FORESTRY IDEAS, 2022, vol. 28, No 1 (63): 194–204

VOCAL ACTIVITY OF URAL OWL (*STRIX URALENSIS*, STRIGIFORMES, STRIGIDAE) IN THE MIDDLE VOLGA RIVER REGION

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Received: 11 October 2021 Accepted: 28 May 2022

Abstract

Both daily and seasonal year-round vocal activity of Ural owl were recorded in the Middle Volga River Region, Russia with the use of digital dictaphones. Two best-expressed peaks of long-term activity were revealed during the year: one starting in March and the other in September. In the spring, calls were recorded from 19:51 to 04:04. During this period, Ural owl's total length of calls varied from 1 to 35 min per day, on average 12 min. The second annual peak was restricted to brood dispersal. In this period, the total duration of calls varied from 1 to 32 min per day, on average 9 min. In the spring, Ural owls always started calling from 24 min to 4 h after sunset. Vocalisation began at an average of 2 h 34 min after sunset. Completion of morning vocal activity always ended from 1 h 30 min to 2 h 40 min before sunrise.

Key words: birds of Mordovia, diurnal activity, phenology of avian vocalisation, seasonal activity.

Introduction

Vocalisation of various species of animals carries a lot of scientific information about features of their biology and ecology (Catchpole and Slater 2003, Burgos and Zuberogoitia 2020). Most studies are devoted only to certain groups of animals (Catchpole and Slater 2003, Pukinsky and Pukinskaya 2011). The vocalisation of some owl species is of priority importance (Mikkola1970, Cramp 1985, Odom and Mennill 2010, Korpimaki and Hakkarainen 2012, Lourenço et al. 2013, Ševčík et al. 2019, Pérez-Granadoset al. 2020, Clément et al. 2021).

The calls of Ural owl (*Strix uralensis* Pallas, 1771) are used in the classical version for tracking when using the direction finding method (Voronetsky et al. 1990, Fischer et al. 1997, Haselmayer and Quinn 2000, González et al. 2008, Tutis et al. 2009).In descriptions of Ural owl vocalisations, the fundamental work by Scherzinger (1980) is of great importance. Pukinsky (1977) points out that the spring arrival of Ural owl on nesting sites, as a rule, is observed in the first days of March. But there are still big differences depending on the region and even on the habitat. Of important interest, at what hours of the day does the owl most vocal-

ise? As well as how it changes by season and month. What factors can affect vocalisation? We want to highlight one of the works in this sector of research. This is the work of Spanish zoologists on Eagle owl (*Bubo bubo* Linnaeus, 1758). For the South-Western part of Spain, it is shown that the beginning and end of the sound activity of owls are timed to sunset and sunrise, respectively. This circumstance is explained by the authors from the position of good visual contact between individuals (Penteriani 2002, Delgado and Penteriani 2007). Researchers highlight the influence of weather, climate, and trophic conditions on vocalisation (Southern 1970, Wijnandts 1984, Korpimaki 1987, Tome 1997, Clark and Anderson 1997, Lehikoinen et al. 2010, Sharikov and Shekhovtsov 2013).

The aim of our research is to determine the vocal activity of Ural owl (daily and seasonal rhythm) and the possible influence of weather and climatic factors on it in the Middle Volga Region. We consider the hypothesis that vocalisation does not depend on meteorological conditions.

Material and Methods

Voice activity of Ural owl was recorded in the period 2015–2019in various districts of the Republic of Mordovia (53º38' – 55º11' N and 42º11' – 46º45' E). The dictaphones were moved by car from one point to another. The climate of the region is moderate continental with pronounced seasons throughout the year. The average annual air temperature varies from 3.5 to 4.0 °C. The average annual precipitation in the territory is 480 mm (Andreychev 2017).

Ural owl is widespread in Mordovia (Lapshin et al. 2005, Andreychev and Lapshin 2017). It inhabits forests of various types, but is more common in ripe coniferous and mixed forests. The vocalisation was recorded in the following settlements and districts: Bolshebereznikovsky district (Nerley, Starye Naimany, Chernaya Promza, Sosnovy Gart, Russkie Naimany, Parakino, Shugurovo), Chamzinsky district (Michurino, Picheury, Kamenka, Chamzinka, Chkalovo), Dubensky district (Purkaevo, Engalychevo, Cheberchino, Kaybichevo, Nikolaevka), Atyashevsky district (Dyurki), Insarsky district (Luhmensky Maidan, Svistovka), Kochkurovsky district (Kochkurovo, Stary Turdaki), Staroshaygovsky district (Letki, Kuvay, Novoe Akshino, Kuldym, Lemdyay), Ichalkovsky district (Rezovatovo), city of Saransk (Fig. 1).

The acoustic material was collected through Olympus VN-416PC, VN-406PC, VN-712PC autonomous recording units. Voice recorders were installed in the daytime for 3–5 days. The maximum duration of continuous operation of voice recorders was about 140 h. By the time the previous recording was finished, we have moved the recorder to a different location (Andreychev et al. 2017, Lapshin et al. 2018, Andreychev 2019, Andreychev et al. 2020).More than 600 h of audio recordings were processed each year. Most of them were made during the spring-summer period (more than 400 h/1 year). Registration of the activity of Ural owl is, first of all, registration of the calls of males, as females call less often and mainly as a response to male calls. Therefore, most of the material was obtained from the vocalisation of male (Vrh and Vrezec 2006).

The resulting audio records were processed using AIMP (2007) and Audacity (2015) programs. We looked at the spectrograms (time on x-axis; frequency on y-axis; amplitude on z-axis visualized

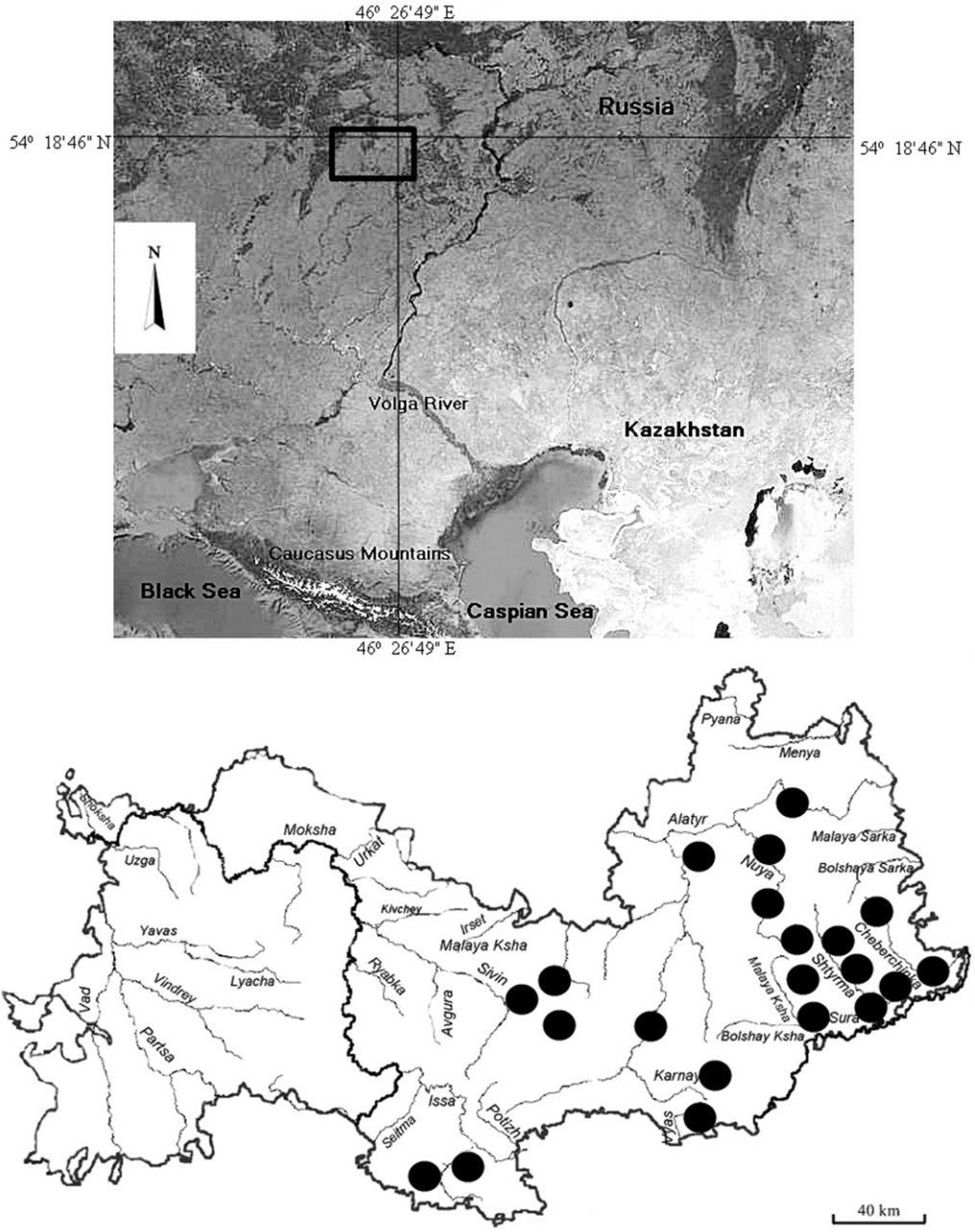

Fig. 1. Map of the Republic of Mordovia with vocalisation registration points (black circles).

as a colour) using software. Purpose of the spectrograms was to more effectively identify the calls and to easily check at what time the vocalisations started and

ended.

We singled out the beginning and end of vocal activity in the evening, night and morning hours when analysing the recordings. Evening vocal activity was restricted to two hours before and after sunset, while morning took place within two hours before and after sunrise. The beginning and end of night time activity was recorded in the remaining interval of the night between sunset and sunrise. The duration of individual periods of vocalisation was determined. When identifying the confinement of the beginning and end of calls, only those days were taken into account when Ural owl called in the interval up to 5 h relative to sunset and sunrise, respectively. Days with calls outside of these time limits were not taken into account. Comparison was made for the months and seasons of the year. Similarly, a possible dependence of vocalisation on moon phases was revealed. Ural owl calling activity was analysed for correlations with weather conditions (temperature (°C), force ($m \cdot s^{-1}$) and direction of the wind, precipitation in the form of rain or snow, cloud cover (%) and pressure (mm Hg). These variables were measured daily. To characterise climatic conditions, we used data from a weather station Bolshie Berezniki (Sun and Moon Wall Calendar 2021, rp5.ru 2021, Well and weather 2021, Phase of the Moon 2021).

Correlation analysis (r_s – nonparametric coefficient Spearman) was used to identify the relationship between vocalisation and variables. We tested the next aspects: number of calls per day, start or end of calling time and total length of calling time. All these variables were defined in the Audacity program. Comparison of the average number of calls per day for each month was made using One-way ANOVA. Statistical calculations were carried out by means of computer program AtteStat (2010), Past (Hammer et al. 2001).

Results and Discussion

During the research period, 116 sound recordings were obtained and processed, with a total length of about 3000 h. Ural owl can be attributed to moderately vocalising birds (Pukinsky1977), and calls were recorded for 5 months (January, March, April, May, and September).

A common version of the vocalisation of Ural owl males in Mordovia is a series of double calls, with the first one always louder than the second. The frequency range of male calls is 250–400 Hz. The intervals between calls are 5–8 s. A similar sound reaction of a female is rougher, hoarser, is uttered much less often. The frequency range of female calls is 550–900 Hz. A separate call of a female usually lasts 0.3–0.6 s and is issued at irregular intervals. The intervals between individual calls are from 4 or more seconds.

Analysis of vocalisation showed two of the clearest intense peaks of activity in the year: the whole of March and the second-third decades of September. In the spring months, calls of Ural owl were recorded from 19:51 to 04:04. During this period, Ural owl's total duration of calls varied from 1 to 35 min per day, with an average of 12 min. However, calls were mostly recorded in the evening hours (before 00:00 h). They account for 71.4 % of all spring calls. Calls after 00:00 h were recorded less frequently, mainly in the most active month (March). During the incubation period, owls were vocalising over the whole night. Vocalisation continued until May 14 (near the village of Sosnovy Garth Bolshebereznikovsky district). In summer, there is no vocalisation. Comparing the

timing of laying the first eggs in nests with the longest period of vocalisation during the day (276 calls/day) should be considered the period of mating calls the third decade of March.

The second peak of vocalisation in the year is timed to the period when broods usually break up. In September, calls of Ural owl were recorded from 19:54 to 04:24. In the warm and dry September, the birds did not call for long. During this period, Ural owl's total duration of calls varied from 1 to 32 min per day, with an average of 9 min. Other researchers also reported vocalisation during this period (Saurola 1992).

In the third decade of January, Ural owl rarely called. Calls were recorded from 23:40 to 00:23. The periods of series of calls were short.

Thus, it is shown that the vocalisation of Ural owl is high in the nesting and autumn periods, which can be used for census work. In the third decade of September, calls were heard only in the evening hours from 20:29 h to 21:02 h, that is, a short period.

Duration was significantly shorter in the evening that in the morning. Using the Mann-Whitney test, statistically significant differences between the first and second defined periods were revealed ($Z = -2.39$; $p < 0.05$) (Fig. 2). This was significantly influenced by statistical differences in the duration of vocalisation in autumn ($Z = -2.83$; $p < 0.05$) (Fig. 2). For the rest of the year, there are no differences ($p > 0.05$). There were differences between evening and morning hours.

As it was found out as a result of research, the vocalisation of Ural owl depends on some factors of the meteorological conditions. There is a statistically significant relationship between binary variable of vocalisation (yes –owl calls is present or no –owl calls is absent) and precipitation in the form of rain and snow ($r_s = -0.25$, $p = 0.01$). This is indirectly evidenced by the cessation of vocalisation of Ural owl with the beginning of rain. No statistically significant relationships were found with temperature ($r_s = -0.13$, $p = 0.94$) and pressure ($r_s = 0.08$, $p = 0.63$). It was observed in the temperature range

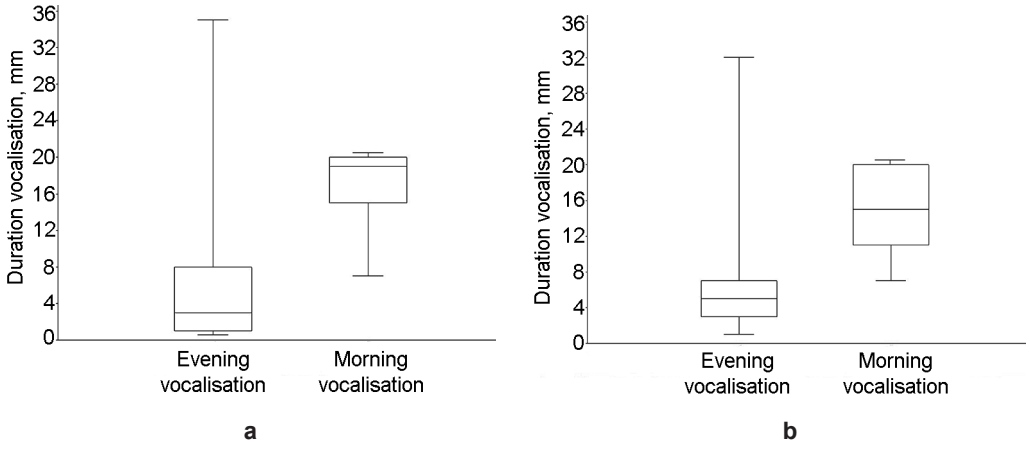

Fig. 2. Ranges of vocalisation based on materials for the autumn period (a) and for all the year (b).

Note: 'strip on box'is the median, the boundaries of the box are 25–75 % quantiles, whiskers – minimum and maximum values.

from -10 to +15 °C (+2 ±6.52 °C; *N* = 550). Calls of Ural owl in the region were recorded at cloud cover from 10 to 100 % (75 ±0.73 %; *N* = 550), at pressure from 744 to 762 mm Hg (752 ±3.92 mm Hg; *N* = 550). Calls were recorded equally in both the rising and waning phases of the moon. No calls were recorded during the full moon. Calls in the region were recorded at wind strength from 0 to 6 $m \cdot s^{-1}$ (3 ±1.11 $m \cdot s^{-1}$; *N* = 550). When the wind was strong (>6 $m \cdot s^{-1}$), they were not recorded. It was shown in some other related owls, that meteorological conditions have high influences on the owl vocalisations due to noise production (Lengagne and Slater 2002).

Comparison of the timing of vocalisation beginning in the evening and its completion in the morning did not reveal a statistically significant relationship. But, nevertheless, we consider it appropriate to give the results for the region. In the spring, Ural owl began to call always after sunset from 24 min to 4 h. Vocalisation started after sunset for an average of 2 h and 34 min (Fig. 3). It always ended before dawn (from 1 h 32 min to 2 h 46 min) (Fig. 4). In September, the overall trend continued. Vocalisation was absent before sunset and after sunrise, i.e.so in daytime. We explain this by the regional specific of the species, since the recorders work around the clock and did not record the daytime calls of the owl. In January, the calls were not timed to sunset or sunrise, as they were heard more than 5 h before and after.

In Sweden, vocal activity is at its highest level in late April and the first half of May (Lundberg 1980). In Mordovia, maximum vocalisation was noted in March. We believe that these differences may be influenced by the geographic latitude and climatic conditions. In Sweden, the winter and duration of the snow cover is longer

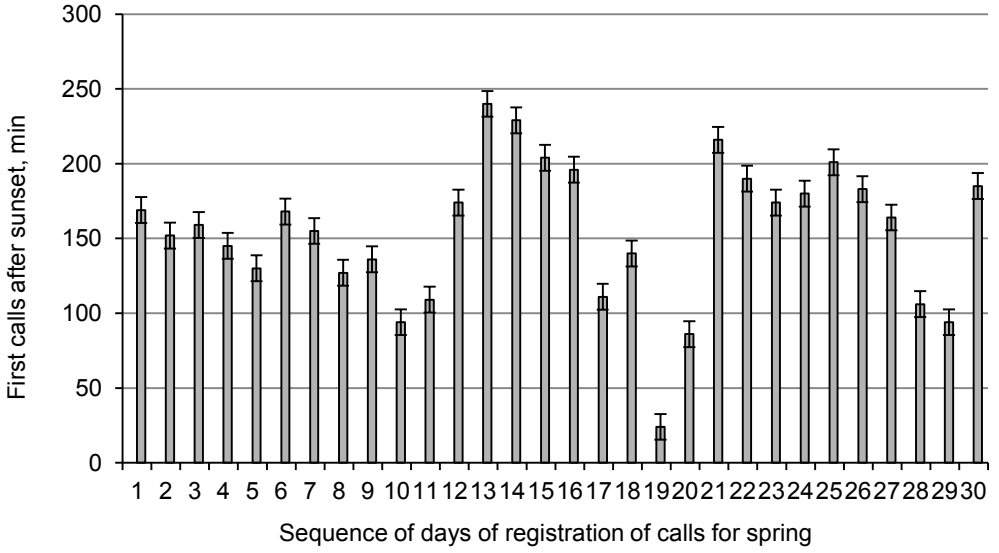

Fig. 3. Seasonal variation in the time of the first call to sunset.

Note: the number of columns corresponds to the number of days when Ural owl began vocalisation in the interval after 5 h relative to sunset.

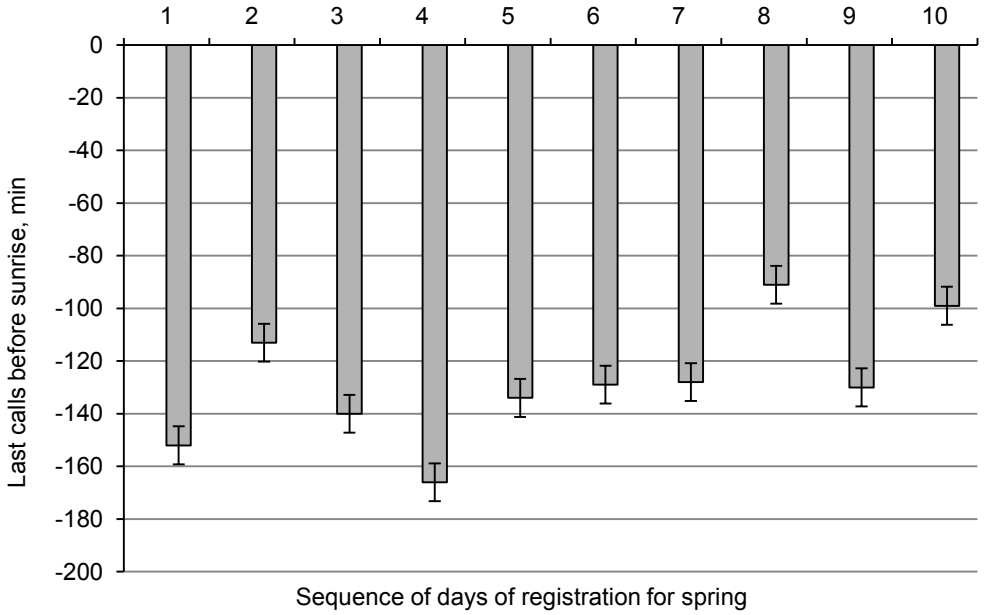

Fig. 4. Seasonal variation in the time of the last call to sunrise.

Note: the number of columns corresponds to the number of days when Ural owl finished vocalisation in the interval after 5 h relative to sunrise.

than in Mordovia. Our research covers the southern sections (approx. 54º N), in Sweden these are the northern sections (approx. 60º N), therefore the peak of vocalisation of Ural owl in Mordovia is earlier. In montane forests of Slovenia the first eggs in Ural Owl nests were found from 15 March to 21 June (Vrezec 2007), but in lowlands vocaling and breeding can start already in February (Vrezec and Tutiš 2003, Vrezec 2016).

There are slight differences between Mordovia and Sweden in daily activity with the general tendency of birds to start vocalising after sunset. So vocalisation in Mordovia began after sunset on average for 2 h 34 min. And in Sweden, this activity during incubation and the chick period was recorded on average one hour after sunset. A similar discrepancy in the vocalisation of owls was noted earlier on the example of Eagle owl in Mordovia (Lapshin et al. 2018) and Spain (Delgado and Penteriani 2007).

In terms of vocal characteristics, the recorded calls of Ural owl are similar to those recorded for other regions (Lundberg 1980, Cramp 1985, Tishechkin 1986, Shibnev 1989, Pukinsky and Pukinskaya 2011). In Finland, it shows the relationship between breeding and ambient temperature. Increasing late winter or early spring temperature advanced breeding at least as much as did high autumn abundance of prey (voles) (Lehikoinen et al. 2010).

The similarity of Ural owl with respect to the timing of vocalisation to sunset and sunrise in comparison with other species of owls is of significant interest. For Eagle owl in Mordovia, evening calls were recorded, as a rule, 1 h before sunset. Morning vocalisation usually ended 1.5 h

before sunrise (Lapshin et al. 2018). For Tawny owl (*Strix aluco* Linnaeus, 1758) in Moscow Region, voice responses were recorded mainly after sunset, and for the Pygmy owl (*Glaucidium passerinum* Linnaeus, 1758) 1.5 h before and after sunset (Sharikov and Shekhovtsov 2013). For Blakiston's fish owl (*Bubo blakistoni* Seebohm, 1884) in Primorye, voice responses were recorded 20–40 min after sunset (Andreev 2009, Pukinsky and Pukinskaya 2011). Thus, we can say that the timing of vocalisation to sunrise and sunset in different types of owls has a specific character. Spring and autumn distributions of calls of different species by time of day differ slightly.

Some differences in the number of calls of Ural owl per day in different regions can be explained by the results obtained by researchers in Spain on the example of Eagle owl. There is a lower intensity of vocalisation of single males by season compared to males which are in pairs (Martínez and Zuberogotia 2002). In areas with a high population density, calls are heard much more often in order to mark their sites from possible intruders (Martínez and Zuberogotia 2003). However, in Scandinavia, more often single males call more intensely than males in a pair bond (longer periods and longer time in spring) when calling for mates (for instance boreal owls). A possible explanation for the high vocal activity is that single males need to find a mate.

Conclusions

Thus, two best-expressed peaks of long-term activity were revealed during the year: one starting in March and the other in September. During the spring, calls were recorded from 19:51 to 04:04. During the incubation period, owls were vocalising over the whole night. In autumn, calls were recorded from19:54 to 04:24. Owls uttered calls for a duration longer in the evening than in the morning. We have identified the influence of the following meteorological factors in the form of rain, snow and wind on the vocalisation of Ural owl in Mordovia. The influence of temperature, pressure, cloudiness on the calls of an owl was not noted. Thus, the importance of this study in the priority of registration by acoustic signals, both for identifying the biology of the species in a particular area, and/or species monitoring, conservation, faunistics. A researcher in a certain area needs to know the periods of registration of a species and the conditions of environmental factors when it is better to identify a particular species.

Acknowledgement

We are grateful to Vladimir I. Velmakin, Gennadiy V. Shkolov, Irina V. Korotina, Ruslan V. Tuboyakov, Maksim A. Alpeev, and Alexander A. Shkulyov for support in carrying out of field studies.

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