The Regional Aspects of Biodiversity Preservation under Oil Deposit Exploitation and Oil Transportation

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Abstract. The structure and composition of the forming vegetation at the developed oil field in Western Siberia is considered. The absence of pathologies in plants in reclaimed and self-growing developed areas and the growth of Dactylorhiza maculata (a specially protected plant from the Khanty-Mansi AO Red Book) in the post-technogenic territory testify to the restoration of biodiversity and environmental safety of the emerging post-technogenic communities. Dactylorhiza baltica populations from the Red Book of the Russian Federation have been identified on the Russian Plain in the Leningrad and Yaroslavl Regions in the protected area of oil pipelines. In addition, in the Yaroslavl region, populations of Neottia nidus-avis, Platanthera bifolia, Glyceria lithuanica, Carex sylvatica, Dactylorhiza incarnata, Dactylorhiza maculata, Dactylorhiza fuchsii, Listera ovata, Ophioglossum vulgatum, Veratrum lobelianum, were found. These species are especially protected in the Yaroslavl region. The characteristics of their populations are given: the number of locations, the number of specimens, biotopes. The areas of various grassy biotopes in forest regions are increased through the length of treeless and protected spaces above oil pipelines. Thus these treeless spaces contribute to the conservation of rare and endangered edge-meadow, meadow and bog-meadow plants. Measures for the conservation and restoration of populations of specially protected species are recommended. A suggestion is made about the necessity to expand the assortment of sown plant species when carrying out reclamation work on post-technogenic lands using indigenous species for sowing seeds.

1. Introduction
A high load on the environment negatively affects the conservation and state of biodiversity [1,2], in particular, vegetation. The development of oil fields, the construction of pipelines and the transportation of oil are inevitably associated with the destruction of soils and natural phytocenoses, including specially protected plant species. A regional feature of the development of oil fields is significant land allotment areas, the implementation of oil production at sparsely populated areas remote from settlements, and work under various climatic conditions [3]. Oil is transported via pipelines through many regions of Russia. In the forest zone of Russia, the gradual overgrowing of the protected area of oil pipelines by trees and shrubs requires periodic cleaning of small forests to ensure their normal operation. The conservation and restoration of biological diversity contributes to the sustainable development and stability of ecosystems and society [4,5]. In solving this problem, a significant place is given to the restoration of natural ecosystems (primarily vegetation cover) and the
conservation of species [6] included in the Red Book of the Russian Federation [7], regional [8-11] and international [12,13] Red Books and lists of specially protected species [14,15].

2. Objects and research methods
The object of the study was the vegetation cover (phytocenoses and species composition of vascular plants) of exploited and developed oil fields in the taiga zone of Western Siberia and the protected areas of oil pipelines in the taiga zone of the Russian Plain within the Leningrad and Yaroslavl Regions. The purpose of the research was to identify the post-technological biodiversity of the vegetation cover. In this regard, the tasks were set to determine the structure and species composition of plant communities during self-growth and reclamation of these territories, assess the state of populations of specially protected species of vascular plants, and develop measures to protect them.

Description of phytocenoses was carried out according to the standard method using the Brown-Blanquet scale [16]. Floristic studies were carried out by the route method within the 25-meter strip of the protected areas of oil pipelines. In the Leningrad region, the total length of the routes was about 60 km, in the Yaroslavl region - more than 30 km. To fix the location of protected species, the “Get Point” program was used - GPS, version 1.8.6. This mobile GIS (created by Joubert Vasconcelos) is an Android operating system software designed for professional and amateur geolocation during field research and subsequent viewing on Google Earth. Processing of quantitative results and graphing was carried out using Microsoft Excel-2007.

3. Results and discussion
3.1. The formation of vegetation in the exploited and developed areas of the oil field
The studies were carried out in the northern part of the Central Ob Lowland of the West Siberian Plain - Surgut Polesie (woodland). The entire territory is covered by forests and huge sphagnum bogs, confined to the watershed. Near rivers and flowing lakes, lowland sedge and sedge-sphagnum swamps are developed. In the river valleys, medium-taiga Pinus sylvestris forests with an admixture of Pinus sibirica and Larix sibirica predominate. In the middle taiga forests, birch plays a significant role, which often forms aspen-birch stands together with aspen. Picea sibirica and Pinus sibirica forests are found mainly in forest valleys. They are characterized by a diverse grass cover and dense undergrowth from various shrubs. Beneath forests, predominantly podzolic-boggy sandy-loamy and sandy and peat-bog soils are formed. Alluvial soils are developed in the valleys of large tributaries of the Ob.

Our studies have shown that with self-growth over time, the ratio of native species (forest, meadow, marsh, coastal-aquatic and aquatic ecological-coenotic groups of plants) and adventive species (weed and ruderal groups) changes in favor of the former. In the formation of forest and wetland communities, adventitious species almost immediately disappear. In this regard, the species composition of spontaneously forming forest and wetland plant communities is increasingly approaching the species composition of the natural vegetation cover of natural biotopes characteristic of Surgut woodland. All plants in plant communities of reclaimed and self-growing areas have no signs of pathological changes: their size, appearance and phenophases are the same as in plants in natural biotopes.

The life forms of emerging communities are also changing. Over time, there is an increase in the number of tree and shrub species. During self-growth, the number of tree species in the first 20 years increases by almost 10 times, almost reaching the maximum possible number, characteristic of natural biotopes, similar in degree of moisture. The largest number of tree species is characteristic of small-leaved forest communities that form during self-growth in drier modes of moisture. Under conditions of increased stagnant wetting of the swamp type during self-growth, a sphagnum pine forest with swamp shrubs and the participation of a small number of tree species is formed. In drier biotopes, self-

1https://play.google.com/store/apps/details?id=jv.android.getpoint&hl=ru
growth leads to the formation of pine forests with grass or green moss cover, with a slightly larger number of tree species.

Among the native plant species, 2 populations of the rare and protected in the Khanty-Mansi Autonomous Area [11] Dactylorhiza maculata were noted (Table 1).

Table 1. Finds of Dactylorhiza maculata on a self-growing developed area of a deposit in Khanty-Mansi Autonomous Area, 2015.

| Biotopes                          | Number of populations | Number of individuals | Area of populations, m² |
|-----------------------------------|-----------------------|-----------------------|-------------------------|
| Dry meadow in the birch forest    | 1                     | 3                     | 1                       |
| Wetland edge of a birch forest    | 1                     | 2                     | 1                       |

In oil-producing areas during remediation work, the main focus should be the restoration of biodiversity. In this regard, to accelerate the process, it is recommended that indigenous and specially protected plant species growing in the area be introduced into crops on disturbed areas of seeds and planting material.

3.2. Populations of Red book vascular plant species in protected areas of the oil pipelines of the north-west and the north of the Russian Plain

3.2.1. In the north-west: Leningrad region. Regional features of the Leningrad Region are due to its coastal location along the Gulf of Finland on the western borders of the Russian Plain in the zone of its contact with the Baltic Shield, a special Quaternary story related to the last glaciation. At the same time, this territory has well-developed agriculture and industrial production with the presence of one of the largest Russian megacities - St. Petersburg. In this regard, the natural taiga ecosystems of the Leningrad Region are significantly transformed. In the protected areas of the oil pipelines in July 2017, we noted 8 populations of Dactylorhiza baltica (Table 2) - a species of vascular plants listed in the Red Book of the Russian Federation [7], the Red Book of Nature of the Leningrad Region [8] and the Red Book of the Leningrad Region [10].

Table 2. Habitats of Dactylorhiza baltica along the oil pipelines protected area in the Leningrad Region, 2017.

| Biotopes in the protected area of oil pipelines | Number of populations | Number of individuals | Area of populations, m² |
|-----------------------------------------------|-----------------------|-----------------------|-------------------------|
| Dry edge of a birch forest                    | 2                     | 3                     | 3                       |
| Dry meadow                                    | 1                     | 1                     | 1                       |
| Moist meadow                                  | 3                     | 5                     | 7                       |
| Wetland meadow                                | 2                     | 3                     | 4                       |

The limiting factors for Dactylorhiza baltica are anthropogenic impacts leading to a complete change in habitats: plowing of lands, changes in the hydrological regime. In addition, with the natural overgrowing of habitats, the formation of a dense tree-shrub layer leads to the complete disappearance of plants. At the same time, this species easily populates disturbed habitats without vegetation, including embankments over oil pipelines.

3.2.2. In the north: Yaroslavl region. The northern part of the Yaroslavl region lies in the taiga zone, and the southern part in the zone of mixed forests. This is the Volga river basin, connecting the basins of 5 seas. This location determines a high level of biodiversity. The region is a densely populated territory, subjected to intense exposure to various forms of human activity. In this regard, natural ecosystems are strongly transformed and are represented by secondary, mainly small-leaved, forests.
Along the surveyed sections of oil pipelines in the Yaroslavl region, 11 species of protected plants were found (Table 3) by us, and their total counts hundreds of specimens [17]. Representatives of the orchid family predominate in the protected areas of the oil pipelines. Among them: Dactylorhiza fuchsii in places forms numerous populations having up to 50 flowering individuals; Dactylorhiza maculata with populations of up to 12 flowering individuals; Dactylorhiza incarnata, whose populations are 1-3, with a maximum of 5 individuals. A large number of growing Dactylorhiza ssp in the protected area of oil pipelines is due to favorable lighting and humidification conditions in the meadow-meadow, meadow, and bog-meadow biotopes that are formed during regular cleaning of trees and shrubs. We found a number of specially protected species in a single habitat (1 specimen of Neottia nidus-avis), in 2 habitats (1 and 3 specimens of Dactylorhiza baltica), and in 3 habitats (1-3 specimens of Platanthera bifolia).

**Table 3.** Red book vascular plants found along the protected area of oil pipelines in the Yaroslavl region (second half of June 2017).

| Species name                  | The number of biotopes | Number of individuals | Area of populations, m² |
|-------------------------------|------------------------|-----------------------|-------------------------|
| Neottia nidus-avis            | 1                      | 1                     | 1                       |
| Platanthera bifolia           | 3                      | 6                     | 3                       |
| Glyceria lithuanica           | 1                      | 26                    | 2                       |
| Carex sylvatica               | 1                      | 10                    | 2                       |
| Dactylorhiza baltica          | 2                      | 4                     | 2                       |
| Dactylorhiza incarnata        | 10                     | 25                    | 21                      |
| Dactylorhiza maculata         | 4                      | 12                    | 5                       |
| Dactylorhiza fuchsii          | 11                     | 180                   | 83                      |
| Listera ovata                 | 5                      | 55                    | 49                      |
| Ophioglossum vulgatum         | 2                      | 50                    | 33                      |
| Veratrum lobelianum           | 1                      | 2                     | 1                       |

In modern conditions, when abandoning the traditional use of natural meadows and pastures and replacing them with productive crops of forage grasses in forest zones, there are less and less suitable biotopes for growing meadow plants. In this regard, the extended treeless spaces above the oil pipelines to some extent make up for the diverse herbaceous communities that are leaving in the past and give a chance to preserve rare and endangered meadow plants. The protection regime that prevents the recreational use of these territories and protects populations of rare plants from their collection and trampling contributes to this.

### 4. Recommendations for the conservation of specially protected species of vascular plants in the protected area of pipelines

When carrying out work on cleaning the protected areas of pipelines from growing trees and shrubs, it is necessary to identify the boundaries of the places of growth of the found populations of specially protected species by installing a fence (posts) using a signal tape, a signal plastic mesh around the perimeter.

During technological work on oil pipelines with the complete destruction of biotopes, the transfer of populations of specially protected species to the nearest similar biotopes should be ensured. It is necessary to justify the choice of the most suitable transplantation method for specific plant types with a detailed step-by-step description of its implementation. It is important to determine how plants are transported to new habitats that are not harmful to plants. In addition, it is recommended to transfer especially valuable species to nature reserves, to specially protected territories with similar growing conditions.
For successful seed specially protected species, we recommend the cleaning work to be carried out in the protected areas of pipelines from growing trees and shrubs at the end of the growing season.

To confirm the successful self-renewal of populations and assess the status of specially protected plant species after any technogenic intervention in the pipeline section, a repeated botanical examination (monitoring) is recommended [18, 19].

5. Conclusion

Over time the vegetation cover of the forming forest and wetland ecosystems in the developed areas is increasingly approaching the natural vegetation cover of natural biotopes characteristic of Surgut woodland in its structure and species composition. The absence of visible pathological changes in plants may serve as an indirect proof of the ecological safety of these communities. Moreover, the finds of a specially protected plant from the Red Book Area Dactylorhiza maculata in a self-growing developed area indicates post-technogenic restoration of biodiversity.

An important condition for accelerating the restoration of biodiversity is the introduction of indigenous and specially protected plant species growing in the area into crops on disturbed areas of seeds and planting material.

When oil is transported in the forest zones of the Russian Plain along extended treeless protected zones of oil pipelines, biotopes are created that favor the growth of edge-meadow, meadow, and bog-meadow species, including specially protected plants.

The presence of populations of species of specially protected plants should be taken into account when designing and conducting technological work. At the same time, it is necessary to develop measures for the conservation and restoration of biodiversity based on regular monitoring of post-technogenic ecosystems.

A significant variety of violations arising from the industrial development of oil fields and oil transportation, their location in various climatic conditions, the different composition of plants falling into the area of development of the territory indicate the impossibility of applying the same solutions for the conservation and restoration of biodiversity. There should be a differentiated and systematic approach for each disturbed area.

6. References

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