

# Features of natural plant complexes restoration and land reclamation in the area of Ust-Srednekanskaya hydroelectric power plant on the Kolyma river

*Pavel E. Tikhmenev<sup>1</sup>, Andrey A. Smirnov<sup>2,3,\*</sup>, Evgeniy A. Tikhmenev<sup>1,2</sup>, and Galina V. Stanchenko<sup>1,2</sup>*

<sup>1</sup>Institute of Biological Problems of the North of the Far Eastern branch of the Russian Academy of Sciences,

<sup>2</sup>North-Eastern State University,

<sup>3</sup>Russian federal research institute of fisheries and oceanography

**Abstract.** The low resistance of the landscapes of the North-East of Russia to anthropogenic influences is shown. The features of natural plant complexes restoration and land reclamation in the area of the Ust-Srednekanskaya hydroelectric power station are considered. In order to create conditions for the successful restoration of vegetation cover after the impact of anthropogenic factors, it is recommended to carry out measures for leveling the disturbed surface and terracing it. It is proposed to carry out artificial sowing of cereals, which are characterized by regular and abundant fruiting.

## 1 Introduction

The main prospects for economic growth in the North-East of Russia are currently associated with the priority development of the mining industry, the development of deposits of precious and non-ferrous metals, coal and hydrocarbons.

To do this, it is necessary to increase the amount of electricity generated in the region, and in connection with this, in 1991 in the Magadan region the construction of the Ust-Srednekanskaya hydroelectric power plant on the Kolyma River was started, with the formation of a reservoir with a length of 123 km and a maximum width of 4 km, the area of which should be about 265 km<sup>2</sup>.

It is known that the construction of a hydroelectric power station dam and the formation of a reservoir led to the regulation of the river flow, a change in its hydrological regime and a negative impact on the habitat and reproduction of fish [1,2].

In addition, the construction of a hydroelectric power station dam and its infrastructure, as well as the development of minerals in the surrounding areas, inevitably leads to an increase in the anthropogenic load on the landscapes and ecosystems of the region, which

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\* Corresponding author: [author@email.org](mailto:author@email.org)

causes an increasing risk of destruction of the existing soil and plant complexes (hereinafter-SPC).

The landscapes of the North-East of Russia are characterized by low resistance to anthropogenic influences [3]. Their ability to resist external influences depends on the nature of the impact and is determined by the position of the landscape in the relief, its natural dynamic trends, the properties of soils and underlying rocks, the nature and level of permafrost occurrence, and climatic conditions.

The upper reaches of the Kolyma River, where the Ust-Srednekanskaya hydroelectric power plant is located, are characterized by a large variety of SPC. The main conditions that determine the features of SPC are differences in the nature of moisture, thermal conditions, surface and subsurface drainage, and other abiotic factors. The predominant plant communities in the study area are not specific only to this area, they are also widely represented in the subarctic regions of Eurasia and North America [4].

## 2 Materials and methods

The features of natural restoration and recultivation of soil and plant complexes in the area of the Ust-Srednekanskaya hydroelectric power plant were studied by us in the summer months of 2013-2020 using the method developed by G.N. Egorova [5] and generally accepted methods [6,7].

## 3 Results and discussion

Recultivation of man-made landscapes and care of crops in permafrost landscapes is a complex and lengthy process. The agro-climatic resources of the northern territories are very limited. For this reason, the process of self-restoration of disturbed land is significantly slowed down. This problem is complicated by extremely low humidity and a small amount of y earth.

Questions of the direction and method of recultivation of disturbed lands are solved specifically for each technogenic formation, taking into account the applied technology and conditions of development, agrochemical and physical-mechanical properties of soils.

Previously, we performed various experiments in the studied territories of the North-East of Russia – in the tundra, forest tundra and taiga, using various types of seeds (mainly native flora), during the reclamation of man-made objects. In areas with potentially fertile soils, seeds were introduced using the FINN 90 hydroseeder.

Seeds, mineral fertilizers and, in the required volumes, water are poured into the hopper of the hydraulic sower. The main results of the work are published. In 2020, the authors obtained a patent for a method for restoring land disturbed by mining operations.

Our research in the area of construction of the Ust-Srednekanskaya hydroelectric power plant showed that the total area of disturbed land subject to priority reclamation here is 20.5 hectares. After performing such works, anti-erosion measures will be carried out, approximately on the same area. Restoration work is already underway.

The features of the degradation of SPC here consist in the manifestation, in addition to the usual mechanisms of violation – erosion, deflation, pyrogenesis, etc., also specific (cryoturbation, thermokarst, etc.), determined by the cryological state of the soil. Manifesting in natural conditions, these mechanisms of violations are sharply activated by anthropogenic impact on the ecosystem, contributing to the acceleration of degradation processes.

Previously, it was found that self-regrowth of soil areas disturbed as a result of anthropogenic activity, in various natural zones of the studied territories of the North-East of Russia – in the tundra, forest-tundra and taiga, in the conditions of permafrost landscapes, is

unsatisfactory [8], and the process of complete restoration of plant communities can last for decades. According to our data, in the area of the construction of the Ust-Srednekanskaya hydroelectric power plant on disturbed soils, mass species are again.

Our studies have shown that for the primary restoration of vegetation cover in disturbed areas, it is most promising to carry out, using the method of hydroseeding, artificial sowing of cereals, which are characterized by regular and abundant fruiting: *Alopecurus alpinus*, *Hierochloë alpina*, *H. pauciflora*, *Poa abbreviata*, *Poa arctica*, *P. pratensis*, *Dupontia fisheri*, *Arctagrostis latifolia*, *A. borealis*, *Elymus interior*, *E. sibiricus*, *E. mutabilis*, *E. confusus*, *Festuca rubra*, *Calamagrostis holmii*, *C. langsdorffii*. In the future, it is possible to sow the seeds of Siberian Dwarf Pine (*Pinus pumila*) and Cajanderi larch (*Larix cajanderi*).

In addition, in order to level the landscape irregularities obtained as a result of economic activity (soil dumps, pits, etc., which contribute to the strengthening of the process of soil degradation), it is necessary, before sowing, with the help of construction equipment (bulldozers, front loaders, etc.), to carry out special measures for leveling the soil, and its terracing, with the addition, if possible, of fertile soil to the areas being prepared for reclamation, in order to create conditions for the successful natural and artificial restoration of vegetation cover.

Such measures, the economic assessment of which is carried out by the enterprise at the design stage, will speed up the restoration of the SPC in the area of construction of the Ust-Srednekanskaya hydroelectric power station in compliance with environmental legislation. In the area we studied, the primary restoration of the SPC began 3 years after the start of reclamation.

We found that in the area of construction of the Ust-Srednekanskaya hydroelectric power station, the leading method of restoring plant communities is seed propagation, vegetative reproduction occupies a clearly subordinate position and has no special value.

## 4 Conclusions

For the development of the mining industry in the North-East of Russia, the development of deposits of precious and non-ferrous metals, it is necessary to increase the amount of electricity generated in the region. In this regard, the construction of the Ust-Srednekanskaya hydroelectric power plant on the Kolyma River was started.

The construction of the hydroelectric power plant reservoir dam and its infrastructure, as well as the development of minerals in the surrounding areas, leads to an increase in the anthropogenic load on the landscapes and ecosystems of the region, which have low resistance to anthropogenic influences.

The features of natural restoration and recultivation of soil and plant complexes in the area of the Ust-Srednekanskaya hydroelectric power station were studied. It is established that on disturbed soils in this area for the first time there are perennial grasses, species of shrubby willows and birches, but the vegetation cover is revived very slowly.

To speed up the restoration of vegetation cover in disturbed areas, it is recommended to carry out artificial sowing with cereals that have regular and abundant fruiting: *Alopecurus alpinus*, *Hierochloë alpina*, *H. pauciflora*, *Poa abbreviata*, *Poa arctica*, *P. pratensis*, *Dupontia fisheri*, *Arctagrostis latifolia*, *A. borealis*, *Elymus interior*, *E. sibiricus*, *E. mutabilis*, *E. confusus*, *Festuca rubra*, *Calamagrostis holmii*, *C. langsdorffii*.

In addition, in order to level the landscape irregularities resulting from economic activity, which increase the process of soil degradation, it is necessary, with the help of construction equipment, to level the soil and perform terracing.

Such measures, the economic assessment of which is carried out by the enterprise at the design stage, will speed up the restoration of the SPC in the area of construction of the Ust-

Srednekanskaya hydroelectric power plant in compliance with environmental legislation. In the area we studied, the restoration of the SPC began 3 years after reclamation.

It is established that in the area of construction of the Ust-Srednekanskaya HPP, seed propagation is the leading method of restoring plant communities, and vegetative reproduction occupies a subordinate position.

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