Assessment of the fauna reserve "Bragunsky" in conditions of anthropogenic transformation of ecosystems and measures for its optimization

A Batkhiev\textsuperscript{1}, T Avtaeva\textsuperscript{2}, M Jamalova\textsuperscript{1}, L Saparbayeva\textsuperscript{1}, Sh Kushalieva\textsuperscript{3}, D Arsanukaev\textsuperscript{1}, M Kaimov\textsuperscript{4}

\textsuperscript{1} Kh. Ibragimov Complex Institute of the Russian Academy of Sciences, Grozny, Russia
\textsuperscript{2} Academy of Sciences of the Chechen Republic
\textsuperscript{3} Chechen State Pedagogical University, Grozny, Russia
\textsuperscript{4} Chechen State University, Grozny, Russia

Email: batkhiev@kniiran.ru

Abstract. The article presents the materials of bioecological studies on the fauna state of biological reserve "Bragunsky", located in the plains of the Chechen Republic, the assessment of the degree of anthropogenic transformation, as a result of increased agricultural and manufacturing activities of the population in some parts of the reserve, the assessment of the current state of landscapes and biotopes, developed under the influence of anthropogenic transformation. The results of a comprehensive survey and inventory of the composition and species distribution of vertebrate and invertebrate animals are described. The article describes the characteristics of ecological and faunal groups, the representation of rare and protected species about anthropogenic changes. We used methods of cartography, multimedia modeling of satellite images, accounting for the number of species and their ecological and faunal analysis. Based on the research, based on the assessment of the results of anthropogenic changes, a justification was made for changing the current boundaries of the reserve, optimizing its territory and removing from the reserve some areas that are most anthropogenically transformed and are not of value for the composition of species and their protection. Practical recommendations are given.

1. Introduction

The system of specially protected natural reservations (SPNR) of the Chechen Republic is quite diverse and was created in the seventies of the last century, back in the Soviet Union, when it was considered the best in the world. All the main reserves of the Republic were organized and opened, starting from 1963 (Soviet, Vedensky, Parabochevsky), in 1970 (Urus-Martanovsky), in 1973 (Bragunsky and Stepnoy). Argunsky and Shalinsky reserves were established as hunting reserves in 1977 [1]. Thus, the Bragunsky biological reserve has been functioning for 50 years, during which there was an active increase in the anthropogenic load intensity on the natural complexes of the surrounding territory.

The maximum environmental effect of SPNR can be achieved only if their organization meets the main criteria of representativeness: the value of biodiversity indicators, the state of rare and endangered taxa as indicators of anthropogenic load, the representativeness of fauna and flora, the SPNR boundaries, the performance of environmental functions in the natural region [2].
The need to assess these criteria of representativeness, the functional state of the ecosystems of the Bragunsky reserve and the quality of its territorial structure, to improve the organization and efficiency improvement of its functioning, caused the relevance of the study. In this regard, in addition to the ecological and faunal state analysis of biota, the tasks of our research included determining the degree of optimality of the border areas of the Bragunsky reserve, indicators of environmental permeability of borders, and anthropogenically transformed areas of this specially protected natural reservation.

The Bragunsky reserve is located on the territory of the Chechen Republic and covers an area at the junction of the Grozny district, Shelkovsky, and Gudermessky districts (Fig. 1). The total area of SPNR is 17 000.0 hectares. The area of land plots included in the boundaries of SPNR without withdrawal from economic use is also 17000.0 ha. Protective zone of the reserve "Bragunsky" is missing.

**Figure 1. Geographical location and borders of the reserve "Bragunsky"**

**2. Methods and Equipment**

Material for this article is based on field studies in the territory of the reserve Bragunsky conducted by the authors in the years 2017-2019. On the reserve territory were conducted studies vertebrate, using standard methods were set pitfall traps, were collected manually insects and was collected herbarium material. The methods of cartography, ecological, and faunal analysis, the trap-day method, and the analyzing method of traces of vital activities of animals were used. A multi-time composite based on satellite images from the Landsat-8 satellite based on space information data from 2018 and 2015 was prepared for the anthropogenic load analysis.

**3. Results**

The main reserve area is a gently-rolling lowland plain with a continuous gradient from West to East. The South-Western part captures Bragunsky's ridge. The Northern area of the reserve is represented by the river valleys of the Terek and Sunzha rivers (Table 1).

| Landscape type in % of the area                |
|-----------------------------------------------|
| Fluvial plains and deltas-69.2                |
| Dry-steppe Eastern European plains (upland) - 24.3 |
| Eastern European (mountain belt) low-mountain - 5.6 |
| Semi-desert Kazakhstani and Central Asian plains (lowlands) 0.9 |

2
The climate in the area where the reserve is located is dry, with long and hot summers and short and warm winters. Spring begins in the first half of March. Autumn is dry, warm, the average monthly temperature in January is from -50\degree C to + 20\degree C, in July - from + 21\degree C to +25\degree C, the average yearly temperature is +10.4\degree C. The average yearly precipitation is 502 mm, of which 133 mm falls during the cold period and 369 mm falls during the warm period.

Most of the reserve territory is dominated by meadow and alluvial-meadow, carbonate, mostly salty, and saline soils. The Northern part is dominated by chestnut with patches of chestnut solonetzic and saline soils and solonetzic soils [3]. The Sunzha and Terek rivers flow through the reserve territory, and there is also a hydrological natural monument "Bragunsky mineral springs".

The flora and vegetation on the reserve territory are quite diverse. Here grow common oak, common ash, hornbeam, elm, common maple, wild pear tree, apple trees, white poplar. Among the rare plants listed in the Red Book of the Chechen Republic [4], there are maple, sea buckthorn, ivy, wolfberry, the lappaceous caper bush, silk vine, primrose, bear's-foot, helleborine, star-of-Bethlehem, madder, mortification root, peony, violet, colewort, Dutchman's pipe. Most of the reserve is located on the forestry fund lands-10.2 thousand hectares, two local forest districts, Grozny and Goryacheistochnensky. All reserve forests are classified as the first group of soil and water protection. Forest crops of floodplain forests are mainly represented by common oak and elm, but in places, there are birchbark-ash and oak, of vegetative origin. The admixture includes common ash, hornbeam, birch, field maple, pear, apple, and sometimes white poplar [5].

The reserve territory was designed taking into account the coverage and inclusion of floodplain forests of the Terek river, forests of the Sunzha river, and forests of the Bragunsky range. At the same time, the reserve also included agricultural land of three state farms, which included 6.8 thousand hectares of fields, pastures, hayfields, gardens, and vegetable gardens. Also included were the settlement lands - the Braguny village in the center, with its residential and economically developed areas, the Darban-Hi village, located on the southern border of the reserve. This structure of the reserve territory could not but have an adverse anthropogenic impact on the role and functionality of this SPNR. [6]

The Northern boundary of the reserve is partly on the boundary between the floodplain forest Chervleny forestry and dry land of semi desertic area, and partly along the river bed of the Terek. At the northern end of the reserve borders with agricultural land, which is a kind of buffer zone. The Eastern boundary of the reserve passes through Bragunsky ridge and is bordered by farming lands in the Grozny district of the Chechen Republic. The southern border of the reserve is bordered by farming lands of Ilinskaya village with a small number of inhabitants and floodplain forests of the Sunzha River, which does not significantly affect the ecosystem, vegetal and animal world of the reserve. As for the Western border, almost all of it runs along with the agricultural lands of the Komsomolskoye village, which serves as a kind of buffer zone for the reserve ecosystems. And only the Hangish-Yurt village located directly on the extreme Eastern point of this border also directly affects the anthropogenic transformation of a significant part of the reserve's territory.

Anthropogenic interference to a certain extent disrupted and changed the natural bounds in the plain-meadow and forest ecosystems of the reserve, due to long-term forest exploitation area. Forest stands of floodplain forests are upset by excessive systemless logging. Most of the reserve edges and along the roads are economically developed especially in the vicinity of settlements. On the Bragunsky ridge, the previously dominant dry ash oak-forest is also disturbed by unsystematic excessive logging, alternating with large haying and pascual forest openings. Paved roads and multiple lines of former oil pipelines significantly impair the ability of animals to live, making it difficult free movement. The anthropogenic intervention has disrupted and altered the natural bounds in the plains and riparian forest ecosystems, although natural properties are yet to a greater extent. Most of the modern valley of the Terek river and the mouth of the Sunzha River, inter-and intra-floodplain areas are reclaimed and economically developed. As a result, two ecosystems began to function in the Terek valley-river complex. The first of them is anthropogenic, which is in a crisis state, is represented by the developed valley of the Terek river and the mouth of the Sunzha River, as well as agricultural facilities [7]. The second is natural, represented by various types, which can be divided into floodplain water-near-water, barrier or intermediate (floodplain-forest), steppe xerophytic.
The diversity of habitat conditions and mosaic conditions cause a fairly large variety of invertebrates. The study area includes forest, near-water mesophilous and hygrophilous species, as well as xerophilic species that prefer open, well-lit areas.

A total of 99 species of insects were found during the study, including the order Odonata is represented by 8 species from 5 families, the order Mantodea is represented by 1 species from 1 family, the order Coleoptera, the family of ground Carabus-Carabidae includes 65 species. The family Scarabs-Scarabaeidae includes 5 species, 11 species from the order Hymenoptera; 4 species from the order Lepidoptera. The Coleoptera fauna is the most diverse, 8 of the presented species are included in the new list of rare and need of protection, and essays have been compiled in the new edition of the Red Book of the Chechen Republic.

The results of our research on the composition and structure of vertebrates have shown the following. The species composition of the fish fauna of the Bragunsky reserve in the Terek and Sunzha rivers, including on the territory of The Bragunsky reserve, includes up to 30 species and subspecies of fish belonging to 10 families, of which the most common species are about 20 [8,9]. All these fish belong to three biological groups: anadromous, semi-anadromous freshwater [10].

Herpetarium has not been fully studied in the Fore-Caucasus. Generalized information is given in the works of S. L. Kuzmin [11], N. B. Ananyeva, and co-authors [12], A. M. Batchiev [13] K. Yu. Lotieva [14]. Information on protected species of amphibian and reptile fauna is provided in the Red Book of the Chechen Republic [4].

Herpetobatrach Fauna of the state reserve "Bragunsky" is represented by three species of amphibians and 5 species of reptiles. Lake frog, Iranian long-legged wood frog, fresh-water turtle, grass, and water snake are common throughout the reserve. Along the ridges, in the vicinity of settlements, there is the green toad and sand lizard, and five-streaked lizard. According to the zoogeographic characteristics of herpetofauna, the reserve territory belongs to the North-East Pre-Caucasian region of the South-Eastern plain district, the European-Siberian subdistrict of the Palearctic.

The Amphibian class (Amphibia) is represented in the reserve by the order Tailless (Anura) with 4 species - the green toad (Bufo viridis), the Eastern tree frog Hyla Orientalis, the Iranian long-legged wood frog (Rana macrocnemis), and the lake frog (Rana ridibunda).

Class Reptiles (Reptilia) is represented in the reserve by 3 orders: the Turtle order (Testudines) with 2 species - the fresh-water turtle (Emys orbicularis), the Greek turtle (Testudo dgaesa), and the Scaly order (Squamata) – lizard suborder (Striata), with 6 species and Snake suborder (Ophidia) with 7 species.

As usual, the taxonomical structure of the ornithologic fauna in the reserve ecosystems is the most representative. The main composition of birds on the reserve territory is formed of at least 125 species, which are included in 16 orders: grebe – 4, stork - 5, Anseriformes – 9, bird of prey – 15, fowl-like birds – 2, Gruiiformes - 5, wading birds – 9, doves – 5, Cuculiformes – 1, owls – 4, goosanders – 1, hummingbirds – 1, Coraciiformes – 3, upupiformes – 1, Piciformes-1, perching birds-59 [15]. From the list of major bird species listed for the reserve, the most different species of perching birds, wading birds, Anseriformes, and birds of prey. They accounted for 76.8% of the total bird diversity in the reserve "Bragunsky". The dominant position on this territory is occupied by bird species associated with plain habit area and forest plantings. They form the core of the nesting ornithologic fauna, and are most fully represented by species of such orders as stork and wading birds. This pattern can be traced for some groups of birds, distinguished by the nature of their stay. Analysis of the relative occurrence of birds shows that the basis of ornithologic fauna is common and limited species. Typical indicator species that have adapted to the anthropogenic impact are synanthropic species: the common swallow (Hirundo rustica) and white wagtail (Motacilla alba), in open areas the crested lark (Galerida cristata). The ecological structure of the ornithologic fauna of the research area is diverse. It includes 4 groups of species: limnophile, dendrophil, campophile, sclerophyllous plant [16]. A secondary position in this territory is occupied by bird species associated with water-near-water habit areas along the Terek river and floodplains of the mouth of the Sunzha River. They form the part of the breeding ornithologic fauna of the Bragunsky reserve and are most fully represented by species of such orders as stork, Anseriformes, and wading birds. They inhabit open water masses of the Terek river,
floodplains of the Sunzha river and other reservoirs, thickets of bog vegetation, shoals, and the coastline of small reservoirs.

Class Mammals is represented on the reserve territory by at least 31 species and 6 orders and 9 families: the order insectivores (Eulipotyphla) – 4; the order lagomorphs (Lagomorpha) – 1; the order gnawing beasts (Rodentia) - 8; the order chiropterans (Chiroptera) – 3; the order carnivores (Carnivora) – 13; the order artiodactyles (Artiodactyla) - 2. [17]. Among mammals of economic importance, all groups of habitat areas are widely developed: the jackal Canis aureus Linnaeus, 1758, and the fox (Vulpus vulpes), whose numbers are high here. The distribution of phytivorous species is confined to freshwater reservoirs, floodplain forests, and adjacent open spaces: the water vole (Arvicola Terrestris) is a common species, the muskrat (Ondatra zibethica) is not numerous brown hare (Lepus europaeus) is common. The American mink (Mustela vison), a small species, is one of the predatory ones. The Caucasian otter (Lutra lutra meridionalis) is represented by no more than 20 - 25 individuals and is a rare species. Of the hoofed mammals in the floodplain of the Terek river, the common boar (Sus scrofa), rare, but inhabits the Caucasian deer. Among the chiropterans, the lesser and great bat (Nyctalus leisleri, Nyctalus noctula) are common. The order Insectivora is insectivores, in the research area includes 2 families: hedgehogs are 2 species and shrews are 2 species.

Of the protected terrestrial vertebrates species in the reserve "Bragunsky" and its vicinity have not been found amphibians included in the list of protected species, but there are at least five rare and protected species of reptiles of the Chechen Republic. On the territory of the Bragunsky reserve, there are at least 20 species of birds with different conservation status and rare distribution, included in the list of protected species by the legislation of the Chechen Republic and Russian laws. Of these, 12 protected species nest or are presumed to nest on the territory under consideration. The ecological structure is mainly birds dendrophil, campofile, and limnophile.

The protected species of theriofauna in the reserve "Bragunsky" found at least eight species of rare, protected, and listed in the Red Book of the Chechen Republic in mammals with different conservation status and bio topic allocation. According to their ecological status, they can be classified as plain species-xerophiles (steppe polecat), dendrophiles (forest cat, red deer, giant noctules), hygrophilous near –water species (Caucasian otter, European mink, jungle-cat) widespread species (badger).

The results of expeditions to the reserve area confirmed the assumption about the great conservation value of the surveyed territories. Detections of some species having protected status across the Caucasus and national scale are a sufficient argument, evidence of the conservation role and value of the reserve, and its biosphere functions as a protected natural area [18,19]. Floodplain forests and wetlands of the reserve are of particular importance.

4. Discussion

Taking into account the intensive economic development of forest and meadow-steppe lands by humans, it becomes necessary to identify the most significant and biologically productive natural areas in order to preserve their biodiversity and maintain them in their natural state. [20]. At the same time, it is necessary to exclude from the SPNR developed and highly modified areas that, due to their economic functions, cannot meet the goals and objectives of the reserve. The boundaries of the SPNR should be adjusted so that they coincide, if possible, with existing natural or artificial landmarks (ridges, canals, roads, etc.). Based on the above and according to the results of the fauna survey and analysis of the degree of anthropogenic transformation of various areas, it is recommended to exclude from the reserve territory:

- southeastern projection of the territory, covering the vicinity of the Hangish-Yurt settlement and farming lands around the village of Braguna, together with its surroundings, since the border existing here includes this territory, which has long been actively used for economic purposes, which does not allow establishing the border of the reserve directly on a natural and naturally significant area and effective protection of the object (Fig. 2.)
Figure 2. Map-scheme of the Bragunsky reserve territory optimization

Proposed for withdrawal the territory indicated on the map of the reserve is not a key location for the concentration of protected species of flora and fauna, hunting is allowed here within the time limits established by law without significant disturbing the nesting and wintering areas of birds. The proposal to remove this area from the territory of the Bragunsky reserve is justified by the fact that these settlements – the village of Khangash-Yurt and the village of Braguna with their surroundings, where the road passes, as well as actively used arable and hay lands, cannot meet the requirements of the reserve's tasks.

The second area recommended for removal from the territory of the Bragunsky reserve, as not of conservation value due to the presence of certain rare, endangered, or economically significant animal species, places of their concentration, reproduction or experiencing adverse conditions, is the territory from the Western border of the reserve towards the East. This is the area between the Bragunsky ridge and forests along the right bank of the Terek river, with the capture of points indicating local enterprises on the map of the reserve, approximately to a conditional line between mount Karada and the end of the forest at map-scheme of the Bragunsky reserve.

5. Conclusion
The results of investigation of the Bragunsky reserve territory substantiate the need of including the following territories in the reserve in order to preserve the identified habitats of some rare species of land animals, nesting, feeding and migration routes of rare and hunting birds:
- the territory from the Western border of the reserve and along the Bragunsky ridge, covering its area approximately to the vicinity of the village of Vinogradnoe, according to the map of changes in the territory of the reserve;
- the territory from the southernmost point of the reserve border, along the banks of the Sunzhi river, covering the entire forest area of the floodplain forest between the border of the Grozny-rural district and the Novy Tsentoroy – Gudermes road, as a habitat for rare, protected species listed in the red book of the Chechen Republic. These include the Caucasian otter, the Caucasian deer recorded in the floodplain of the Sunzhi river and the forest of the Dzhalka village, as well as a number of bird species. In our view, implementation of the proposed changes in the territory of the Bragunsky reserve meets the requirements of the tasks of the reserve for the protection of the animal world. It should be mentioned that the category of protected areas does not change.
References

[1] Ryzhikov V V, Golobuckij A A 1985 Natural monuments and reserves of the Checheno-Ingush ASSR. Grozny: Checheno-Ingush book publisher

[2] Dyozhkin V V, Popova L V 2006 Environmental ethics and biological nature management: elements of theory and ethical and environmental restrictions, Use and protection of natural resources in Russia 1 28-37

[3] Golovlev A A, Golovleva N A 1989 Soils of Chechen-Ingushetia. Grozny: Checheno-Ingush book publisher

[4] 2007 Red Book of the Chechen Republic. Rare and endangered species of plants and animals. Grozny

[5] Umarov M U 2003 Plant resources of the Chechen Republic, prospects for use and protection. Proceedings of the all-Russian scientific conference. Grozny

[6] 1994 Topical issues of ecology and nature protection of steppe ecosystems and adjacent territories. Proceedings of interdisciplinary applied research conference. KGU KNK

[7] Bathiev A M 2010 Crisis state and ways to solve environmental and ecological problems of the Terek river basin, Reflection 4-6 3-8

[8] Bathiev A M 2008 Ichthyofauna conspectus. Reflection 1 3-12

[9] Kaimov M G 2015 General description of ichthyofauna of the Chechen Republic. Ecology of Jejenamsk brook trout in the waters of the Chechen Republic Grozny

[10] Reshetnikova Yu S 2003 Atlas of Russian freshwater fises: Ch. 2 t. Vol.1. Moscow: Nauka Publishing House

[11] Kuzmin S L, Semenov D V 1999 Conspect of the fauna of amphibians and reptiles of Russia Moscow: KMK Scientific Press Ltd

[12] Ananeva N B, Orlov N L, Halikov R G 2004 Atlas of the reptiles of the North Eurasia (Taxonomic Diversity, Distribution, Conservation Status). Saint Petersburg

[13] Bathiev A M 2009 Local fauna (animals of the Chechen Republic). Grozny

[14] Lotiev K Yu 2003 Species and subspecies composition of reptiles of the Chechen Republic. Biological Diversity of the Caucasus Proceedings of 5th International Conference. Magas

[15] Bathiev A M 2008 A synopsis of the avifauna of the Chechen Republic. Reflection 5 3–29

[16] Gizatulin I I, Hohlov A N 2001 Birds of Chechnya and Ingushetia. Stavropol: SOPR Publishing House

[17] Bathiev A M 2008 A synopsis of the theriofauna of the Chechen Republic. Reflection 6 3 - 16

[18] Rejmers N F 1992 Protection of nature and the human environment. Moscow: Prosveshchenie Publishing House

[19] Tishkov A A 2005 Biosphere functions of natural ecosystems in Russia. Moscow: Nauka Publishing House

[20] Abdurahmanov G M, Shkhagapsoev S H, Bathiev A M 2014 Current state of regional mountain biodiversity, problems of its conservation and rational use, Sustainable development of mountain regions of the North Caucasus in the context of global changes [Proceedings of Scientific Conference] Grozny, pp. 162–167.