

Conference Paper

Some Features of the Distribution of Aquatic Vascular Plants in Asian Russia

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Abstract

Some features of the distribution of aquatic vascular plants in Asian Russia (limits of distribution and phytogeographical patterns) are discussed. Many northern species penetrate far to the south via watersheds and mountain systems, while southern species go far to the north by the valleys of large rivers. Some species considered circumpolar are represented by 2–3 allopatric species. For some species, the ranges have been expanded in Asian Russia, some other taxa have been combined in one widespread species. The possible centers of the diversity of this group are outlined (Southern Siberia, Amur and Primorie areas, Central Yakutia and Kamchatka).

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1. Introduction

We carried out the revision of aquatic vascular plants in Asian Russia, including West and East Siberia and the Russian Far East. We studied species composition, solved some taxonomic problems and investigated features of distribution, ecological preferences and biological characteristics. The character of the distribution of aquatic vascular plants of Asian Russia has been poorly studied. This article presents some results on the distribution of aquatic vascular species and preliminary biogeographical patterns.

2. Methods

Information on the distribution of aquatic vascular plants was obtained from different floras, manuals and papers concerning the regions of the area and Asian Russia as a whole. The results were checked during the revision of herbarium collections in IBIW, LE, MAG, MHA, MW, NS, NSK, SAS, TK, VLA and some others. During our own field studies in Yakutia, Magadan Region, Kamchatka, Chukotka, Amur Region, Khabarovsk

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Territory and Primorskii Territory, previously known information was verified and a great deal of new data were obtained.

3. Results

According to our data, about 245 species and a number of hybrids of aquatic vascular plants occur in Asian Russia [1]. During our study, we obtained substantial new data about the distribution of aquatic vascular plants in the area.

3.1. Limits of distribution

We have found that the northern limits for many species extend further to the north than was previously known. Many species in Yakutia penetrate far to the north (over the Arctic circle) via the valleys of large rivers, such as the Lena, Yana, Indigirka and Kolyma. Thus, on the Kolyma River at a site 150–200 km downstream from the town of Srednekolymsk (67°30′ –69°30′ N), there are numerous collections of *Ceratophyllum demersum*, *Lemna turionifera*, *Myriophyllum sibiricum*, *M. verticillatum*, *Potamogeton berchtoldii*, *P. compressus*, *P. gramineus*, *P. natans*, *P. perfoliatus*, *P. praelongus*, *P. pusillus*, *P. sibiricus*, *Ranunculus mongolicus*, *R. subrigidus*, *Sparganium angustifolium*, *S. emersum*, *S. hyperboreum*, *Stuckenia subretusa*, *Utricularia macrorhiza*, etc. On the Yana and Indigirka rivers, some of the listed species were found even further to the north (70°–71° N) [2].

These localities are situated 2–3° further to the north (at least 250–300 km) than the northernmost localities of many species known from the northwestern part of the Magadan Region and the Kolyma River basin (64°–65° N) [3] or from Chukotka, the Anadyr River basin, the Chukchi Peninsula etc. (mostly 65°–67° N) [4, 5]. However, the northernmost localities for aquatic vascular plants were recorded for the fairly well-studied flora of the Taimyr Peninsula [6], where many species occur northward (71°–74°50′ N). The most likely explanation may be that Taimyr extends further to the north (up to 77°40′ N). The extreme northern mainland point of Yakutia lies at 74° N, but aquatic plants are distributed up to 71° N. The continental land of Chukotka extends to 70° N, while the known northern boundaries of aquatic species are situated to 67° N. The distance from the northern limit of the continental edge to the northernmost localities where aquatic vascular plants can be found is about 3° in latitude.

An interesting situation was discovered in Central Yakutia, in the Leno–Aldan interfluvium. *Hydrilla verticillata* and *Potamogeton maackianus* were found there in significant

abundance in lakes on the lower Amga River (actually in the Aldan River valley). Both species belong to the thermophilic element of the flora, and their Yakutian localities are situated ca. 1000 km to the north of their main geographical range in Asian Russia. Their populations may be rather recent in origin (Holocene) as a result of the long-distance dispersal of germs by migrant waterfowls. The records of *H. verticillata* and *P. maackianus* are the northernmost to date (to 62.18° N) [7].

Together with these species in these lakes in the Aldan River valley, we also found mainly European *Potamogeton rutilus* [8]. We confirmed the presence of *P. rutilus* in 5 localities in Central Yakutia and 13 more in other regions of North Asia. These records greatly extend the distribution range of this species to the east, since the previous distribution range was set mainly west of the Middle Volga. Most likely, the presence of *Hydrilla verticillata*, *Potamogeton maackianus* and *P. rutilus* in the Leno–Aldan interfluvium is promoted by the specific carbonate character of landscape, the softer climatic regime and the more favorable conditions of lakes situated in a river valley.

Invasive *Elodea canadensis* has expanded its range to the north in West Siberia and to the north and east in East Siberia along large river valleys [7, 9]. Thus, the 2 localities recently found in Yakutia are ca. 650 km distant to the northeast and 1370 km to the east-northeast from the nearest point in Irkutsk Region. This invasive species has spread out as a result of floods from the Upper Lena populations (Irkutsk Region), the downstream of the Lena River being a good invasive corridor.

3.2. Phytogeographical patterns

Within the latitudinal groups, plurizonal and predominantly boreal species prevail, making up to three quarters of the list. Among the longitudinal groups, species with wide distribution ranges (Holarctic and Eurasian) also dominate, making up more than half of the list. Such proportions are consistent with the intrazonal character of aquatic flora as a whole, which has been shown for many regions [10–12].

It is necessary to note that many northern species penetrate far to the south via watersheds and mountain systems (found from the Arctic to mountain ranges on the southern borders of Russia), while southern species go far to the north by the valleys of large rivers (often over the Arctic circle). This is also a fairly general biogeographical pattern [13, 14]. At the same time, however, there are some examples of allopatry, for example, the Arctic *Stuckenia subretusa* and the boreal *S. vaginata*, whose ranges are distinctly separated [1, 15].

The longitudinal distribution is more interesting. On the one hand, species considered circumpolar in distribution were found to be represented by 2–3 allopatric species: for example, *Isoetes muricata* – *I. asiatica* – *I. echinospora*, *Myriophyllum spicatum* – *M. sibiricum*, *Ranunculus (Batrachium) codyanus* – *R. subrigidus* – *R. circinatus*, and *Utricularia macrorhiza* – *U. vulgaris* (– *U. australis*). All of these can be considered examples of speciation as a result of geographical isolation. On the other hand, species with ranges which have been expanded as a result of finding of new localities in Asian Russia (e.g., *Potamogeton lucens*, *P. rutilus*) and the combining of taxa (e.g., *Nuphar pumila* + *N. microphylla*, *Potamogeton alpinus* + *P. tenuifolius*, *Stuckenia filiformis* + *S. borealis* + *S. austrosibirica*).

To date, the western distribution limit for eastern species is West Siberia and the Urals, while the eastern limit for western species is the Upper Lena and the Baikal region, which is quite consistent with existing views [16]. Specific aquatic flora is represented in Amur and Primorie areas, where the proportion of thermophilic East Asian species is very high.

4. Conclusion

The obtained facts confirm the important role of large rivers as ecological corridors for the latitudinal and longitudinal distribution of aquatic vascular plants; also, the long-distance dispersal of germs (seeds, turions, fragments) by migrant waterfowls is important. The latter factor is poorly studied in the domestic literature, but it plays a great role, especially in Asian Russia, where the main migration routes of birds are from south to north and back.

In the valleys of large rivers, one finds the concentration of aquatic vascular plants (high number of sites and high species diversity), most probably due to lower climatic contrasts in the valleys of large rivers and, accordingly, more favorable conditions in the water bodies located there. Considering the rather severe natural and climatic conditions of the region, this is of no small importance and contributes to the growth and maintenance of these plants. In addition, the influence of permafrost, which strongly reduces the diversity of aquatic plants in watersheds (only a few species are able to survive in thermokarst water bodies) is greatly diminished in the valleys of large rivers by ground talik waters.

It is also possible to preliminarily outline the centers of diversity of aquatic vascular plants in Asian Russia. One is Southern Siberia, where mainly European taxa and mainly Asian species occur, and this area is enriched with thermophilic and halophilic

forms. Amur and Primorie areas are the most prominent, with a high concentration of thermophilic East Asian species generally found only there. Rather surprisingly, a high diversity was found in Central Yakutia, where aquatic flora is represented by the slightly depleted Southern Siberian variant. Kamchatka can also be considered a center of diversity, since one can find a 'fusion' of more northern and southern species, species endemic to the volcanic island arc and some North American forms that occur only there. A local strong increase in diversity was found in the Kolyma River valley [1], the same can be assumed for the valleys of all large rivers in Siberia. There are also reasons to expect a specific composition of aquatic plants in Chukotka, in the center of Beringia, which is one of the most important refugia for many plant groups [16–18].

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