Preservation of Regional Biodiversity Associated with Gold Deposits Development in the Khabarovsky Krai (Based on Mammals Population)

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Abstract. There are presented the results of the field research of biodiversity and the wildlife state in the aspect of the study of fauna and population of mammals in the land allotment of the exploitable Albazino deposit in the P. Osipenko Municipal District of the Khabarovsky Krai in July-August, 2017. The field surveys of the territory for identification of common and Red Book species of animals were carried out to ensure their safety. The species composition and the numerical vertebrate animals assessment within the land allotment have been studied. The problem of possible preservation of fauna and animal population in connection with precious metal commercial development was researched. The recommendations for preservation of numerically predominant, rare and very rare species of the animal world having significant biocenotic importance in the nature and for a human being have been developed.

1. Introduction
The relevance of studying the plant and animal world in connection with the industrial development of mineral raw materials in the Khabarovsky Krai is obvious, because research of biodiversity in the land allotment of the Albazinsky developing deposit in the Khabarovsky Krai is pioneering. In July-August 2017, the scientific team of the biological profile from the Far Eastern Forestry Research Institute (FEFRI) conducted the research of organization of flora and fauna mining and environmental monitoring of the Albazinsky deposit under development in the P. Osipenko district of the Khabarovsky Krai. The numerically predominant and Red Book species of the Khabarovsky Krai [1] were surveyed in field to ensure their safety.

The species and quantitative composition of mammals in the territory of the land allotment of the exploitable deposit was studied. Due to this, the purpose of the work was to study the biodiversity of mammals, their quantitative composition and to develop the proposals for organization of mining and environmental monitoring of the wildlife changing in the area of study. From this purpose, the following tasks were defined: 1. To carry out field research for the purpose of inventory of available animal species taking into account the species and quantitative composition in different types of plant formations within the limits of the land allotment of a gold deposit under development; 2. To analyze and summarize the information for the study of the theriogroup biodiversity problem in the land allotment; 3. To reveal objects of the Red Book of the Khabarovsky Krai; 4. To reveal the economic activity impact on fauna and animal population.
2. Methods of research
During 2017, the field works of the flora and fauna study were carried out. 7 permanent sampling areas were laid, on which the authors made the assessment of small and big animals, birds, reptiles, amphibians in the most characteristic areas (phytocenoses) according to generally accepted methods considering planting uniformity [2]. Reservoirs and watercourses were examined for ichthyofauna studying.

The work was carried out using a set of generally accepted methods of zoological research of vertebrate animals: a group of small and big mammals, analysis of theory and practice of monitoring in the mineral development area, systematic analysis of natural material sampling [5]. For the quantitative assessment of mammals the trap-day method was used. The handicraft hypersensitive traps were used. They were set 5 meters far from each other in the evening, taking into account twilight and night activity of animals. The bait was vegetable oil impregnated bread. The catch was collected in the morning. The statistical estimation was carried out for 100 traps. The assessment of the animals abundance is given according to a point scale of A.P. Kuzyakin, 1962. Small animals were ranked by the number: the numerous species (+ + +) – more than 10 species per 100 trap-days (t-d); common species (+ +) type – 9.9 - 1; rare species (+) – from 0.9 to 0.1; very rare species (+-) – less than 0.1 specimens per 100 t-d. The species of hunting animals were taken into account visually on linear routes by tracks and by encounters, with possible recognition on a foot lane, not more than 10-15 m, by certain signs of their activity: traces, biting marks, diggings, remains of a hair cover and etc [5]. The survey of wildlife-biologists, amateur-hunters and other kinds of population was conducted.

3. Results and discussion
Albazinskoe gold deposit is located in the Far Eastern Federal District (FEFD), in the eastern part of the P. Osipenko District of the Khabarovsky Krai in the Amgun-Somnya interstream in the axial part of the Omalsky Ridge with absolute marks of 350-800 m. The projected construction site belongs to poorly developed regions of the Khabarovsky Krai. The problems related to the assessment of the wildlife and its biodiversity changing remain insufficiently studied. Only fragmentary data or initial quantitative estimates are available.

The results of quantitative accounting at permanent sample areas indicate that from small mammals 102 animals of 8 species (long-clawed, slender and masked shrews, Northern pika, chipmunk, Korean field mouse, gray-sided vole and Northern red-backed vole), 3 units, 5 families and 5 genera were obtained; from big animals, 5 species (a squirrel, a weasel, a Siberian weasel a fox, a polar hare) of 4 units were found visually and by enquiry of well-informed persons (including the experts from district administration) (table 1). Fur hunting animals were included in the lists of vertebrate animals (table 2), typical for the territory of the P. Osipenko District, and relatively undeveloped by Albazino mining enterprise. The new reliable information about 7 species of commercial animals (American mink, ermine, glutton, raccoon dog, lynx, beaver-rat, wild reindeer), periodically visiting natural complexes, was acquired. It is known that chipmunk, weasel and flying squirrel, previously being hunting species, have been actually withdrawn from hunting since 1959.

From 76 species [3,4] living at the territory of the Khabarovsky Krai, 29 (about 40%) were found in the P. Osipenko District, 22 species of mammals - within the Albazino exploitable deposit (table 1).

The sexual and age peculiarities of three background species – gray-sided and red-back voles, Korean field mouse were studied. It was found out that 24 males and 29 females of gray-sided vole, 12 males and 12 females of red-back vole; 2 males and 10 females of the Korean field mouse, respectively, were obtained at the studied territory. The background species are represented by breeding adults (adultus); non-reproducing adults (subadultus) and young individuals (juvenius). From 89 animals 51 (57%) individuals were adult, 30 (33%) – sub-adults and 8 (10%) – young. Among the adults there were 32 females, 12 – nursing and 4 – pregnant, while 16 – non-reproducing individuals (subadultus). Considering that the pregnancy of females lasts 21 days, and youngsters are
growing up during 3 months, it should be assumed that the background animals breeding began not in April-May, but from the beginning of June and was lasting during July and August due to the weather conditions.

The studies made allowed to draw a conclusion that the population of all three background species (grey-sided and red-back voles, and Korean field mouse) continues to be stable with a higher quantitative state, which has a positive effect on predatory animals – animals and birds.

Table 1. Mammals of the Albazino GOK territory (with possible animals’ visits).

| No | Units, species | Forest formations (forest types) | Abundance |
|----|----------------|----------------------------------|-----------|
|    |                | 1c 2d 3e 4f 5g 6h 7i             |           |
|----|----------------|----------------------------------|-----------|
| 1  | Long-clawed shrew Sorex unguiculatus Dobson, 1890 | 4b + + + + |           |
| 2  | Slender shrew Sorex gracillimus Thomas, 1907 | + ++ |           |
| 3  | Masked shrew Sorex caecutiens Laxmann, 1788 | + + + + +++ |           |
| 4  | Polar hare Lepus timidus Linnaeus, 1758 | + +++ |           |
| 5  | Northern pika Ochotona giperborea Pallas, 1811 | + + ++ |           |
| 6  | Squirrel Sciurus vulgaris Linnaeus, 1758 | + ++ |           |
| 7  | Siberian chipmunk Tamias sibiricus Laxmann, 1769 | + + + + +++ |           |
| 8  | Korean field mouse Apodemus peninsulae Thomas, 1907 | + + + + +++ |           |
| 9  | Gray-sided vole Clethrionomys rufocanus Sundevall, 1846 | + + + + + + + +++ |           |
| 10 | Northern red-backed vole Clethrionomys rutilus Pallas, 1779 | + + + + + +++ |           |
| 11 | Beaver-rat Ondatra zibethica Linnaeus, 1758 | + + + + ++ |           |
| 12 | Fox Vulpes vulpes Linnaeus, 1758 | + ++ |           |
| 13 | Wolf Canis lupus Linnaeus, 1758 | ques. | ++         |
| 14 | Brown bear Ursus arctos Linnaeus, 1758 | ques. | ++         |
| 15 | Sable Martes zibellina Linnaeus, 1758 | ques. | ++         |
| 16 | Siberian weasel Mustela sibirica Pallas, | + |           |
| No | Units, species                      | Abundance |
|----|------------------------------------|-----------|
|    |                                    | 1<sup>c</sup> | 2<sup>d</sup> | 3<sup>e</sup> | 4<sup>f</sup> | 5<sup>g</sup> | 6<sup>h</sup> | 7<sup>i</sup> |
| 17 | Weasel Mustela nivalis Linnaeus,1766| +          | ++          |
| 18 | Otter Lutra lutra Linnaeus,1758     | ques.      | +           |

**Artiodactyla**

| No | Units, species                      | Abundance |
|----|------------------------------------|-----------|
| 19 | Musk deer Moschus moschiferus Linnaeus, 1758 | ques.      | +           |
| 20 | Red deer (Siberian stag) Cervus elaphus Linnaeus, 1758 | +          |
| 21 | Siberian roe deer Capreolus pygargus Pallas, 1771 | +          |
| 22 | Elk Alces alces Linnaeus, 1758       | +          |

Note: <sup>a</sup> ques. - questioning; <sup>b</sup> + presumed and caught individuals; in the "abundance" column species abundance is given at the Albasinsky GOK territory (+++ - multiple species, ++ - common species, + - rare species, + - very rare species). Albasino forest objects (Forest type, Formations):

<sup>c</sup>1 - Spruce tall-grass-fern forest;
<sup>d</sup>2 - Larch forest, shrubby-motley grass;
<sup>e</sup>3 - Larch forest, blueberry-labrador-moss;
<sup>f</sup>4 - Larch forest, sorbifolious;
<sup>g</sup>5 - Larch forest, vaccinium-green moss;
<sup>h</sup>6 - Larch forest, labrador - green moss;
<sup>i</sup>7 - Larch forest, grass-moss.

In relation to other species – the representatives of Rodentia, Insectivores and Lagomorpha, it can be said that their populations are relatively stable, requiring further research during the warm seasons of their stay in the territory. From 5 species of the obtained animals there were two species of shrews – masked and long-clawed, (5 and 4 persons) joined the rank of common, which made respectively 4.9 and 1.1% of the catch. The Northern pika was captured twice and by one individual - slender shrew and chipmunk. It should be noted that pika and chipmunk are mostly diurnal.

Thus, in our opinion, the quantity of these 5 types of small mammals of two units – Insectivora and Rodentia, is sufficient and they can be attributed to the common or background species. The species from the Red Book of the Khabarovsk Krai, such as: common Kutora (Insectivora), from the bat unit, 6 species: Amur, long-tailed and Brandt's bats, long-eared bat, Northern bat, Siberian tubenosed bat are not specified in the table 1 [6-11].

The basis of the hunting resources of the Khabarovsky Krai was 29 species of big and relatively small mammals [5, 12]. They are slightly less at the territory of the P. Osipenko Municipal District (20) of four units: Lagomorpha – 1 species, Rodentia – 2 species, Carnivora – 12 and Artiodactyla – 5, which are reliably difficult to find out in summer. In the area of our research 6 species were revealed – Asian chipmunk, polar hare, squirrel, fox, brown bear, weasel.

Table 2 shows the fauna and population of fur hunting animals. It is concluded that the absolute majority of hunting animals constantly or periodically visit the territory under study.
Table 2. Fauna and population of fur hunting animals at the P. Osipenko Municipal District territory (in the average, 2004-2013) [5].

| No | Species            | Number of individuals (animals) | Density per 1,000 ha |
|----|--------------------|---------------------------------|----------------------|
| 1  | Sable              | 9,838                           | 3.61                 |
| 2  | Siberian weasel    | 197                             | 0.20                 |
| 3  | American mink      | 1,348                           | 0.37 per 1 km of flood plain |
| 4  | Ermine             | 1,865                           | 0.79                 |
| 5  | Otter              | 282                             | 0.78 per 10 km of flood plain |
| 6  | Badger             | 114                             | 1.64                 |
| 7  | Brown bear         | 396                             | 14.2 per 100,000 ha  |
| 8  | Fox                | 434                             | 0.28                 |
| 9  | Raccoon dog        | 10                              | 0.04                 |
| 10 | Wolf               | 104                             | 3.35 per 100,000 ha  |
| 11 | Lynx               | 21                              | 0.92 per 100,000 ha  |
| 12 | Glutton            | 38                              | 2.00 per 100,000 ha  |
| 13 | Squirrel           | 12,389                          | 5.81                 |
| 14 | Beaver-rat         | 8,375                           | 0.63 per ha          |
| 15 | Polar hare         | 6,896                           | 2.4                  |
| 16 | Siberian stag      | 163                             | 0.21                 |
| 17 | Roe deer           | 169                             | 0.30                 |
| 18 | Elk                | 2,044                           | 0.70                 |
| 19 | Wild reindeer      | 763                             | 0.40                 |
| 20 | Musk deer          | 322                             | 0.43                 |

On the basis of the carried out field researches the conclusion was made that impact of the exploitable Albazino deposit on biodiversity of mammals does not exceed the norms stipulated by the current legislation.

4. Conclusion
The absolute majority of the population species of these animals (table 2) inhabits the surviving plant groups and do not want to leave the genetically mastered (adapted) habitats. For example, a brown bear for years is living at the deposit mastered territory and during twilight and night time can appear in a settlement that causes huge excitement among people. Big hunting animals, quickly moving, expand the possibilities of distribution. However, the transformation of the land under the impact of quite extensive logging, explosions, fires, and other anthropogenic actions contributes to stress of the animals that are frightened and leave the mastered places. It has been established that the number of animals is reduced near the human habitat, although the species composition characteristic of the relatively vast territory of the administrative region is maintained.

In our opinion, the number of hunting and fishing species, especially significant in the economy of the region and the Khabarovsk krai, such as: sable, as well as elk and other ungulates, will decrease. However, due to population adaptation, big mammals remain in the natural environment within the boundaries of the developing Albazino deposit. Moreover, such animals as beaver-rat, squirrel, polar hare, etc., being not big in size, will be able to adapt and slightly change the habitat in their peculiar plant groups. Animals, smaller in size (weasel, chipmunk, flying squirrel), practically are not mastered by hunting. There is nothing to threaten them, they are not rare [5].

Thus, in the process of construction and development of the Albazino gold mineral deposit the impact on the mammal class representatives does not exceed the standards provided by the current legislation.

5. References
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