Findings of animal and plant objects listed in the Red Book of the Russian Federation on the territory of Shihan Kushtau (Republic of Bashkortostan, Russia)

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Abstract. The article presents information about the findings of rare species of plants and animals on the territory of Mount Kushtau (Republic of Bashkortostan). During the period from 2014 to 2019, six representatives of the flora of the species and eight representatives of the fauna listed in the Red Book of Russia were discovered. Their brief characteristics and population characters are given. Based on that studies we recommend that Shihan Kushtau be given the status of a specially protected area.

1. Introduction
Shihan-mountains in the Republic of Bashkortostan are the remains of Permian reefs. They were immersed in the Ural ocean about 300 million years ago. Their deposits consist mainly of limestone and abound with fossils of ancient organisms [1]. Sterlitamak Shihans were brought to the surface of the earth relatively recently and practically retained their original appearance [2]. At the same time, the flora and fauna of Shihan also significantly differs from the background biodiversity of the region. On the calcareous slopes of these mountains many relics and endemic plants grow. Among the latter the Pimpinella tomiophilla (Woronow) Stank., occurring only on Tratau and Kushtau Shihans.

In total, the chain of Shihan includes four largest mountain group: Tratau, Yuraktau, Kushtau and Shakhtau. The last Shihan is completely metamorphosed for today to produce limestone. In its place is located a quarry now. Many rare organisms disappeared together with the Shihan Shakhtau.

Two of the group are – Tratau and Yuraktau, they are included in the list of the Global Indicative list of Geological sites and they are official monuments of nature in the Republic of Bashkortostan. Now the issue of including these mountains in the UNESCO list of heritage is being considered. The biodiversity of Shihan Tratau and Yuraktau is well explored.

The third and the largest Shihan Kushtau was recently officially transferred to mining organizations by the Bashkortostan government for the extraction of limestone, however, it has not begun yet.

Kushtau is a two-peaked Shihan. Its total area is 5.6 km². A significant part of the Shihan is covered with deciduous forest. Calcareous slopes and petrophytic steppes represent about 25% of its...
area. Apparently, the interest of scientists in this Shihan was insufficient due to the small area of the ancient calcareous outcrops. Biodiversity of Kushtau is poorly explored.

At the same time, Kushtau differs from other Shihan due to some factors. Its relatively large area and forest covered area, as well as the mosaic arrangement of rocks, create more diverse ecosystems. Accordingly, the total biological diversity of this complex is increasing. In addition, Kushtau is completely surrounded by anthropogenic landscapes: settlers of soda production, quarry on-site Shihan Shahtau, roads, settlements, and other facilities. The city of Sterlitamak is in a few kilometers from Kushtau. This environment creates on Shihan "island" conditions. Kushtau is a kind of "refuge" for many species of animals and plants.

A detailed study and analysis of the state of biodiversity confined to this landscape complex is necessary in connection with the upcoming development of the Kushtau massif mass.

2. Materials and methods
Investigation were conducted over six field seasons (2014-2019). Examination of flora and vegetation were carried out by the route method. Platforms for geobotanical descriptions were laid in typical areas of vegetation. Population-based studies were carried out in accordance with the traditional directions of the study of rare species [3, 4]. The abundance, density, and condition of rare species of flora were evaluated by their occurrence in geobotanical descriptions and by taking into account age-related conditions in cenopopulation studies. The population area was determined based on the area of landscape-floristic complexes to which they are confined using the Garmin GPS navigator.

The identification of the bats species diversity was carried out by the method of their capture using cobweb networks and mobile traps [5, 6], as well as examining possible places of day’s rest. The population density was determined by the number of individuals flying over an interval of 1-2 minutes on an area of 100 m² (visibility in the dark in clear weather).

The study of birds was carried out by the route method [7].

Amphibians and reptiles were counted on areas 2 meters wide and 1 km long. Routes ran through all typical biotopes of the Shihan [8].

Invertebrate abundance was calculated on the basis of the approaches of Kuzyakin A.P., Mazina L.N. [9] and Pesenko Yu.A. [10]. In favorable weather for the flight of one species or another, in the most typical biotopes, areas of 100 m² were laid in which all the individuals encountered were caught using an entomological net or collected by manual collection for one hour.

The total population size was determined based on the area of biotopes typical of its representatives.

All captured and recorded individuals were released into the territory where they have been found.

3. Research results
As a result of studies in the Shihan of Kushtau, 6 species of plants from the Red Book of the Russian Federation [11] and 8 species of animals from the List of objects of the animal world listed in the Red Book of the Russian Federation (1997) were identified. The following is a list of species, their brief description and population features in the study area.

Plants

1. European feather grass Stipa pennata L. It is included in the Red book of Russia Federation – III category. It is confined exclusively to steppe plant communities; it lives in thickets of bushes, along slopes and scree of carbonate rocks. Propagated by seeds, which are characterized by low germination. The greatest number reaches on the eastern and southeastern slope of Kushtau up to 10-30 specimens per 25 m². On talus and forest edges, the abundance is lower - 2-3 specimens on 25 m².

2. Koeleria sclerophylla P.A. Smirn. It is included in the Red book of Russia Federation – III category. It grows on carbonate soils, usually in rarefied communities, on limestone outcrops, and in rock fissures. It propagated by seeds. It is an endemic of the Southern Urals. On Kushtau, the population is mosaic: in communities with high competition from other plants, the number is low, up to 10 individuals on 25 m², on rocky limestone outcrops up to 20-30 individuals on 25 m².
3. *Hedysarum grandiflorum* Pall. It is included in the Red book of Russia Federation – III category. It is confined to alluvial calcareous slopes, marls, petrophytic steppes, chernozems with a carbonate sublayer. It is pollinated by insects. According to our observations, the bee carpenter *Xylocopa valga* Gerstäcker, 1872 (a species also from the Red book of the Russian Federation) makes a 30% contribution to the pollination. It is propagated by seeds. It is quite common in characteristic communities on Kushtau, but the abundance is everywhere low - from 1 to 10 individuals on 25 m².

4. *Fritillaria ruthenica* Wikstr. It is included in the Red book of Russia Federation – III category. It is steppe perennial bulbous plant. It is confined to shrouded petrophytic communities with carbonate soils. It is pollinated by insects, reproduction by seeds. On Kushtau, it grows on the edges of the forest, along shrubs along the steppe western and eastern slopes. The number is from several copies to 40-80 plants of all ages per 1 m².

5. *Minuartia krascheninnikovii* Schischk. It is included in the Red book of Russia Federation – III category. It grows exclusively on calcareous slopes and screes in conditions of reduced competition from other plants. It is propagated by seeds. It was also noted on the Shihan of Toratau, the population dedicated to the Shihan of Shakhtau was eliminated [12]. It is rare in Kushtau - from 1 to 3 specimens per 25 m² in the descriptions of the vegetation of slopes and screes.

6. *Thymus cimicinus* F.K. Blum ex Ledeb. It is included in the Red book of Russia Federation – I category. It has a half shrubs form. It is petrophyte and calcephilus, grows on slopes and screes, in rock fissures. It is pollinated by insects. It is noted only on limestone slopes on Kushtau. It has the mosaic population - from single encounters, up to 10-20 copies on 25 m².

Animals

1. Pallid harrier *Circus macrourus* (S. G. Gmelin, 1770). It is included in the Red book of Russia Federation – II category, IUCN List category: NT. It is endemic to the steppes of Eurasia. It nests in flooded floodplains. It is main prey is rodents. We noted a pair of males rapidly flying one after another over an open steppe section of the western slope. The birds were distinguished by light ash color and wedge-shaped black ends of the wings. The observation distance is 7-10 meters.

2. The eastern imperial eagle *Aquila heliaca* Savigny, 1809. It is included in the Red book of Russia Federation – II category, IUCN List category: VU. This is a large eagle, characteristic of the forest-steppe zone. We have observed Kushtau almost every year, since 2014, this shows that somewhere inside the mountain massif there is a nest (nesting sites for this species are constant). The nest location of is not known, but at the same time the individual is always occurred on the bank of the river, on the southern slope of Shihan.

3. The Eurasian oystercatcher *Haematopus ostralegus* ssp. longipes Buturlin, 1910. It is included in the Red book of Russia Federation – III category, IUCN List category: LC. It lives along the floodplains of medium and large rivers in areas with extensive pebbles. We noted a couple flying along the river bank of Belaya along the eastern slope of the Shihan in 2014 and three individuals in 2018.

4. *Lucanus cervus* (Linnaeus, 1758). It is included in the Red book of Russia Federation – II category, IUCN List category: NT. The largest species of European beetles. Larvae develop under the roots of stumps, where they feed on rotting wood, most often oak. It takes 4 to 8 years to development from larva to imago. It is rare occur in Kushtau, but everywhere. We recorded two males of a stag beetle and one female along the route, as well as more than 30 larvae found under rotting oak stumps. The estimated population on Kushtau is more than 10,000 individuals.

5. The Russian leather beetle *Osmoderma eremita* (Scopoli, 1763). It is included in the Red book of Russia Federation – II category, IUCN List category: VU. It confined to old-growth broad-leaved forests, larvae develop in rotten wood. For the first time we discovered it in 2019 on the territory of Ishimbay district. One individual was found on the eastern slope of Shihan Kushtau. We suppose that the natural conditions of the mountain are suitable for the habitat of the species and the development of its larvae, most likely the population confined to Kushtau has many individuals. The estimated population is about 500 individuals.
6. The clouded Apollo Parnassius Mnemosyne Linnaeus, 1758. It is included in the Red book of Russia Federation – II category, IUCN List category: NT. It is a butterfly species of the family of swallowtail butterflies. It is shown that the number of representatives of this species decreases (Red Book of the Republic of Bashkortostan, 2014). The limiting factor for the butterfly - mosaic populations dedicated to forage plants caterpillars – the fumewort (Corydalis solida). This plant is widely distributed on Kushtau, grows in forests and on the edges. The clouded Apollos population on the Shihan is isolated by anthropogenic landscapes, but numerous. In May 2019 we were caught 18 individuals of clouded Apollo in a biotope with area is about 300 m² per hour (later they were released). On a route of 4 km in length we occurred at least 1 individual per 25 m². Although apparently specific studies of the clouded Apollo abundance in Bashkortostan have not been conducted, the population of this butterfly on the Shihan Kushtau can be considered the largest for the region. Estimated population is more than 15,000 individuals.

7. The Armenian bumblebee Bombus Armeniacus Radoszkowski, 1877. It is included in the Red book of Russia Federation – II category, IUCN List category: EN. The number of this species is declining throughout the country, but the reasons are not very clear. For Kushtau, it is also a rare species, it does not occur annually, the population is confined to the entire Shihan area. The steppe, meadow, and marginal phytocenoses are forage areas, and forests are a place for the creation of earthen burrow colonies. Estimated population is more than 2300 individuals.

8. Carpenter-bee Xylocopa valga Gerstaecker, 1872. It is included in the Red book of Russia Federation – II category, IUCN List category: LC. A rare species for the Russian Federation and the Republic of Bashkortostan, but for the local fauna of the Shihan Kushtau is relatively numerous. On Kushtau are created unique conditions that combine the biotopes necessary for the successful existence of this bee: broad-leaved forests and steppes rich in nectariferous plants. In wood, a bee carpenter arranges nesting chambers. The carpenter bee population on Shihan Kushtau can be called the largest in the Republic of Bashkortostan, and possibly in the Russian Federation. On the route, we noted from 2 to 5 individuals per 100 m². Per hour, were caught 32 individuals (which were subsequently released). Estimated population is more than 21,000 individuals.

4. The discussion of the results
Thus, on the Shihan Kushtau a rather significant number of rare species of animals and plants was revealed. It should be noted that in addition to the species listed in the Red Book of Russia, on Kushtau we also described another 14 species of animals, 6 species of plants and 1 species of mushrooms from the Red Book of the Republic of Bashkortostan [12, 13]. In addition, with the highest degree of probability, such rare species as the Rosalia longicorn (Rosalia alpina Linnaeus, 1758), the forest caterpillar hunter (Calosoma sycophanta Linnaeus, 1758) and the European mantis (Mantis religiosa Linnaeus, 1758) are confined to the territory of the Shihan Kushtau. More research is needed to detect these species and determine the status of their populations. In general, at least 38 species of animals, plants, and fungi belong to the rare ones, which are confined to the territory of Shihan Kushtau.

On the territory of the natural complex of Shihan Kushtau, we also described about 400 species of plants, 500 species of invertebrates, 60 species of birds, 16 species of mammals and 5 species of amphibia and reptiles.

In accordance with the Law on the Animal World of 2019 (Article 24): Actions that may lead to the death, reduction in the number or disturbance of the habitat of objects of the animal world listed in the Red Books are not allowed.

Also, in accordance with Order No. 264 of May 29, 2017 and the Red Book of the Russian Federation (2008): Activities that lead to a reduction in the number of rare plant species and worsen their growth environment are prohibited.

In terms of the value of biological diversity, Shihan Kushtau fully meets the requirements of the Federal Law “About Specially Protected Natural Areas” (as amended on July 26, 2019) and should receive the status of a natural monument on a par with the Shihans Yuraktu and Tratau.
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