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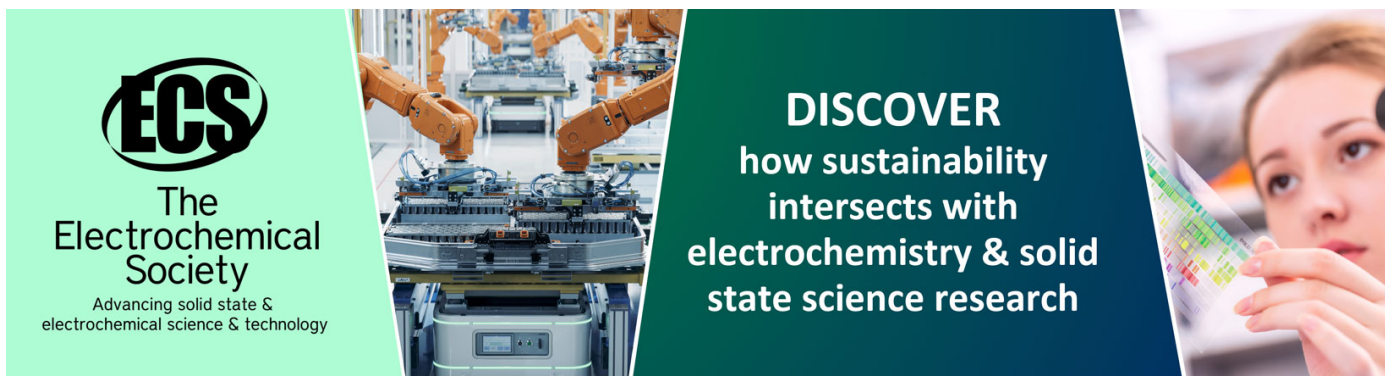
Biodiversity of the Abyiskaya lowland (northeast of Yakutia) and the issues of its study and conservation

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Biodiversity of the Abyiskaya lowland (northeast of Yakutia) and the issues of its study and conservation

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Abstract. For the first time, general data on the study of the composition of vascular plants and plant community's characteristic of the sparsely populated northern taiga plain territory in the Indigirka River's middle reaches are presented. The well-known visual methods of studying the vegetation cover have been used. These methods are effective when studying remote little or completely unexplored regions, especially in the north of Russia. As a result, new data were obtained on the composition of this territory's flora, the state, and the diversity of its vegetation cover. Five species included in the Red Book of the Republic of Sakha (Yakutia) have been identified. The issues of protection measures for territories with non-unique sets of plants and their communities, typical for a wide range of northern taiga and forest-tundra regions, are presented.

1. Introduction

The study of the biodiversity of the remote northern territories of Russia is an urgent direction of scientific research since it is these territories that represent a preserved model of a floristic complex and vegetation cover that naturally developed over a long period, as a rule, not disturbed or slightly disturbed by human activity. Revealing the composition of flora and plant communities, their distribution over the study area, the relationship with habitat conditions, and the influence of environmental factors makes it possible to clarify the features of this model's stability to determine the ways of its conservation. A significant result of such studies should be considered the identification of plants' composition, hence their gene pool, and the composition of plant communities inhabiting this territory. The northern plains of the strip of light forests and northern taiga in northeastern Russia, as a rule, have a low floristic richness and a poor set of types of plant communities, are usually sparsely populated and are used mainly for hunting and fishing by the local population, which raises questions about the expediency of conservation measures for such territories.

2. Studying the biodiversity of the flat northern taiga territories of Yakutia

2.1 Materials and methods

In the summer of 2018, the authors carried out botanical research in the vicinity of two villages (Belaya Gora, 68°32'N, 146°11'E and Suturuokha, 68°33'N, 146°09'E). on the right and left banks of the river. The Indigirka in its middle reaches. Walking and boat routes covered the territory within a radius of 10–15 km from the villages. They included the search and collection of plants from all



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available habitats in remote replications, the compilation of field descriptions of the communities that form the vegetation cover of this region, photographic recording of the entire diversity of both upland and non-upland plant communities, photographs of flowering and fruiting plants, collection of critical taxa from different habitats. Particular attention was paid to the discovery of rare for Yakutia and the Red Data Book species and the state of flora and vegetation in disturbed habitats in and around villages. As a result, about 200 descriptions of vegetation were compiled, about 600 sheets of herbarium specimens of vascular plants, about 150 packets of mosses and lichens were collected. Based on the collections and field records, a consolidated list of species growing in the study area was compiled, geobotanical descriptions were processed, and an overview of plant communities in this region was compiled, which served as the basis for this article. The collected material can be presented as the local flora of the vicinity of the village. Belaya Gora and represents the flora characteristic of the flat northern taiga and forest-tundra regions of Eastern Siberia.

2.2 Natural conditions

The villages of Belaya Gora and Suturuokha are located within the previously almost unexplored by botanists of the Abyyskaya (Sredneindigirskaya) lowland, located in the area of permafrost (cryolithosis) and a sharply continental subarctic climate. The climatic conditions in the region are very harsh: long and icy winters, short cool summers. The average temperature in January is -40.7°C ; in July, $+14^{\circ}\text{C}$. The annual precipitation is 218–240 mm. The duration of days with snow cover is 236 days, the duration of the frost-free period is 90–94 days.

The Abyisky lowland (Figure 1) is a vast, rolling, swampy plain surrounded by mountains. Most of the plain is covered by larch forests from *Larix cajanderi* Mayr. and lakeside swamps. Forests predominantly have a continuous lichen-moss cover with a dense layer of shrubs of 5–6 species of willows (*Salix*), *Betula divaricata* Ledeb., *Rosa acicularis* Lindl., and shrubs: *Ledum palustre* L., *Vaccinium uliginosum* L., *V. vitis-idaea* L. The Indigirka valley and its tributaries are characterized by small areas of willow groves, shrub thickets, and floodplain herbaceous communities of meadow and boggy genesis.



Figure 1. The Abyisky lowland territory with the location of the site for field research in 2018 in the vicinity of the villages of Belaya Gora and Suturuokha

2.2.1 Diversity of plant communities. The least diverse communities of arboreal vegetation represented here only by single-story low sparse larch forests with several variants of lower levels – from swampy to moderately dry: shrub, grass-shrub moss-lichen, moss, including sphagnum. Hanging birch (*Betula pendula* Roth), which until recently was called flat-leaved birch (*Betula platyphylla* Sukacz.) It is found in single specimens in our work area, but to the south, it creates birch groves. Species names are given according to reports [1, 2].

Shrub vegetation occupies small areas and is represented primarily by willows, widely developed on river terraces, along channels, and near lake basins, in depressions and damp valleys on the plain. Alder forests occupy the dampest areas at the foot of the coastal slopes and terraces from the tree form *Duschekia fruticosa* (Rupr.) Pouzar, which sometimes reaches 3–4 m in height. Birch communities from *Betula divaricata* are characteristic of treeless (clear-cut) areas on elevations and old fires. Finally, in depressions near the coastal slopes, where for some time water stagnates, rosehip and raspberry-rosehip communities from *Rosa acicularis*, sometimes *Rubus matsumuranus* Levl. et Vaniot.

Shrub vegetation is represented only as of the lower layer in larch forests; in the damp ones, abundant layers of *Vaccinium uliginosum* L. and *Ledum palustre* L. are more common, in moderately moist and moderately dry lingonberry larch forests, *Vaccinium vitis-idaea* L. moss-lichen dominate. On slightly raised areas with good drainage, larch forests (*Empetrum nigrum* L.) are formed, with a moss-lichen cover.

The most extraordinary diversity is observed among herbal vegetation: there are both aquatic, boggy, damp-meadow, and dry-meadow, steppe and steppe communities, the latter in the form of fragments of relict communities.

The abundance of lakes on different relief elements caused the wide development and relatively high diversity of aquatic and coastal aquatic plants and communities: *Caltha palustris* L., *Comarum palustre* L., *Menyanthes trifoliata* L., *Ranunculus gmelinii* DC are often found in the water. Among the thickets of *Equisetum fluviatile* L., large sedges (*Carex aquatilis* Wahlenb., *C. vesicata* Meinsh., *C. rostrata* Stokes) and grasses – *Arctophila fulva* (Trin.) Anderss. Often, each of these species forms clean thickets. *Calamagrostis* sp.sp., *Arctophila fulva*, *Eriophorum* sp.sp., *Equisetum* sp.sp. dominate along the lake shores.

Often in the middle of the taiga and along the foothill lowlands, there are hummocks (*Carex juncella* (Fries) Th. Fries subsp. *wiluica* (Meinsh.) Egor., *Calamagrostis langsdorffii* (Link) Trin.), And on lowlands flooded with water, coarse sedge communities (*Carex appendiculata* (Trautv.) Kuk., *C. acuta* L.).

It is not uncommon to meet cotton grass communities from *Eriophorum brachyantherum* Trautv. et C.A. Mey., *E. polystachion* L., *E. scheuchzeri* Hoppe, rarely with *E. russeolum* Fries.

Along the banks of rivers and numerous low floodplain islands, there are purely horsetail communities, at drier levels from *Equisetum arvense* L., and on humid levels, *E. fluviatile*.

On real meadows along the floodplain terraces of rivers, it is not common, but there are pure foxtail meadows from *Alopecurus rozhevitzianus* Ovcz., and two more species of foxtails can be found in disturbed habitats. On warm glades in the middle of the forest, in relatively humid places, there are abundant thickets ("glades") of the princess (*Rubus arcticus* L.).

On drier and less knocked down areas in the river valley and on the coastal slopes, moderately dry bluegrass meadows from *Poa pratensis* L. and *P. glauca* Vahl are developed. Dry meadows from *Bromopsis pumPELLIANA* (Scribn.) Holub are found on the river terrace above the floodplain and along the river banks, under willows, and on the edges.

On shallow, gravelly slopes, xeromesophytic meadows from *Vicia macrantha* Jurtz can also be observed. Along the root banks of rivers on the slopes of southern exposures, areas of steppe and meadow-steppe communities have been preserved in places (for example, *Calamagrostis purpurascens* R.Br., *Poa botryoides* (Trin.ex Griseb.) Kom., *Festuca lenensis* Drob., *F. brachyphylla* Schult. Et Schult., *Poa glauca*, *Thymus reverdattoanus* Serg., *Saxifraga spinulosa* Adams).

Quite many areas with disturbed natural vegetation, inhabited mainly by local plant species, were noted on the studied territory. In settlements, near roads, in areas disturbed by machinery, under the

dominance of *Hordeum jubatum* L., *Puccinellia hauptiana* V. Krecz., *Elytrigia repens* (L.) Nevski, and weed species (*Taraxacum ceratophorum* (Ledeb.) DC., *Plantago media* L.), among which *Arnica iljinii* (Maguire) Iljin, *Astragalus alpinus* L. s. str., creating a colorful bluish-yellow aspect. In more damp places, rushes settle. Abundant thickets of *Descurainia sophioides* (Fisch. Ex Hook.) O.E. Schulz, *Chamaenerion angustifolium* (L.) Scop., rarely *Artemisia dracunculus* L.

2.2.2 Diversity of vascular plants. In total, 252 species of vascular plants belonging to 117 genera and 49 families were identified in the study area. This fact indicates its low floristic richness at the level of species diversity. However, a sufficiently high level of diversity of superspecific taxa compared to the floras of the more northern plain north taiga regions. Undoubtedly, this is influenced by the influence of a wide river valley of a large river (Indigirka) and closely located high mountain ranges with rich and varied flora.

The composition and role of the leading families and genera of this flora are quite typical for the northern taiga's boreal floras. They are quite different from the local forest-tundra and tundra floras located to the north [3]. Such an important indicator evidences the same as to the coverage of the ten leading families of flora composition (less than 70 %). It should be noted here that one-third of the composition of the studied flora is made up of graminoids (grasses and sedges), and the three richest families are characteristic of both tundra and boreal floras. Leading genera (numbering more than 8–10 species) are few and are characteristic of the north of Siberia's marshy plains and cover only about 20 % of the flora.

Table 1. Leading families and genera of flora in the vicinity of the "Belaya Gora" village

Leading families	Number of species	Percentage of total flora species (%)	Leading genera	Number of species	Percentage of total flora species (%)
<i>Poaceae</i>	42	16.7	<i>Carex</i>	26	10.3
<i>Cyperaceae</i>	34	13.1	<i>Salix</i>	13	5.2
<i>Asteraceae</i>	17	6.7	<i>Poa</i>	8	3.2
<i>Salicaceae</i>	13	5.2	<i>Juncus</i>	7	2.8
<i>Ranunculaceae</i>	13	5.2	<i>Ranunculus</i>	7	2.8
<i>Brassicaceae</i>	13	5.2	<i>Elymus</i>	6	2.4
<i>Caryophyllaceae</i>	11	4.0	<i>Calamagrostis</i>	6	2.4
<i>Juncaceae</i>	9	3.6	<i>Eriophorum</i>	6	2.4
<i>Fabaceae</i>	9	3.6	<i>Potentilla</i>	6	2.4
<i>Ericaceae</i>	8	3.2	<i>Stellaria</i>	5	2.0
<i>Scrophulariaceae</i>	7		<i>Artemisia</i>	5	
A total in 10 families:	169	67.1	A total in 10 genera:	90	35.9

3. Results and Discussion

Although no unique or endemic plant species have been found in this area, the flora contains the localities of 5 species included in the Red Book of the Republic of Sakha (Yakutia) [4]. These are *Platanthera oligantha* Turcz., *Montia fontana* L., *Stellaria monantha* Hulten, *Rhodiola rosea* L., *Potentilla sanguisorba* Willd. ex Schlecht. Their habitats are mainly confined to limestone outcrops on the indigenous left bank of the river. Suturuhi, which is already included in the protected areas. However, habitats are located right near the "Belaya Gora" village (coastal slopes), which are not under protection.

The subject of discussion is the need to include such habitats in protected areas and natural monuments. This issue cannot be resolved immediately and unambiguously since creates inconvenience, if not hindrance, for the life of the local population, which is already difficult in such harsh conditions.

In the surveyed area, the entire valley of the Suturuokha River from its source to its mouth and Lake Suturuokha, from where it flows, are included in the system of specially protected natural areas of the Republic of Sakha (Yakutia) in the status of a resource reserve. This protection format is being created in Yakutia to preserve typical landscapes where small peoples live and engage in their traditional fishing while preserving the full completeness of biodiversity. For the summer, Lake Suturuokha is a zone of absolute rest to provide an opportunity for rest for migratory birds and the nesting of a more significant number of species of different ducks. This place is of hunting grounds in winter, where local residents, under licenses and agreements, can hunt elk, squirrel or sable, upland game, or go fishing. These fisheries are tightly controlled by inspectors and neighbors in hunting areas and the public. Poachers are not favored here. Probably, this format is the optimal solution for territories remote from villages. However, the Red Book species sometimes settle right on the lawns of villages, which once again reminds everyone of an unsolved problem.

4. Conclusion

Conservation measures for botanical sites are also necessary for areas where species and plant communities common in large areas are shared. The reason is that it is difficult to preserve the ecosystems of the northern plains untouched by human economic activity in the context of a changing climate and the involvement of more and more areas in regions extracting minerals and other resources.

The authors believe that scientists' task is to consider and propose to the public measures to protect such habitats or ways to preserve protected species without isolating their habitats from the population.

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