An analysis of changes in biological diversity of rare animal species within the boundaries of the Natural Monument "Serebryany Bor"

A A Sorokina¹, V M Zubkova¹, A V Gaponenko¹, N U Belozubova¹, M V Soshenko¹, F F Arslanbekova¹

¹ Department of Technosphere Safety and Ecology Russian State Social University, st. Wilhelm Pika, 4/1, Moscow 129226, Russian Federation
E-mail: SorokinaAA2@eco.mos.ru

Abstract. The article provides data on changes in the number of rare species of birds, mammals and reptiles living in the specially protected area "Serebryany Bor". The number dynamics is presented for 2018-2020. The main research methods were visual accounting, winter route accounting, and route accounting of birds developed by E.S. Ravkin. The research result is the recording of rare species of animals listed in the Red Book of Moscow, which indicates the biological diversity and justifies the need to use nature conservation measures to preserve rare species. The data can be used in a new edition of the Red Book of Moscow which will be published in 2020.

1. Introduction
Specially protected natural areas (SPNA) within the boundaries of Moscow play a key role in the preservation of biological diversity and unique natural ecosystems. The conservation and protection activities can be performed through constant observations of numbers, habitat and changes in the environment of animals.

The natural monument "Serebryany Bor" is a protected area, located in the North-Western Administrative District of Moscow in the Khoroshevo-Mnevniki region [1].

The total area of the Serebryany Bor is 328.6 hectares, of which 202 hectares are protected areas. Green spaces occupy 144.18 hectares (43.8%), water bodies - 18.72 hectares (6.2%). The remaining 165.7 hectares (about 50% of the total area of the island) are owned by third-party land users, recreational, walking, administrative and other facilities not related to the protected areas [2].

2. Problem statement
As a result of the data analysis for 2012-2017 revealed that there is no systematic and comprehensive analysis of biological diversity of rare animal species. The study aims to conduct complex records of objects of the animal world. The information obtained can be used for environmental purposes and included in a new edition of the Red Book of Moscow, which will be published in 2020.

3. Materials and methods
In 2018-2020, more than 65 counts of flora and fauna were carried out. The censuses were carried out along various routes, covering various biotopes, in order to obtain the most reliable data on the presence
and number of objects. The methods of visual counting, winter route counting, and route counting of birds developed by Ravkin were used [3].

The length of each route was at least 4 km; the counts were carried out throughout the year due to different seasonal activities of birds, mammals and reptiles, and the specifics of the methodology for counting mammals - the possibility of identifying their individual species by traces on the snow cover.

4. Results

During the censuses of wildlife objects, many rare species were recorded. In the Red Book of Moscow, each species has a category of rarity:

- Category 0 - extinct species - species that stopped inhabiting (birds - nesting) in Moscow after 1960 and have not been recorded there for the last 20-30 years;
- Category 1 - endangered species – species whose number has decreased to a critically low level and (or) whose habitats have been preserved on such a small area that these species may disappear in the near future;
- Category 2 - rare species with a reduced or diminishing number – species whose number and distribution have decreased so much that with further manifestation of negative factors they may become extinct in Moscow;
- Category 3 - vulnerable species - species initially scarce in natural conditions or common in their habitats in the non-urbanized areas;
- Category 4 - undetermined status - species that belong to one of the previous categories, but there is no enough data to accurately determine their status in Moscow;
- Category 5 - recovered species - species that have recently been rare in Moscow. Their number and distribution increased to a safe level, but anthropogenic factors can cause a decrease in their number [4].

The following number of species was recorded: category 1 - 1 species of mammals; category 2v- 5 species of birds, 1 species of mammals, 1 species of reptiles; category 3 - 4 species of birds; Category 5 - 1 species of birds.

There is a list of species of animals, plants and fungi that are not included in the Red Book of Moscow, but need constant monitoring and control (Appendix to the Red Book of Moscow).

Figures 1 and 2 show photographs of rare bird species. The greatest species diversity of birds is confined to the lake "Bezdonnoe", which covers an area of about 16-17 hectares. It is adjacent to the largest reed bog in Moscow, and this biotope also provides the presence of rare species that do not inhabit other biotopes.

![Figure 1](a) ![Figure 1](b) ![Figure 1](c)

**Figure 1.** Rare bird species. (a) - river tern (Sterna hirundo); (b) - yellow (Dryocopus martius); (c) - Crested Duck (Aythya fuligula).
Figure 2. Rare bird species. (a) - moorhen chick (Gallinula chloropus); (b) Sparrowhawk (Accipiter nisus); (c) Long-tailed tit (Aegithalos caudatus).

Reptiles identified (common snake and marsh turtle) prefer wet areas, including the Kopan pond, which is located on the territory of the Serebryany Bor. The marsh turtle lives only in this pond, it has no rarity category, but listed in the Appendix to the Red Book of Moscow. Photos of reptiles are shown in Figure 3.

Figure 3. Rare species of reptiles. (a), (b) - marsh turtle (Emys orbicularis); (c) - common snake (Natrix natrix).

Since the recording of mammals is laborious due to their fearfulness and secrecy, there is a generally accepted method of winter route recording, where the main feature indicating the presence of mammals is their traces left on the snow cover. The identification of traces was carried out with the help of the enzclopedic guide-determinant developed by V.M. Gudkov. The traces of a hare are shown in Figure 4 [5].

Figure 4. Traces of rare mammals. (a), (b) – traces of a hare (Lepus europaeus).

The comparative graphs show changes in the abundance of rare species. The graphs are presented in pictures. Figure 5 shows the dynamics of the number of protected bird species.
Species such as Gallinula chloropus, Sterna hirundo, Larus ridibundus, Dryocopus martius, Aegithalos caudatus, Parus montanus, Larus canus, Accipiter gentilis and Accipiter nisus increased their numbers in 2019. The Aythya fuligula population decreased by 7 in 2019. The data for 2020 are not complete, but they deserve attention, since many species have already been recorded again, which indicates their stable population.

Figure 6 shows changes in the number of protected species of mammals and reptiles.

The graph shows an increase in the number of Lepus europaeus in 2019, the number of Lepus timidus decreased, the number of Emys orbicularis was not recorded, and the number of Natrix natrix did not change. Figure 6 shows data for 2020, since some species were found in the current year.
5. Conclusion
The data indicate that in 2019 the majority of rare birds and Lepus europaeus increased their number. This can be due to the following factors:
- improvement of the ecological situation in the Serebryany Bor, reduction of the level of anthropogenic impact on the habitat of species that have increased their numbers;
- a decrease in the number of competitors or natural enemies;
- deterioration of the ecological situation in other natural areas where rare species used to live. They were forced to move to the Serebryany Bor.

Thus, as a result of the analysis of the data obtained, it can be concluded that many species of animals are still recovering their numbers, but some species are gradually disappearing from natural areas. It is necessary to take measures for their preservation, including timely updating of the Red Data Book of Moscow and record fauna objects in PAs, including the Serebryany Bor nature monument [1].

References

[1] Sorokina A A, Zubkova V M 2020 Dynamics of the number of rare and protected species of herbaceous plants on the territory of the nature Monument of regional significance «Serebryany Bor» Modern science №2 56-62
[2] Federal law of 14.03.1995 No. 33-FZ «On specially protected natural areas»
[3] Ravkin E S, Chelincev N G 1990 Guidelines for integrated route accounting of birds (Moscow: printing house of the Ministry of building Materials of the USSR)
[4] Resolution of the government of Moscow 19.02.2013 N 79-PP «About the red book of Moscow»
[5] Gudkov V M 2007 Traces of animals and birds. Encyclopedic reference guide (Moscow: Veche)
[6] Kashin I V 2009 Natural resources as part of the national wealth of Russia Use and protection of natural resources in Russia № 5 3-7
[7] Mischenko A L, Belic V P 2017 Estimation of population and its dynamics for birds of the European part of Russia (Voronezh: Russian society for the conservation and study of birds named after M. A. Menzbir)
[8] Sorokina A A, Zubkova V M 2019 The specific features of the monument of nature of regional significance "Serebryannyy bor" and the assessment of its assimilation potential Contemporary Problems of Social Work №5 113-121
[9] Demakov U P, Korneev V A 2015 Dynamics of the white hare population and some aspects of its behavior in the reserve Scientific works of the state nature reserve «Bolshaya Kokshaga» (vol 7) ed. (Yoshkar-Ola: Volga state technological University) 258-273
[10] Chabirov N G, Bukatina E G 2017 Analysis of rational use of biological resources and conservation of biological diversity in the Republic of Tatarstan Vector of economy № 3 14-23
[11] Tony W Norton 1996 Conservation of biological diversity in temperate and boreal forest ecosystems Forest Ecology and Management №85 1-7
[12] Cucherousset J, Santoul F 2008 How do biodiversity patterns of river animals emerge from the distributions of common and rare species? Biological Conservation №141 2984-2992
[13] Laura E D, Cowles J 2019 When Do Ecosystem Services Depend on Rare Species? Trends in Ecology & Evolution №34 746-758