): 275–281. DOI: 10.1080/11250003.2016.1158874
- Belik, V. P. 2014. Филин *Bubo bubo* [Eagle Owl *Bubo bubo* (Linnaeus, 1758)]. – In: Arzanov, Yu. G. (ed.) Красная книга Ростовской области. Животные, 2-е изд [Red Data Book of the Rostov Region. Animals 2nd ed.]. – Rostov-on-Don, Russia, pp. 1168–1173. (in Russian)
- Brambilla, M. & Bionda, R. 2013. Variation in productivity and territory occupancy in an Eagle Owl *Bubo bubo* population. – *Ornis Fennica* 90(1): 50–56.
- Brauneis, W. & Hormann, M. 2005. Bestand und populations dynamic des Uhus *Bubo bubo* in Hessen [Population dynamics of the Eagle Owl *Bubo bubo* in Hesse]. – *Ornithologischer Anzeiger* 2–3: 113–116. (in German)
- Brichetti, P. & Fracasso, G. 2006. Ornitologia italiana. V. 3: Stercorariidae – Caprimulgidae [Ornithology Italiana. V. 3: Stercorariidae – Caprimulgidae]. – Alberto Perdisa Editore, Bologna, Italy (in Italian)
- Cabral, M. J., Almeida, J., Almeida, P. R., Dellinger, T., Ferrand de Almeida, N., Oliveira, M. E., Palmeirim, J. M., Queiroz, A. I., Rogado, L. & Santos-Reis, M. 2005. Livro Vermelho dos Vertebrados de Portugal [Red Book of Vertebrates of Portugal]. – Instituto da Conservação da Natureza. Lisbon, Portugal (in Portuguese)
- Cochet, G. 2006. Le Grand-duc d'Europe [The Eagle Owl]. – Editions Delachaux et Niestlé, France (in French)
- Danko, Š. & Karaska, D. 2002. Výr skalný (*Bubo bubo*) [Eagle Owl (*Bubo bubo*)]. – In: Danko, Š., Darolová, E. & Krištin, A. (eds.) Rozšírenie vtákov na Slovensku [Distribution of Birds in Slovakia]. – Veda, Bratislava, pp. 360–362. (in Slovakian)
- Delgado, M. M. & Penteriani, V. 2005. Eagle Owl *Bubo bubo* dispersal patterns and the importance of floaters for the stability of breeding populations. – *Ornithologischer Anzeiger* 2–3: 153–158.
- Dravecky, M. & Guziová, Z. 2012. A preliminary overview of monitoring for raptors in the Slovak Republic. – *Acrocephalus* 33: 261–269.
- Gorner, M. 1983. Ansprüche der felsennistenden Uhus (*Bubo bubo*) in Thüringen an den Horstplatz [Requirements of the rock-nesting Eagle Owls (*Bubo bubo*) in Thuringia for the nest site]. – *Beiträge zur Vogelkunde* 29: 121–136. (in German)
- Gritschik, W. W. & Tishechkin, A. K. 2002. Филин (*Bubo bubo*) в Беларуси: распределение и биология гнездования [Eagle Owl (*Bubo bubo*) in Belarus: distribution and breeding biology]. – *Subbuteo* 5(1): 3–19. (in Russian)
- Gugueva, E. V. & Belik, V. P. 2013. Результаты инвентаризации редких видов птиц Волгоградской области [Results of the inventory of rare birds in Volgograd region]. – In: Dzhamirzoev, G. S. (ed.) Охрана птиц в России: проблемы и перспективы. Материалы Всероссийской научно-практической конференции с международным участием, посвященной 20-летию Союза охраны птиц России (Москва, 7–8 февраля 2013 г.) [Problems and outlook of bird conservation in Russia. Proceedings of the All-Russian Conference, dedicated to the 20th anniversary of Russian Bird Conservation Union (Moscow, 7–8 February 2013) Moscow]. – Mahachkala, Russia, pp. 70–75. (in Russian)

- Fedosov, V. N. 2019. Филин в Ставропольском крае [Eagle Owl in the Stavropol region]. – In: Litvinov, K. V., Kalmikov, A. P., Meshcheryakova, N. O., Zhuzhneva, I. V. & Podolyako, S. A. (eds.) Природные экосистемы Каспийского региона: прошлое, настоящее, будущее: Материалы Всероссийской научной конференции с международным участием, посвященной 100-летию Астраханского государственного заповедника [Natural ecosystem of the Caspian region: past, present, future. The proceedings of the All-Russian scientific conference with international participation dedicated to the 100th anniversary of Astrakhan State Nature Reserve]. – Astrakhan, Russia, pp. 59–63. (in Russian)
- Hadad, E., Charter, M., Kosicki, J. Z. & Yosef, R. 2022. Prey-base does not influence breeding success in Eagle Owls (*Bubo bubo*) in Judea, Israel. – *Animals* 12(10): 1280. DOI: 10.3390/ani12101280
- Hagemeijer, W. J. M. & Blair, M. J. 1997. The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. – Poyser, London, UK, pp. 102–107.
- Harms, C. 2017. Unmittelbare Einblicke in das ungestörte Verhalten von Uhus (*Bubo bubo*) am Brutplatzauswertung von Infrarot-Videoaufnahmen während Balz, Brut und Jungenaufzucht. Teil I: Vorbalz und Balz bis zur Eiablage [Direct insights into the undisturbed behaviour of Eagle Owls (*Bubo bubo*) at their nesting site – Evaluation of extended infrared video recordings during courting, nesting and chick rearing. Part I: Pre-courting and courting periods]. – *Naturschutz am südlichen Oberrhein* 9: 71–91. (in German)
- Hellström, P. & Helander, B. 2012. A preliminary overview of monitoring for raptors in Sweden. – *Acrocephalus* 33: 277–282.
- Hora, J., Brinke, T., Vojtěchovská, E., Hanzal, V. & Kučera, V. 2010. Monitoring druhů přílohy I směrnice o ptácích a ptačích oblastí v letech 2005–2007: Výr Velký [Monitoring of Annex I species of the Birds Directive and Bird Areas in 2005–2007: Great Eurasian Vulture]. – AOPK ČR, Praha, Czech Republic (in Czech)
- Hristov, I., Boev, Z. & Kovachev, A. 2007. Eurasian Eagle Owl *Bubo bubo*. – In: Iankov, P. (ed.) Atlas of Breeding Birds in Bulgaria. – BSPB Conservation Series, Book 10. Sofia, pp. 324–325.
- Husby, M. & Pearson, M. 2022. Wind farms and power lines have negative effects on territory occupancy in Eurasian Eagle Owls (*Bubo bubo*). – *Animals* 12(9): 1089. DOI: 10.3390/ani12091089
- Ilyukh, M. P. 2017. Филин на Ставрополье [Eagle Owl *Bubo bubo* in the Stavropol region]. – *Russian Journal of Ornithology* 26(1397): 299–323. (in Russian)
- Karyakin, I. V. 1998. ПERNАТЫЕ хищники Уральского региона. Соколообразные (Falconiformes), Совообразные (Strigiformes) [Feathered predators of the Ural region. Falconiformes, Owls (Strigiformes)]. – Perm, Russia (in Russian)
- Klose, O. & Koop, B. 2007. Brutbestand, Verbreitung und Siedlungsdichte des Uhus (*Bubo bubo*) in Schleswig-Holstein [Breeding population, distribution and settlement density of the Eagle Owl (*Bubo bubo*) in Schleswig-Holstein]. – *Corax* 20(3): 251–262. (in German)
- Kotrošan, D. & Hatibović, E. 2012. Raptors in Bosnia and Herzegovina – their status and perspectives for monitoring development. – *Acrocephalus* 33: 173–179.
- Lanz, U. & Mammen, U. 2005. Der Uhu *Bubo bubo* – ein Vogel des Jahres im Aufwind? [The Eagle Owl *Bubo bubo* – a bird of the year on the rise?]. – *Ornithologischer Anzeiger* 44: 69–79. (in German)
- Lapshin, A. S., Andreychev, A. V., Alpeev, M. A. & Kuznetsov, V. A. 2022. Methods and techniques for making artificial nests for Eagle-Owls (*Bubo bubo*, Strigiformes, Strigidae) to increase their population. – *Biology Bulletin* 49(9): 1503–1507. DOI: 10.1134/S1062359022090199
- Lapshin, A. S., Andreychev, A. V., Alpeev, M. A. & Kuznetsov, V. A. 2023. Breeding success of the Eurasian Eagle Owl (*Bubo bubo*, Strigiformes, Strigidae) in artificial nests. – *Biology Bulletin* 50(7): 1486–1492. DOI: 10.1134/S1062359023070166
- Lapshin, A. S., Andreychev, A. V. & Kuznetsov, V. A. 2018. Суточная и сезонная динамика вокализации филина (*Bubo bubo*, Strigiformes, Strigidae) в Среднем Поволжье [Daily and seasonal dynamics of the vocalization of the Eagle Owl (*Bubo bubo*, Strigiformes, Strigidae) in the central Volga region]. – *Zoologicheskii Zhurnal* 97(1): 77–88. DOI: 10.7868/S0044513418010075 (in Russian with English Summary)
- León-Ortega, M., Jiménez-Franco, M. V., Martínez, J. E. & Calvo, J. F. 2017. Factors influencing territorial occupancy and reproductive success in a Eurasian Eagle-owl (*Bubo bubo*) population. – *PLoS ONE* 12(4): e0175597. DOI: 10.1371/journal.pone.0175597
- Liditznig, Ch. 2005. Der Einfluss des Nahrungsverfügbarkeit und Nahrungsqualität auf die Reproduktion des Uhus *Bubo bubo* in Sudwestern Niederosterreichs [The influence of food availability and food quality on

- the reproduction of the Eagle Owl *Bubo bubo* in southwestern Lower Austria]. – Ornithologischer Anzeiger 2–3: 123–136. (in German)
- Lourenço, R., Delgado, M. M., Campioni, L., Korpimäki, E. & Penteriani, V. 2015. Evaluating the influence of diet-related variables on breeding performance and home range behaviour of a top predator. – Population Ecology 57: 625–636. DOI: 10.1007/s10144-015-0506-1
- Lugovoy, A. E. 1975. Птицы Мордовии [Birds of Mordovia]. – Gorkiy, Russia (in Russian)
- Lysenkov, E. V. 1994. Некоторые сведения по экологии филина в Мордовии [Some information on the ecology of the Eagle Owl in Mordovia. Eagle Owl in Russia, Belarus and Ukraine: Collection of scientific articles]. – Moscow, Russia, pp. 60–62. (in Russian)
- Martin, Y. 2010. Grand-Duc d'Europe *Bubo bubo* [Eagle Owl *Bubo bubo*]. – In: Auvergne, L. P. O. (ed.) Atlas des oiseaux nicheurs d'Auvergne (Ligue pour la protection des oiseaux d'Auvergne) [Atlas of Auvergne breeding birds (League for the protection of Auvergne birds)]. – Delachaux & Niestlé, Paris, France (in French)
- Martínez, J. A. & Zuberogoitia, I. 2003. Búho real (*Bubo bubo*) [Eagle Owl (*Bubo bubo*)]. – In: Martí, R. & del Moral, J. P. (eds.) Atlas de las Aves Reproductoras de España [Atlas of the Breeding Birds of Spain]. – DGCN-SEO, Madrid, pp. 316–317. (in Spanish)
- Mihelič, T. & Marčeta, B. 2000. Conservationist problems regarding the rock walls above Osp (Karst edge) as a nest site of the Eagle Owl *Bubo bubo*. – Acrocephalus 21: 61–66.
- Milchev, B. & Georgiev, V. 2020. Temporal and spatial dietary shifts of a generalist top predator: long-term study of an Eagle Owl *Bubo bubo* population. – Forestry Ideas 26(2): 366–379.
- Milchev, B. & Spassov, N. 2017. First evidence for carrion-feeding of Eurasian Eagle-owl (*Bubo bubo*) in Bulgaria. – Ornis Hungarica 25(1): 58–69. DOI: 10.1515/orhu-2017-0005
- Nygård, T., Jacobsen, K. O. & Gjershaug, J. O. 2023. Home-range, movements and use of powerline poles of Eagle-Owls (*Bubo bubo*) at an island population in northern Norway. – Ornis Fennica 100: 1–13. DOI: 10.51812/of.116340
- Obuch, J. 2021. Spatial and temporal changes in the diet composition of the Eurasian Eagle-owl (*Bubo bubo*) in Slovakia comparing three historical periods. – Raptor Journal 15(1): 17–55. DOI: 10.2478/srj-2021-0002
- Øien, I. J., Heggøy, O., Shimmings, P., Aarvak, T., Jacobsen, K-O., Oddane, B., Ranke, P. S. & Steen, O. F. 2014. Status for hubro i Norge [Status of Eagle Owl in Norway]. – Norsk Ornitologisk Forening Rapport 2014-8. (in Norwegian)
- Olsson, V. 1979. Studies on a population of Eagle Owls, *Bubo bubo* (L.), in southeast Sweden. – Viltrevy 11(1): 1–99.
- Pearson, M. & Husby, M. 2021. Supplementary feeding improves breeding performance in Eurasian Eagle Owl (*Bubo bubo*). – Ornis Fennica 98: 46–58.
- Penteriani, V. & Delgado, M. M. 2019. The Eagle Owl. – London, Oxford, New York, New Delhi, Sydney. – T & AD Poyser, pp. 34–97.
- Penteriani, V., Delgado, M. M., Gallardo, M. & Ferrer, M. 2004. Spatial heterogeneity and structure of bird populations: a case example with the Eagle Owl. – Population Ecology 46: 185–192. DOI: 10.1007/s10144-004-0178-8
- Pérez-García, J. M., Sánchez-Zapata, J. A. & Botella, F. 2012. Distribution and breeding performance of a high-density Eagle Owl *Bubo bubo* population in southeast Spain. – Bird Study 59(1): 22–28. DOI: 10.1080/00063657.2011.613111
- Prommer, M., Molnár, I. L., Tarján, B. & Kertész, B. 2018. Preliminary study on the tolerance to human disturbance of Eagle Owl (*Bubo bubo*) in an active quarry in NW Hungary. – Ornis Hungarica 26(1): 54–64. DOI: 10.1515/orhu-2018-0004
- Putshenko, E. S. 1938. Материалы к познанию фауны птиц Мордовского заповедника [Materials for knowledge of the bird fauna of the Mordovian Nature Reserve]. – In: Smidovich, P. G. (ed.) Фауна Мордовского государственного заповедника им. П.Г. Смидовича [Fauna of the Mordovian State Reserve named after]. – Moscow, Russia, pp. 41–106. (in Russian)
- Pukinsky, Yu. B. 1993. Филин [Eagle Owl]. – In: Malchevskiy, A. S. (ed.) Птицы России и сопредельных регионов [Birds of Russia and Adjacent Regions]. – Moscow, pp. 108–120. (in Russian)
- Rockenbauch, D. 2005. Uhu *Bubo bubo* in Baden-Württemberg. – Ornithologischer Anzeiger 2–3: 117–122.
- Sánchez-Zapata, J. A., Sánchez, M. A., Calvo, J. F. & Esteve, M. A. 1995. Ecología de las aves de presa de la Región de Murcia, Murcia, Spain [Ecology of birds of prey in the Region of Murcia, Murcia, Spain]. – Servicio de Publicaciones de la Universidad de Murcia (in Spanish)

- Sergio, F., Marchesi, L. & Pedrini, P. 2004. Integrating individual habitat choices and regional distribution of a biodiversity indicator and top predator. – *Journal of Biogeography* 31(4): 619–628.
- Shepel, A. I. 2011. Филин *Bubo bubo* (L.) в Волжско-Камском Крае [Eagle Owl *Bubo bubo* (L.) in the Volga-Kama Province]. – *Bulletin of Perm University* 1: 46–54. (in Russian)
- Štastný, K., Bejček, V. & Hudec, K. 2006. Atlas hnízdního rozšíření ptáků v České republice 2001–2003: Výr Velký [Atlas of Nesting Distribution of Birds in the Czech Republic 2001–2003: Výr Velký]. – Aventinum, Praha, Czech Republic (in Czech)
- Tobajas, J., Rouco, C., Fernandez-de-Simon, J., Diaz-Ruiz, F., Castro, F., Villafuerte, R. & Ferreras, P. 2021. Does prey abundance affect prey size selection by the Eagle Owl (*Bubo bubo*)? – *Journal of Ornithology* 162(3): 699–708. DOI: 10.1007/s10336-021-01869-x
- Vangeluwe, D., Rousseau, C. H., Goset, P. & Poncin, O. 2010. Grand-duc d'Europe *Bubo bubo* [Eagle Owl *Bubo bubo*]. – In: Jacob, J.-P., Dehem, C., Burnel, A., Dambiermont, J.-L., Fasol, M., Kinet, T., van der Elst, D. & Paquet, J.-Y. (eds.) *Atlas des Oiseaux nicheurs de Wallonie 2001–2007, Serie Faune-Flore-Habitats n°5*. [Atlas of Breeding Birds of Wallonia 2001–2007, Fauna-Flora-Habitats Series n°5.]. – Aves & Région Wallonne, Gembloux, Belgique, pp. 242–243. (in French)
- Velevski, M., Hallmann, B., Grubač, B., Lisičanec, T., Stoynov, E., Lisičanec, E., Avukatov, V., Božič, L. & Stumberger, B. 2010. Important bird areas in Macedonia: Sites of global and European importance. – *Acrocephalus* 31(147): 181–282.
- Wink, M., El-Sayed, A.-A., Sauer-Gurth, H. & Gonzales, J. 2009. Molecular phylogeny of owls (Strigiformes) inferred from DNA sequences of the mitochondrial cytochrome b and the nuclear RAG-1 gene. – *Ardea* 97(4): 581–591. DOI: 10.5253/078.097.0425
- Wójciak, J., Mikusek, R. & Profus, P. 2008. Puchacz [Eagle Owl]. – In: Sikora, A., Rohde, Z., Gromadzki, M., Neubauer, G. & Chylarecki, P. (eds.) *Polski Atlas Ornitologiczny 1985–2004* [Polish Ornithological Atlas 1985–2004]. – Bogucki Wydawnictwo Naukowe, Poznań, Poland, pp. 266–267. (in Polish)
- Zavyalov, E. V. & Tabachishin, V. G. 2006. Филин [Eagle Owl]. – In: Shlyahtin, G. V. (ed.) *Красная книга Саратовской области* [Red Book of the Saratov Region]. – Saratov, Russia, pp. 448–450. (in Russian)
- Zhitkov, B. M. & Buturlin, S. A. 1906. Материалы для орнитофауны Симбирской губернии [Materials for the avifauna of the Simbirsk province]. – *Notes of the Imperial Russian Geographical Society on General Geography* 2: 233–275. (in Russian)

