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Macrophyte flora of the city of Tobolsk: concise analysis

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Abstract

The purpose of the research is the studying of the flora of waterbodies and watercourses of the city of Tobolsk (Tyumen Region, Russia). The work is based on the author's hydrobotanical studies, which have been carried out in the city since 2015. Herbarium materials from the territory of the city of Tobolsk and literature sources were also studied. The macrophyte flora of the city of Tobolsk has 253 species of higher plants (of bryophytes and vascular plants) from 123 genera and 61 families, including 27 species of mosses and liverworts. In the ecological structure of the flora the semi-aquatic plants are dominated, and the proportion of hydrophytes is only 17.0% (43 species). In the composition of studied flora four hybrid taxa (*Nuphar* × *spenneriana*, *Potamogeton* × *acutus*, *Salix* × *fragilis*, *Utricularia* × *ochroleuca*), as well as six protected species in the Tyumen Region (*Acorus calamus*, *Epipactis palustris*, *Lycopodiella inundata*, *Nuphar pumila*, *Nymphaea tetragona*, *Zannichellia repens*) were noted.

Keywords: aquatic and semi-aquatic plants, aquatic macrophyte, flora of water bodies and watercourses, hydrophilic flora, Tyumen region, urban flora, Western Siberia

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Introduction

Tobolsk (58°11.717'N; 68°15.483'E) is a city in the Tyumen region (Russia), located at the confluence of the Tobol and Irtysh rivers. The main part of the city is located on the right coast of the Irtysh River, two microdistricts (Levoberezhje and Sumkino) are located on the left coast of the river. The total area of the city is 222 km².

The position of Tobolsk at the southern limit of the taiga natural zone determines the general south-taiga character of the vegetative cover and high level of the water cut of the territory. Landscape of the city is characterized as a gently sloping, weakly dissected alluvial plain. Only the coastal strips are strongly dissected. The plain is composed of lake clays or layered light loamy and sandy strata overlapped with cover loams. On developed sod-strongly podzolic soils a spruce-fir-birch forests with an

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admixture of linden are grow. In floodplains, floodplain podzolic and sod-gley podzolic soils are common. On these soils, mainly poplar and willow forests grow (Gvozdetsky et al. 1971). According to geobotanical zoning, the territory is included in the Tobolsk-Irtysh district of dark coniferous-birch and dark coniferous-pine grass forests in combination with lowland and riding bogs (Voronov and Mikhailova 1971).

The water bodies of the city are numerous and diverse. Natural waterbodies and watercourses are represented by the Tobol and Irtysh rivers, several small rivers (Kurdyumka, Slesarka, Bekerovka, Abramovskya) and streams – a tributaries of the Irtysh River and small rivers. Floodplain lakes and channels between them are also numerous in the city. In addition, waterlogged areas of lowland (minerotrophic) bogs, swampy forests and floodplain meadows are common. Anthropogenic waterbodies include hydrous quarries, excavations, drainage ditches and reservoirs, ponds, roadside ditches, puddles.

The vegetation cover of the city of Tobolsk and its neighborhood has a long history of study (Drachyov 2010; Glazunov et al. 2017), however, there is still no complete published summary of the flora of the city, and the flora and vegetation of the waterbodies and watercourses of Tobolsk have not yet been the object of special study. Some information about plants growing on aquatic and semi-aquatic ecotopes within the city and its neighborhood can be found in publications of the first half of the 20th century (Pignatti 1911; Ivanovsky 1912; Ivanovsky 1913). Valuable information on the Tobolsk flora was obtained from the fundamental work of P.N. Krylov “Flora of Western Siberia” (Krylov 1927, 1928, 1929, 1930, 1931a, 1931b, 1933, 1935, 1937, 1939, 1949). The study of bryophyte of Tobolsk was intensified at the beginning of the 21st century thanks to special studies by A.G. Bezgodov. In his work, there is quite complete information about mosses found in the city’s water bodies (Bezgodov 2014). The listed sources are of undoubted scientific and historical value; however, they do not contain complete information about the modern hydrophilic flora of the city and its individual parts or water bodies. The purpose of our research is to reveal the flora of waterbodies and watercourses (flora of aquatic macrophyte) of Tobolsk.

Methods

The main materials for the work were hydrobotanical collections and descriptions of aquatic and semi-aquatic vegetation, performed by the author in 2015–2019. Also in the work, extensive herbaria material collected by N.L. Skalozubov, A.Ya. Gordyagin, V.A. Ivanovsky, S.N. Mameev, B.N. Gorodkov in Tobolsk and its neighborhood at the end 19th and beginning of the 20th centuries was used. These materials are stored in the sector of Siberia and the Far East in the Herbarium of the Komarov Botanical Institute RAS (LE, St.-Petersburg). In addition, a herbarium of vascular plants and bryophytes, which is stored at the Tobolsk complex scientific station of the Ural Branch of the Russian Academy of Sciences (TCSS UB RAS, Tobolsk), was studied. Many information about aquatic and semi-aquatic plants was obtained from the literature sources listed in the introduction.

In our work, we base on the definitions of basic hydrobotanical concepts and terms (Papchenkov et al. 2003). In accordance with the definition of the concept of “flora of waterbodies (watercourses)”, we took into account all plants growing during the summer low water season (from the second half of May to September) on the aquatic, watered and wet habitats within the city and its neighborhoods. The standard methods for describing aquatic and semi-aquatic vegetation (Bobrov and Chemeris

2003) and the route method for describing the flora of water bodies (Papchenkov 2003) were used in the work. In general, the area of the studied territory was about 300 km².

The conspectus of macrophyte flora of Tobolsk was published by us earlier (Kapitonova 2020), where the nomenclature of species of vascular plants was given mainly in accordance with the “Synopsis of Asiatic Russia flora” (Baikov 2012). The correctness of the scientific names of plants was verified using the GBIF service (<https://www.gbif.org/tools/species-lookup>). In some cases, the names of the plants were left unchanged; they GBIF Taxonomic Backbone are considered synonyms. In this article, we provide a concise analysis of the identified flora. The analysis of the ecological structure of the flora was carried out according to the classification of V.G. Papchenkov (Papchenkov 2001).

Herbarium plant specimens collected by the author in the waterbodies and watercourses of the Tobolsk (more than 400 sheets) are stored in the herbarium of the TCSS UB RAS.

Results and discussion

Preliminary results of the analysis of the revealed flora show a rather high taxonomic diversity of aquatic and semi-aquatic plants of the city of Tobolsk. The hydrophilic flora of the studied territory includes 253 species of higher plants from 123 genera, united in 61 families and 33 orders. Of these, 27 species (10.67%) belong to bryophytes (mosses and liverworts), the rest species belong to vascular plants (Table 1).

Table 1. Systematic structure of macrophyte flora of Tobolsk.

Clade	Number of taxa			
	Orders	Families	Genus	Species
Marchantiophyta	2	3	4	4
Bryophyta	3	8	12	23
Lycopodiophyta	1	1	1	1
Equisetophyta	1	1	1	3
Polypodiophyta	1	1	1	1
Magnoliophyta	25	47	104	221
Total:	33	61	123	253

By level of species diversity, the studied flora is comparable to such a large city as Izhevsk (Udmurt Republic, Russia), where according to our data 257 species of macrophytes grow, including macroalgae (Kapitonova 2019). Such a high taxonomic diversity of the hydrophilic flora of Tobolsk is explained by the presence of a wide range of aquatic habitats on the territory of city, both natural and anthropogenic.

In the considered flora, the families Poaceae (23 species) and Cyperaceae (21 species) predominate. The families Potamogetonaceae (16 species), Asteraceae (12 species), Salicaceae and Ranunculaceae (11 species each) are also rich in species. Of the genera *Carex* (15 species), *Potamogeton* (14 species), *Salix* (11 species), *Juncus* (8 species), *Ranunculus* (7 species), *Typha* and *Utricularia* (5 species each), *Drepanocladus*, *Sparganium*, *Epilobium*, *Persicaria*, *Rumex*, *Veronica* (4 species each) have the largest number of species. The studied flora includes four hybrids: *Nuphar* × *spenneriana*, *Potamogeton* × *acutus*, *Salix* × *fragilis*, *Utricularia* × *ochroleuca*.

In the waterbodies and watercourses of the city of Tobolsk, there are species of vascular plants alien in the territory of the Tyumen Region: *Chenopodium glaucum*, *Echinochloa crus-galli*, *Echinocystis lobata*, *Epilobium ciliatum*, *E. pseudorubescens*, *Impatiens glandulifera*, *Iris pseudacorus*, *Phragmites altissimus*. Of the listed species, only *I. glandulifera* and *P. altissimus* form large thickets in disturbed areas, mainly in the watered ditches along the roads. The remaining alien species are rare and in small numbers. Some species native to the southern forest-steppe part of the region, within the southern taiga landscape of Tobolsk and their neighborhood, can also be attributed to adventive species. These are, primarily, *Typha laxmannii* and *Zannichellia repens*. In recent years, these species are expanding their area to the north (Kapitonova 2018).

In the macrophyte flora of Tobolsk, hydrophytes are represented by 43 species (17.0%). These are plants completely immersed in water or floating on its surface, such as species of the genera *Potamogeton*, *Lemna*, *Myriophyllum*, *Nuphar*, *Utricularia* and others. The remaining 208 species are semi-aquatic plants and they include ecological groups of helophytes, hygrophytes, and hygromesophytes. The revealed hydrophyte fraction in the studied flora is comparable with the indicators of the hydrophilic flora studied by us in the cities of the Vyatka-Kama Cis-Urals, where the hydrophyte fraction varies from 13.93 to 20.2% (Kapitonova 2019).

Species protected in the Tyumen Region are noted in the macrophyte flora of Tobolsk (The Government of the Tyumen Region 2017): *Lycopodiella inundata*, *Nuphar pumila*, *Nymphaea tetragona*, *Acorus calamus*, *Zannichellia repens*, *Epipactis palustris*. In addition, macrophytes very rare in the region and in the Western Siberia as a whole were found in city's waterbodies: *Elatine alsinistrum*, *Nuphar* × *spenneriana*, *Peplis portula*, *Potamogeton lacunatus*, *Riccia fluitans*, *Ricciocarpos natans*, *Rorippa dogadovae*, *Stellaria fennica*, *Utricularia australis*, *U.* × *ochroleuca*, *Veronica beccabunga*. Some of the listed species are known in the region only from the territory of the city of Tobolsk.

Conclusion

Preliminary results of the study of the macrophyte flora of the Tobolsk city show a high level of taxonomic diversity of aquatic and semi-aquatic plants of the studied territory. The flora of city's waterbodies and watercourses totals 253 species of higher plants from 123 genera and 61 families including 27 species of bryophytes. A high level of taxonomic diversity of the studied flora is provided by a wide range aquatic and semi-aquatic ecotopes on the territory of the city, both natural and anthropogenic. The hydrophilic flora of Tobolsk includes eight vascular plant species alien in the region, four hybrids and six species protected in the Tyumen Region.

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