

Conservation of Rare Plants Using "Ex Situ" And "In Situ" Methods in Coal Industry Objects Designing

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Abstract. The experience of predesign inspection of the territory put under impact of future open pit is observed in the article. Geobotanical researches were carried out and populations of two plant species included in the Red Book of the Kemerovo region were found: *Glycyrrhiza uralensis* Fischer and *Epipactis helleborine* (L.) Grantz. Conservation of *G. uralensis* was carried out by "in situ" method – by transfer on other natural habitat. Individuals of *E. helleborine* were transferred at the territory of the Kuzbass botanical garden. Two years' observations of populations' condition have shown successful growth of all individuals. These methods of conservation of rare plant populations are recommended by Project of UNDP-GEF for implementation at the industrial enterprises.

1 Introduction

In 2014 the Government of the Russian Federation has adopted Strategy for the conservation of rare and endangered species of animals, plants, and fungi in the Russian Federation for the period until 2030 [1]. The main goal of the strategy is adding of questions on biodiversity conservation in documents of strategic planning and (or) projects of economic and other activity that directly concerns coal-mining enterprises. Strategy provides as development of scientific researches in studying of biology, protection and reproduction of rare and endangered species, and also realization of special measures for protection of these types and their habitats.

Biodiversity conservation (including plants) is carried out both in natural habitats (in situ), and out of their (ex situ) and conceptually is based on two approaches: population-specific and ecosystem. Each approach provides development of special measures for plants conservation [2].

There are more than one hundred coal companies which annually extract more than 200 million t of coal in the Kemerovo region. More than 20 coal mining licenses were issued for the last three years. Development of coal branch is followed by destruction of natural ecosystems and destruction of soil landscape, fauna and flora.

One of practical steps of Strategy realization and biodiversity conservation is carrying out by the coal companies the compensation activities aimed to minimization of negative

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impact on biodiversity. With support of Project of UNDP-GEF / Ministry of natural resources and environment of the Russian Federation "Mainstreaming biodiversity conservation into Russia's energy sector policies and operations" [3] and together with SDS-Ugol company were developed and for the first time used the methods of conservation of rare plants populations by *ex situ* and *in situ* methods in the territory of the planned Istoksky open pit.

Research goal: identification of rare and endangered species of plants and animals included in the Red Book of the Russian Federation and the Red Book of the Kemerovo region in the territory of the designed open pit [4], and also development of compensation activities for their conservation.

2 Object and methods

Land allotment of the designed enterprise is located in Promyshlennovskiy district of the Kemerovo region in the neighborhood of villages Lebedi, Ufimtsevo, Novy Istok, Okunevo. Researching of territory biodiversity was carried out by route methods. 47 geobotanical descriptions of various vegetation types were made. Besides, floristic lists of phytocoenosis were made and herborization was carried out on routes [5, 6]. Cameral treatment of collected data was made by standard techniques and with application of the IBIS software on the basis of Kuzbass botanical garden (KUZ) of Institute of Human Ecology of the Federal Research Center of Coal and Coal Chemistry of SB RAS [7, 8]. Also methods of the analysis of remote sensing results were used [9, 10].

The total area of land allotment – 12 sq.km (fig. 1). Forest land of 1,55 sq.km. Birch forest and outlier forest of 0,62 sq.km. Pine forest of 0,48 sq.km. Forest belt of 0,07 sq.km. Plowland of 1,34 sq.km. Hay meadow of 6,38 sq.km. Gills and gullies – 0,12 sq.km. Dry meadow (used as pasture ground) of 0,93 sq.km (fig. 1). Besides alkaline meadow and sodic soil along gullies on riversides and temporary stream coasts. Swamp lands and reed flood plain. Reservoirs – rivers, lakes, ponds.

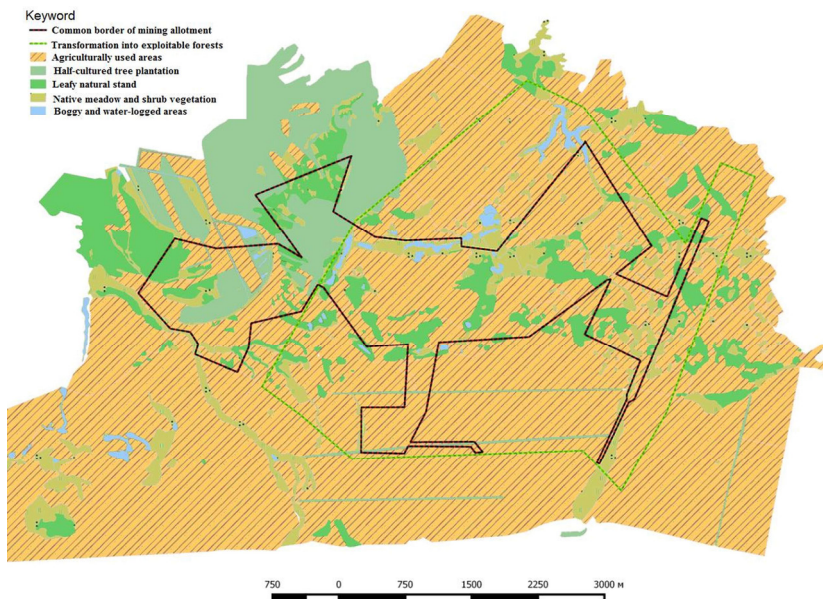


Fig. 1. The pattern of distribution area of the main vegetation communities in work area.

3 Results

Two species of the plants included the Red Book of the Kemerovo region – *Epipactis helleborine* (L.) Grantz and *Glycyrrhiza uralensis* Fischer were found (fig. 2). Compensation activities with taking into account biological features of these plant species were developing during 2015-2016. According to the long-term plan of open pit construction the habitats of these plants were located on the place of borrow cut and enterprise treating facility and had to be destroyed.

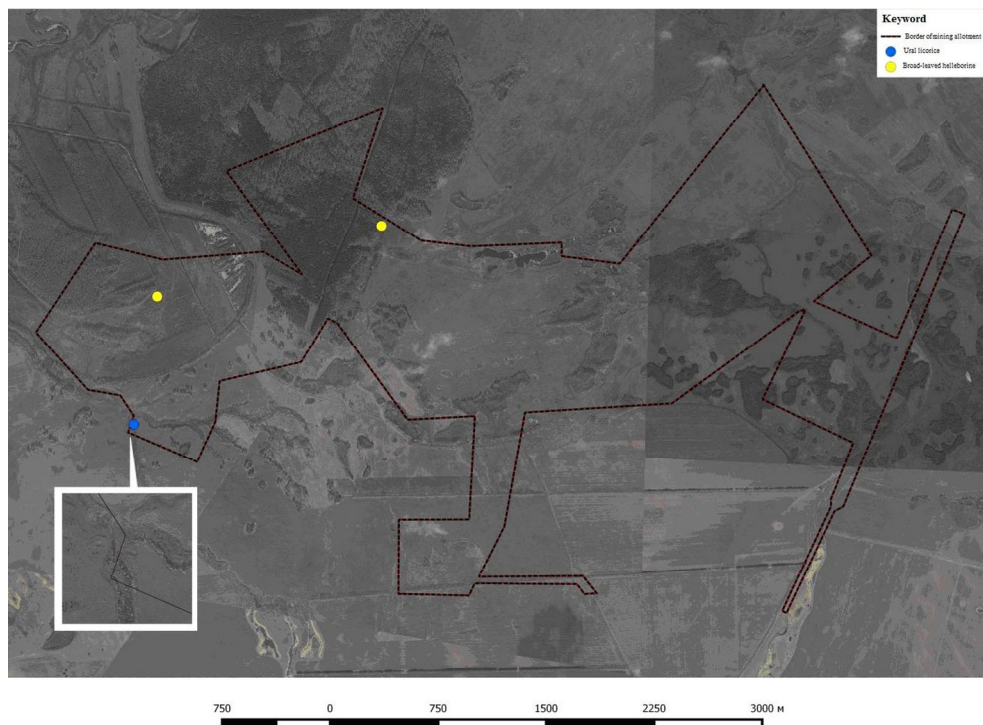


Fig. 2. Distribution area of *Glycyrrhiza uralensis* and *Epipactis helleborine* populations

Okunevsky *Epipactis helleborine* population was found on the southwest of Okunevo village. It has two loci isolated from each other.

Locus № 1: Promyshlennovskiy district, 7 km on the northwest of Okunevo village. 54,9826 ° N, 85,5232 ° E,

Locus № 2: Promyshlennovskiy district, 5 km on the northwest of Okunevo village: 54,97791 ° N, 85,49905 ° E, 158 m above sea-level.

Both populations were parts of herbaceous layer of birch forest with underbrush. Broad-leaved helleborine never forms dense cluster, populations are always small. Groups consist of 1–3 vegetative and 1–2 generative individuals. Density of placement of individuals in cenopopulation is on average 0.02 individual/sq.m. In total 15 individuals of *E. helleborine* were found.

Because of biological features of this specie as conservation method was chosen transfer of all specie individuals to the territory of the Kuzbass botanical garden of The Federal Research Center of Coal and Coal Chemistry of Siberian Branch of the Russian Academy of Sciences (*ex situ* method). It was impossible to mechanize plant digging therefore plants were dug out and packed for transportation manually.

The place for transfer was prepared in the territory of the Kuzbass botanical garden with similar conditions of moistening and illumination.

Okunevsky population of *Glycyrrhiza uralensis* was also located in Okunevo surroundings. Population was caused by alkaline motley grass-grasses meadow, had small area (0,7 hectares) – inarable lands with relief roughness, not included in plowing for agriculturally used areas. The average density of licorece in cenopopulation is – 1,9 individual/sq.m. Generative shoots made 10% of total number which have got to accounts.

Taking into account agrotechnical experience of *Glycyrrhiza uralensis* cultivation within natural habitat, the method of population transfer to natural habitat (*in situ*) was chosen. Selection of similar conditions was necessary for transfer stenotopic species with special requirements to soil conditions. The suitable place was chosen in 12 km to the southeast from Okunevo village, in depression among plowed fields with sufficient salt content.

First of all the platform for transfer was prepared, plants were dug out by the mechanized way and landed on the new platform. At the end of vegetative season assessment of effectiveness was carried out and has shown that more than 80% of licorice plants have taken root after transfer.

4 Conclusions

The conducted researches have shown high efficiency of carrying out of activities for conservation of separate parts of floristic variety prior to full-scale construction of the coal enterprise and destruction of natural ecosystems.

On the basis of the carried out work “Best practices for conservation of rare plant species at conducting of coal mining projects on the example of conservation of *Glycyrrhiza uralensis* and *Epipactis helleborine* for next introduction / reintroduction to places suitable for growth” were made [11]. These methods of conservation of rare plant populations are recommended by the UNDP-GEF project for implementation at the industrial enterprises.

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