

Rare and differential stenotopic plant species from mountain peat bogs in the Teletskoye Lake basin (Republic of Altai, Russia)

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The article presents new localities of five rare stenotopic bog plant species (*Drosera anglica*, *D. rotundifolia*, *Utricularia intermedia*, *U. minor* and *Eriophorum gracile*), of which three species are new for Northern Altai within the Republic of Altai (*Drosera anglica*, *Utricularia intermedia* and *U. minor*). The altitudinal distribution of 19 characteristic plant species of three bog massifs of the Teletskoye Lake basin located in different altitudinal subbelts and stripes of the forest belt is analyzed. Based on the analysis performed, differential bog species were identified that marked the limits of altitudinal stripes and subbelts within the forest belt.

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Keywords

North-Eastern Altai, Northern Altai, forest belt, chern-taiga subbelt, mountain-taiga subbelt, floristic and landscape differentiation

Introduction

The Teletskoye Lake basin without the Chulyshman river basin belongs to the North-Eastern Altai

(province) according to the physical-geographical regionalization (Chernykh and SamoiloVA, 2011) and to the Northern Altai (subprovince) according to the geobotanical one (Kuminova 1960). This is the warmest and at the same time the humidest part of the Russian Altai. Therefore, favorable hydroclimatic conditions are created here for the formation of peat sphagnum bogs at different altitude levels within the entire forest belt. In most other provinces of Altai even under favorable relief conditions, the development of peatlands is limited either by a lack of heat or a lack of moisture (Kuminova 1960).

In this regard, the investigation of phytodiversity, floristic and landscape differentiation of mountain peat bogs of the Russian Altai is most promising in the North-Eastern Altai. In this paper, we summarize the preliminary results of the study of the distribution of rare and differential stenotopic bog species in the Lake Teletskoye basin, taking into account our previous publications (Zolotov et al. 2021, 2022a, b).

Materials and methods

In the course of field work in 2006–2007, researchers of the Institute for Water and Environmental Problems of Siberian Branch of the Russian Academy of Sciences (IWEP SB RAS) studied three peat sphagnum bogs with a peat layer thickness of 1.5 meters or more in the part of the Teletskoye Lake basin located in the North- Eastern Altai (physical-geographical province). These bogs are located in different altitudinal subbelts and stripes of the forest belt (Fig. 1): the chern-taiga subbelt - Kuantang bog (about 650 m above sea level); the lower strip of the mountain-taiga subbelt - bog in the vicinity of Lake Plandukel (about 1000 m above sea level); the middle strip of the mountain-taiga subbelt - bog massifs in the valleys upstream Malye Chily River (Yaryshkol and Archa Rivers, Lake Ezhilyukel, about 1300 m above sea level).

All listed massifs of peat bogs are associated with glacial and lacustrine-glacial deposits and serve as evidence of a significantly greater than previously assumed influence of the last glaciation on the landscapes of the mountain frame of Lake Teletskoye (Chernykh et al. 2014a, b).

During the field work of 2006–2007, landscape and geobotanical descriptions were made, and herbarium material was collected, part of which is cited below. A comparative analysis of the floristic data revealed rare and differential stenotopic bog species, which make it possible to distinguish between the peat bog floras of different altitudinal subdivisions of the forest belt.

Result

During the processing of herbarium collections, new locations of five new and rare for the Northern Altai geobotanical subprovince (Kuminova 1960) stenotopic bog plant species were discovered. All the specimens cited are stored in the Herbarium of the Kuzbass Botanical Garden (KUZ, Kemerovo city).

Droseraceae Salisb.

Drosera anglica Huds.: 1) The Republic of Altai, Turochaksky District, Lake Teletskoye, village Artybash surroundings, upper reaches of the Kuantang River, low-ridge-hollow transitional (mesotrophic) sphagnum peat bog, point No. 34, 51°48'50.22"N, 87°19'6.20"E, 637 m asl., 19 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ); 2) The Republic of Altai, Turochaksky District, Lake Teletskoye, upper reaches of the Karasu River, southeastern shore of Lake Plandukel, sedge-sphagnum bog, point No. 14, 51°40'12.3"N, 87°32'06.2"E, 972 m asl., 23 VII 2007 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ).

According to the annotated conspectus of flora (Ilyin and Fedotkina 2008) and Handbook of plants of Republic of Altai (Khmeleva 2012), *D. anglica* is noted as a very rare species of sphagnum bogs

and bog forests at one point in South-Eastern Altai (Lake Saigonysh). It is a new species for the Northern Altai recorded at two points on the left and right banks of Lake Teletskoye.

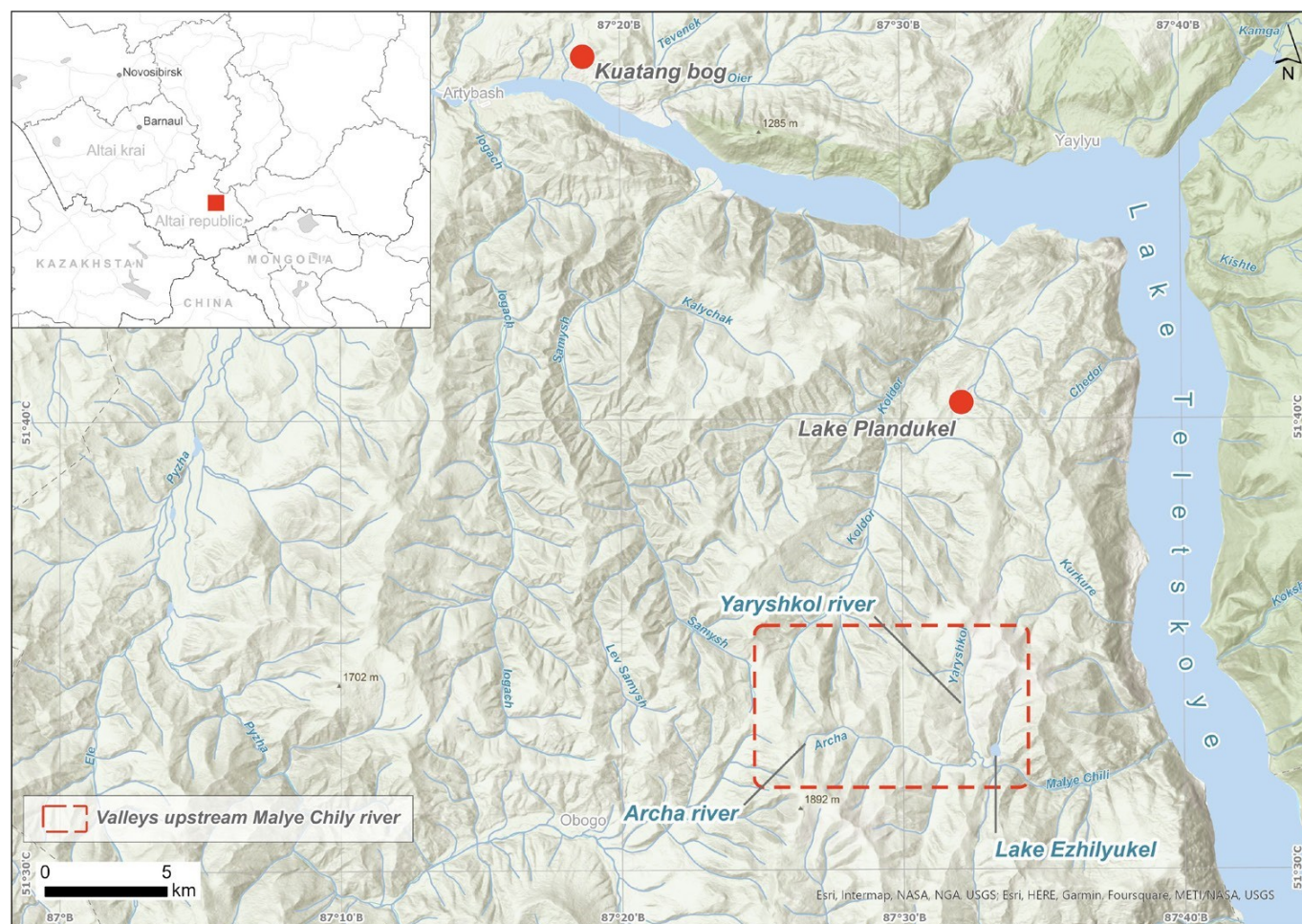


Figure 1. Three studied peat bog massifs in the Teletskoye Lake basin.

***Drosera rotundifolia* L.:** 1) The Republic of Altai, Turochaksky District, Lake Teletskoye, village Artybash surroundings, upper reaches of the Kuatang River, low-ridge-hollow transitional (mesotrophic) sphagnum peat bog, point No. 34, 51°48'50.22"N, 87°19'6.20"E, 637 m asl., 19 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ); 2) The Republic of Altai, Turochaksky District, Lake Teletskoye, upper reaches of the Karasu River, southeastern shore of Lake Plandukel, sedge-sphagnum bog, point No. 14, 51°40'12.3"N, 87°32'06.2"E, 972 m asl., 23 VII 2007 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ).

According to the annotated conspectus of flora (Ilyin and Fedotkina 2008) and Handbook of plants of Republic of Altai (Khmeleva 2012), *D. rotundifolia* is noted as a rare species of sphagnum bogs, bog forests and banks of water bodies in Northern Altai. We present two new locations on the left and right banks of Lake Teletskoye.

Lentibulariaceae Rich.

***Utricularia intermedia* Hayne:** 1) The Republic of Altai, Turochaksky District, Lake Teletskoye, village Artybash surroundings, upper reaches of the Kuatang river, low-ridge-hollow transitional (mesotrophic) sphagnum peat bog, point No. 34, 51°48'50.22"N, 87°19'6.20"E, 637 m a.s.l., 19 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ).

According to the annotated conspectus of flora (Ilyin and Fedotkina 2008) and Handbook of plants of Republic of Altai (Khmeleva 2012), *U. intermedia* is noted as a rare species of bogs, lakes, and oxbows in Central Altai. It is a new species for the Northern Altai recorded at one point on the right bank of Lake Teletskoye.

***Utricularia minor* L.:** 1) The Republic of Altai, Turochaksky District, Lake Teletskoye, village Artybash surroundings, upper reaches of the Kuatang river, low ridge-hollow transitional (mesotrophic) sphagnum peat bog, point No. 34, 51°48'50.22"N, 87°19'6.20"E, 637 m a.s.l., 19 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ); 2) The Republic of Altai, Turochaksky District, Lake Teletskoye, upper reaches of the Karasu River, southeastern shore of Lake Plandukel, in water, point No. 16, 51°40'16,3"N, 87°32'13,9"E, 970.6 m asl, 23 VII 2007 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov [KUZ].

The species is missing in the annotated conspectus of flora (Ilyin and Fedotkina 2008) and Handbook of plants of Republic of Altai (Khmeleva 2012). Previously, *U. minor* was observed for the Western Altai within the Republic of Altai (Zolotov 2013). This is a new species for the Northern Altai recorded at two points on the left and right banks of Lake Teletskoye.

Cyperaceae Juss.

***Eriophorum gracile* W.Koch:** 1) The Republic of Altai, Turochaksky District, Lake Teletskoye, Lake Ezhilyukel, a surface slightly inclined toward the lake along the right bank of inflowing stream, cottongrass-horsetail-sedge bog, point No. 08, 51°32'50,42"N, 87°33'20,45"E, 1294 m a.s.l., 13 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ); 2) The Republic of Altai, Turochaksky district, Lake Teletskoye, village Artybash surroundings, upper reaches of the Kuatang river, low-ridge-hollow transitional (mesotrophic) sphagnum peat bog, point No. 34, 51°48'50.22"N, 87°19'6.20"E, 637 m asl., 19 VII 2006 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ); 3) The Republic of Altai, Turochaksky District, Lake Teletskoye, upper reaches of the Karasu river, southeastern shore of Lake Plandukel, sedge-sphagnum bog, point No. 14, 51°40'12.3"N, 87°32'06.2"E, 972 m a.s.l., 23 VII 2007 D.V. Zolotov, D.V. Chernykh, R.Yu. Biryukov (KUZ).

E. gracile is observed in the flora of the Altaiskiy State Nature Biosphere Reserve (Zolotukhin and Zolotukhina 2003), but it is missing in the annotated conspectus of flora (Ilyin and Fedotkina 2008) and Handbook of plants of Republic of Altai (Khmeleva 2012). We present three new locations on the left and right banks of Lake Teletskoye within the Northern Altai beyond the borders of the Altaiskiy Reserve.

Taking into account previously published data on the findings of stenotopic bog species (Zolotov et al. 2021; 2022a, b), we summarized their distribution in the studied bog massifs (Table 1).

Species	Kuatang bog ~650 m asl.	Lake Plandukel ~1000 m asl.	Malye Chily River ~1300 m asl.
Caryophyllaceae Juss.			
<i>Stellaria palustris</i> L.	- (+)*	+	+
Ericaceae Juss.			
<i>Andromeda polifolia</i> L.	+	+	+
<i>Oxycoccus palustris</i> Pers.	+	+	+
<i>Oxycoccus microcarpus</i> Turcz. ex Rupr.	-	-	+
Droseraceae Salisb.			
<i>Drosera rotundifolia</i> L.	+	+	-
<i>Drosera anglica</i> Huds.	+	+	-
<i>Drosera</i> × <i>obovata</i> Mert. et W.D.J.Koch	+	+	-
Apiaceae Lindl.			

<i>Cicuta virosa</i> L.	+	+	-
Gentianaceae Juss.			
<i>Swertia obtusa</i> Ledeb.	-	-	+
Lentibulariaceae Rich.			
<i>Utricularia minor</i> L.	+	+	-
<i>Utricularia intermedia</i> Hayne	+	-	-
Asteraceae Dumort.			
<i>Solidago dahurica</i> Kitag.	+	+	+
Scheuchzeriaceae Rudolphi			
<i>Scheuchzeria palustris</i> L.	+	+	-
Juncaceae Juss.			
<i>Juncus stygius</i> L.	-	+	-
Cyperaceae Juss.			
<i>Carex limosa</i> L.	+	+	+
<i>Eriophorum gracile</i> Koch	+	+	+
<i>Rhynchospora alba</i> (L.) Vahl	+	+	-
Poaceae Barnhart			
<i>Hierochloë arctica</i> C.Presl	-	+	+
Araceae Juss.			
<i>Calla palustris</i> L.	-(+)*	+	-

Table 1. Distribution of rare and differential stenotopic bog species within bog massifs. Note: - (+)* - not found by us within the surveyed area, but undoubtedly occurs at this altitudinal level in the mountains of Northern Altai.

Only nine species of the 19 bog species analyzed are found in the highest bog massif in the valleys upstream of the Malye Chily River (Table 1). Most of this species (6 of 9) are noted at all altitudinal levels under consideration: *Stellaria palustris*, *Andromeda polifolia*, *Oxycoccus palustris*, *Solidago dahurica*, *Carex limosa*, *Eriophoum gracile*. The middle altitudinal strip of the mountain-taiga subbelt (upstream of the Malye Chily River) is the poorest in the bog species, but there are also several differential elements not identified below: *Oxycoccus microcarpus* and *Swertia obtusa*. The first species is characteristic for northern bogs and bog forests and grows in harsher conditions than *O. palustris*, while the second one descends from the subalpine belt along the Archa river valley from the top of Mount Archa.

The bog massif of Lake Plandukel (lower strip of the mountain-taiga subbelt) is the richest one in characteristic bog species. There are 16 species out of 19 analyzed. Of particular note are 8 differential species that do not rise higher into the middle altitudinal strip of the mountain-taiga subbelt: *Drosera rotundifolia*, *D. anglica*, *D. xobovata*, *Cicuta virosa*, *Utricularia minor*, *Scheuchzeria palustris*, *Rhynchospora alba*, *Calla palustris*. All these are predominantly plain and low-mountain bog species, which are not found at the upper altitudinal levels of the mountains. Only one species occurs in the middle and lower stripes of the mountain-taiga altitudinal subbelt and is not found in the chern-taiga subbelt: *Hierochloë arctica* (Table 1). The distribution of this species in the Republic of Altai still requires detailed study (Zolotov et al. 2022a), so it cannot be confidently assigned to differential elements.

Juncus stygius was observed in the Altai Republic in a single locality at Lake Pladunkel (Zolotov et al. 2022a) and is differential not for the lower belt of the mountain-taiga belt, but for the local flora of Lake Plandukel.

In the Kuatang bog, 13 out of 19 analyzed species were recorded. This habitat is on the second place in terms of richness of characteristic bog species after the Archa River valley. Two more bog species undoubtedly occur in the chern-taiga subbelt, but were not detected by us during the survey: *Stellaria palustris* and *Calla palustris*. Only one species *Utricularia intermedia* can be

attributed to differential elements that do not rise above the chern-taiga subbelt of the Northern Altai.

Conclusion

The bog flora of the lower strip of the mountain-taiga belt (Lake Plandukel) has the highest diversity of characteristic and differential species. The bog floras of the chern-taiga subbelt (Kuatang bog) and the lower strip of the mountain-taiga subbelt are the most similar and differentiated from the most poor flora of the middle strip of the mountain-taiga belt (Archa River valley). This is confirmed by a sharp decrease in the number of characteristic bog species from 16 to 9 at the transition to the middle altitudinal strip of the mountain-taiga subbelt and the disappearance of 8 differential species marking the most pronounced upper boundary of the lower strip of the mountain-taiga belt. The remaining floristic boundaries of altitudinal stripes are much less pronounced and are marked by 1-2 differential species.

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