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MOSS FLORA OF THE UST-NERA REGION IN THE UPPER COURSE OF INDIGIRKA RIVER, EAST YAKUTIA

ФЛОРА МХОВ ОКРЕСТНОСТЕЙ УСТЬ-НЕРЫ, ВЕРХНЕЕ ТЕЧЕНИЕ ИНДИГИРКИ, ВОСТОЧНАЯ ЯКУТИЯ

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Abstract

List of 162 moss species collected in the Ust-Nera region (Oimyakon District) is presented. It includes some interesting records of xeric species growing on steep steppe slopes on the banks of Indigirka River and its tributary, Nera River, i.e., *Hilpertia velenovskyi* and *Pterygoneuron kozlovii*. In the mountain tundra communities on Taas-Kystabyt Mt. Range (Chersky mountain system) two rare species were found. For *Grimmia fuscolutea* it is the fifth locality in Russia; it was previously known in the Caucasus, Altai, Baikal Lake area and Kamchatka. Finding of the suboceanic species, *Pseudotaxiphyllum elegans*, in the area with severely continental climate is quite unexpected; its identity is confirmed by molecular markers.

Резюме

В окрестностях поселка Усть-Нера (Оймяконский улус) собрано 162 вида мхов. Среди них есть интересные находки ксерофитных видов на сухих степных склонах по берегам Индигирки и ее притока, р. Неры, в том числе *Hilpertia velenovskyi* и *Pterygoneuron kozlovii*. На хребте Таас-Кыстабыт, входящем в горную систему Черского, были найдены два редких вида мхов. Для *Grimmia fuscolutea* это пятое местонахождение в России; ранее этот вид был известен из единичных мест на Кавказе, Алтае, в районе озера Байкал и на Камчатке. Находка субокеанического вида *Pseudotaxiphyllum elegans* в районе с резко континентальным климатом оказалась весьма неожиданной; его генетическое сходство с образцами из других регионов подтверждено с помощью молекулярных маркеров.

KEYWORDS: bryophytes, biodiversity, phytogeography, *Pseudotaxiphyllum*

INTRODUCTION

Moss flora of an extensive territory of Yakutia still remains rather unevenly studied. One of its poorly investigated areas, near Ust-Nera settlement, is in the focus of the present paper. It remained hardly accessible until recently, when the new branch of Magadan Hwy was built.

The only data on mosses for the middle course of Indigirka River was published by Afonina *et al.* (1979) for the In'yali Creek area, about 80 km downstream Indigirka River from the study area. It was based on collections made by O.M. Afonina in the course of Polar expedition of Komarov' Botanical Institution; this study especially concentrated on tundro-steppe communities occurring on south-facing slopes. This list comprised 52 moss species, including some newly recorded xeric mosses, such as *Pterygoneurum kozlovii*.

In the present paper, the results obtained mainly during a brief field trip are summarized. The majority of specimens were collected in several localities around Ust-Nera settlement (Fig. 1) in 2015, July 31 to August 7, with few additional samples collected by one of the authors (IB) later on. The resulting list is obviously not exhaustive; however, it includes a number of new and interesting records and fills a gap in our knowledge of bryophyte flora of Yakutia.

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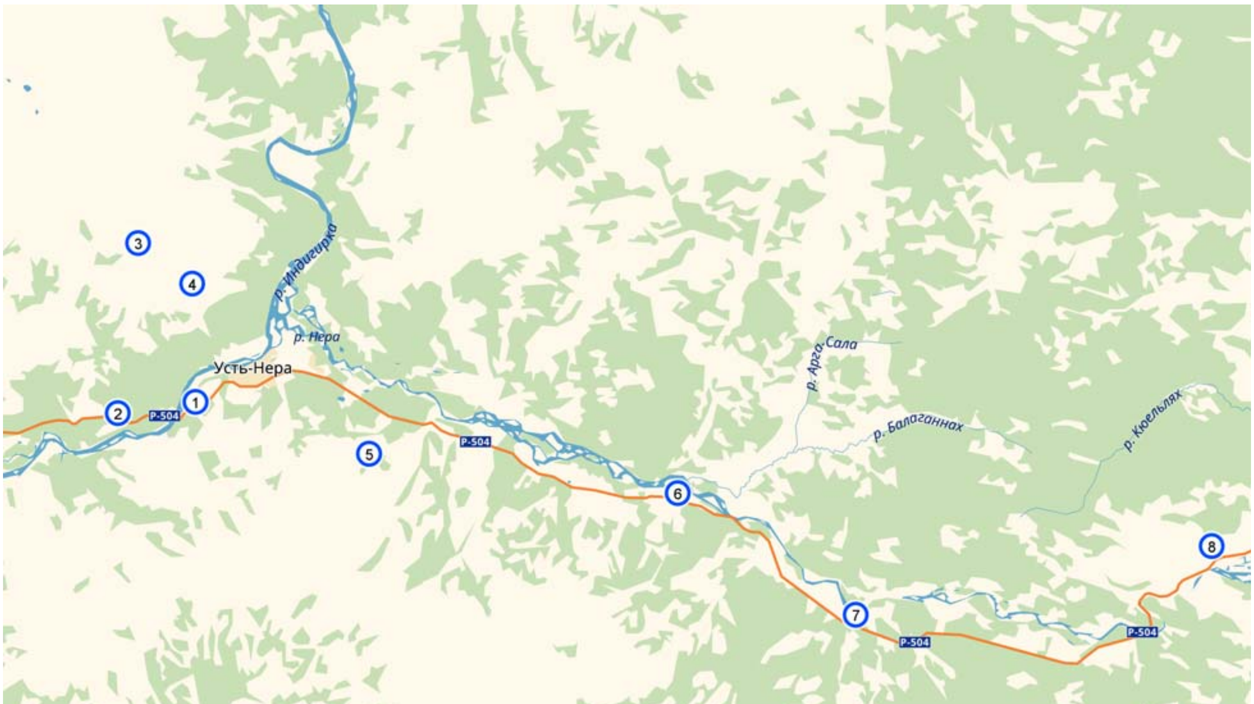

Fig. 1. Collecting localities in the upper course of Indigirka River near Ust-Nera Settlement (see also Table 1).

Table 1 Collecting localities near Ust-Nera Settlement (at 64°25' – 64°42'N, 142°7' – 144°21'E).

Locality	Collectors and years of collecting	Altitude, m	Lat	Long
1. Surroundings of Ust-Nera Settlement	Ignatov, Ignatova, Ivanova, 2015; Balakirev, 2016, 2017	460–770	64°33' – 64°34'	142°7' – 142°15'
2. Ol'chan Pass at 32 km NW of Ust-Nera Settlement	Ignatov, Ignatova, Ivanova, 2015	1100	64°38'	142°34'
3. 40 km NW of Ust-Nera Settlement (Tuora-Tas Creek)	Ignatov, Ignatova, Ivanova, 2015	900	64°39'	142°'32'
4. Ol'chan gold works	Ignatov, Ignatova, Ivanova, 2015	785	64°42'	142°34'
5. 25 km SE of Ust-Nera Settlement, Taas-Kystabyt Mt. Range near Nelkan pass	Ignatov, Ignatova, Ivanova, 2015; Balakirev, 2016, 2017	1260–1600	64°27'	142°35'
6. Nera River valley at ca. 30 km E of Ust-Nera Settlement	Ignatov, Ignatova, Ivanova, 2015	570	64°30'	143°43'
7. 40 km E of Ust-Nera Settlement, Mekcherge Creek mouth	Ignatov, Ignatova, Ivanova, 2015	570	64°25'	144°02'
8. Ca. 60 km E of Ust-Nera Settlement, Topol' Creek mouth	Ignatov, Ignatova, Ivanova, 2015	600–750	64°27'	144°21'

Study area

The explored territory is situated in the upper course of Indigirka River, near the Nera River mouth. Its bryophytes have been collected in several localities within In'yali-Olchan Upland, Mt. Range Taas-Kustabyt (Sarychev), Indigirka River valley up to ca. 10 km upstream Ust-Nera Settlement, and the valley of Nera River, up to ca. 60 km from its mouth (Fig. 1, Table 1).

Geologically, the In'yali-Olchan Upland comprises numerous small massifs of igneous rocks and intrusions. Taas-Kystabyt Mt. Range is rather monolithic (with maximal altitude of 2341 m), formed mainly by aleurolite and argillite interrupted by granite intrusions. Nera River is one of the largest tributaries of Indigirka River, being ca. 300 km long; it flows in northwest direction, crossing zones of different geological structure (Rusanov *et al.*, 1967).

Climate of the study area is severely continental; this place is close to Oimyakon Settlement, where the coldest temperature among lowlands in the Northern Hemisphere, –67.7°C, was recorded in 1938. According to the Nera meteostation data (by four years of observation), the mean annual temperature is –14.6°C; winter lasts more than 7 months, with the number of days with snow cover 2 13; lowest temperature –57.3°C; highest temperature 33.9°C; annual precipitation 230 mm (Table 2). This area is xeric, with precipitation to evaporation ratio being 0.2–0.15.

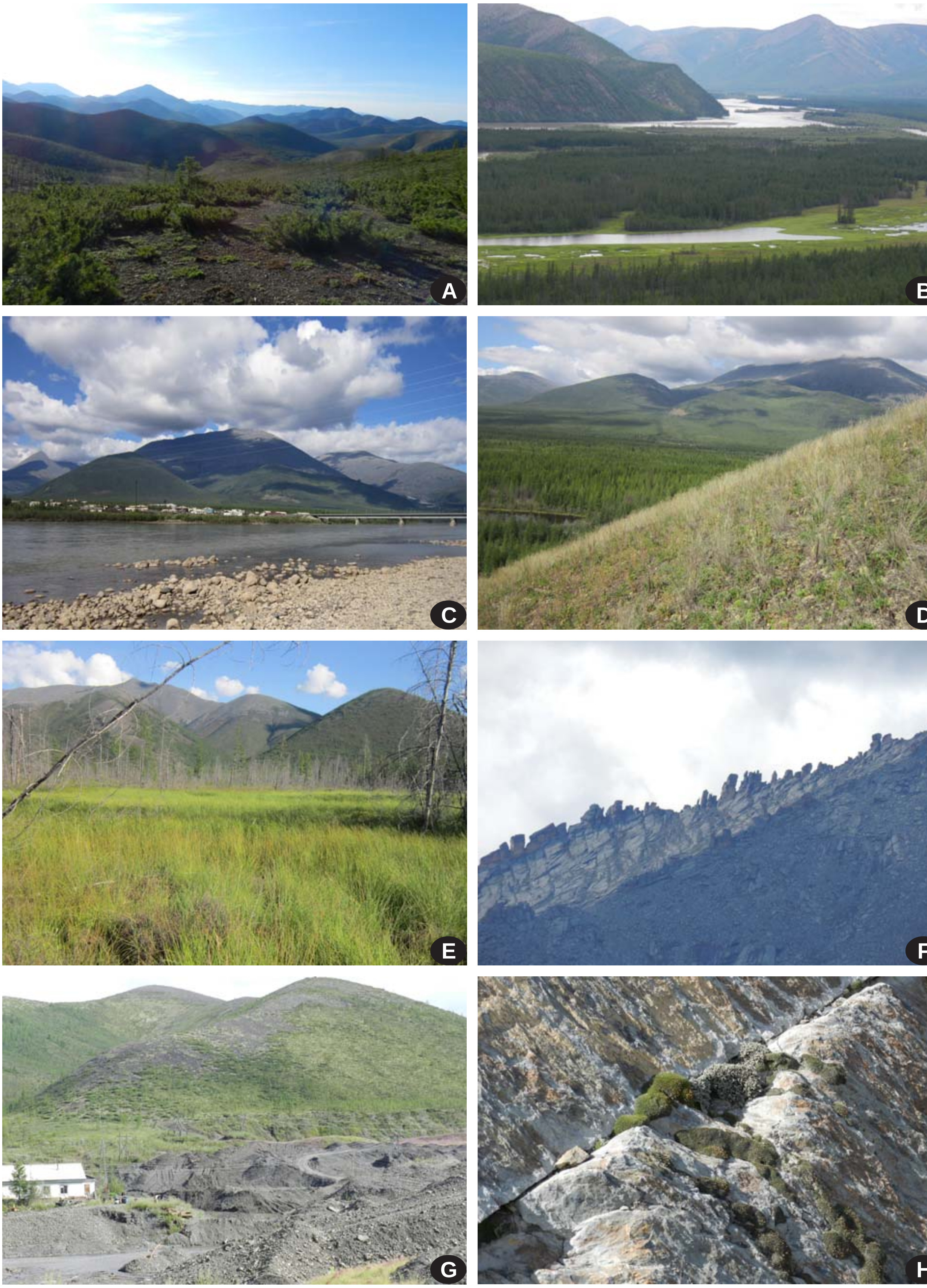

Fig. 2. A: a view of Chersky Mt. System from Ol'chan pass; B: Indigirka River valley near Ust-Nera Settlement; C: bridge across Indigirka River; D: steppe on the right steep slope of Indigirka River; E: mesotrophic mire in the valley of Nera River; F: weathered rocks on the ridge top of Tas-Kystabyt Mt. Range; G: Ol'chan gold works and mine dumps; H: *Coscinodon hartzii* on rocks rich in heavy metals.

Table 2. Meteorological data for Ust-Nera and neighboring meteostations for 1987–1990 (Meteorological annual, 1987-1990).

Meteostations	t_{ann}	t_{max}	t_{min}	$t_{January}$	t_{July}	Annual precipitation, mm	Days with snow cover	Maximal depth of snow cover, cm
Ust-Nera	–14.6	33.9	–57.3	–48.6	16.9	230.0	213	44
Predporozhnaya	–14.0	34.8	–55.6	–44.9	17.5	174.5	212	27
Agayakan	–15.7	30.7	–56.6	–48.2	15.0	196.7	231	42
Oimyakon	–16.5	31.0	–57.9	–49.4	14.9	205.5	226	41

The study area belongs to the territory with continuous permafrost. Cryomorphic structures play a significant role in all relief elements. Soil cover is peculiar, lacking any podsol-forming processes. Strongly acidic thixotropic gley soils prevail. In river valleys, peat boggy and meadow-boggy soils occur at places, while under steppe vegetation chernozem-like soils are formed (Karavaev & Dobretsova, 1964).

Nera River, a right tributary of Indigirka River in its upper course, crosses the highland with sharply expressed altitudinal zonation. Up to 600–650 m a.s.l., belt of open forests of *Larix cajanderi* is situated; in the interval from 650 to 1100 m it gives way to mountain forest-tundra zone, and further up zone of subgoltsy shrubs, mountain tundra and cold deserts occur.

In the valley of Nera River in its middle and lower course, open larch forests occupy 30–35% of the area; they alternate with dwarf birch thickets, grass mires and sedge hillocky mires; groves of *Populus suaveolens* and *Chosenia arbutifolia* develop on alluvial deposits, occasionally with an admixture of *Salix rorida*. Moss cover in open larch forests is insignificant (5–10%), being formed mainly of *Aulacomnium palustre, Poytrichum strictum,* and *Dicranum* spp.

Mossy dwarf birch thickets of *Betula exilis* (cover 60–80%) are in intermediate position between larch forests and mires. They are characterized by a hummocky relief and peat-bog soils, which melt to the depth of 50–60 cm at th end of summer. Moss cover reaches 70–80% (dominating species is *Aulacomnium palustre*).

In the lower course of Nera River, grass mires prevail; they are classified into two groups, *i.e.*, sedge hillocky mires with *Carex caespitosa* and sedge-cotton-grass mires. Moss layer is weakly developed in these communities. In sedge hillocky mires, patches of *Plagiomnium curvatulum, Warnstorfia exannulata, Sanionia uncinata,* and *Aulacomnium palustre* are found between hillocks, rarely also *Sphagnum squarrosum* and *S. fimbriatum* occur in such habitat. *Calliergon giganteum, Warnstorfia fluitans,* and *Scorpidium revolvens* are characteristic components of sedge-cotton-grass mires.

In the mountain forest-tundra zone, open larch forests with shrublets and lichens are most common, on north-faced slopes with addition of *Sphagnum*. In subgoltsy-shrub zone, large area is occupied by thickets of *Pinus pumila, Alnus fruticosa,* and *Betula divaricata*. Zone of lichen tundra is weakly expressed and quickly transits into rocky cold deserts.

Within the forest belt, open larch forests occupy the largest area on mountain slopes. On south-faced slopes, they do not exceed an altitude of 650–700 m and are represented by redberry-moss forests with *Aulacomnium turgidum* (80–90%) and small admixture of other moss species. Closer to subgoltsy zone shrublet-lichen larch forests develop; they have poor moss layer (cover 10–20%) formed by *Aulacomnium turgidum, Polytrichum strictum,* and *Rhytidium rugosum*. On north-faced slopes, boggy larch forests with *Sphagnum* and lichens usually grow; they often have hillocky relief formed as a result of cryogenic processes (hillock height is up to 50 cm). In such forests, frozen soil is observed in the end of summer directly under *Sphagnum* layer. Moss cover is usually 25–30%, rarely up to 60%, moss layer is formed by *Sphagnum spp*. On hillock slopes some green mosses and liverworts occasionally grow, *i.e., Aulacomnium turgidum, Polytrichum strictum, Ptilidium ciliare,* and *Tomentypnum nitens*. In lower part of mountain slopes with constant flow of surface water, shrublet-sphagnous open larch forests develop. Moss cover reaches 70–95%, *Sphagnum girgensohnii* is most common, with patches of *Tomentypnum nitens, Aulacomnium turgidum, Sphagnum compactum, S. aongstroemii,* and *Dicranum spp.*

Dwarf birch thickets of *Betula divaricata* are formed on mountain slopes in places of fire-damaged larch forests. Mosses are represented mainly by *Aulacomnium palustre* and *A. turgidum* with 70–85% cover.

On flat mountain tops 850–900 m high, small areas of *Pinus pumila* thickets with lichens are occasionally present.

On north-faced slopes in forest altitudinal zone, rockfields are sometimes observed. In crevices between rocks *Dicranum elongatum* and *Ptilidium ciliare* are often found in wetter places, while in dryer habitats *Rhytidium rugosum* and *Polytrichum piliferum* are frequent.

A characteristic feature of local landscape is the presence of steppe communities. They frequently occur on south-faced slopes at 600–650 m a.s.l., and, as an exception, they also develop at higher altitudes, up to the timberline. Many xerophytic vascular plants grow in these communities; some of them are local endemics or subendemics and have a relationship to Central Asian center of plant diversity and, partially, to North American steppe flora. However, such steppe sites are scattered in the valley of river Nera (Karavaev & Dobretsova, 1964).

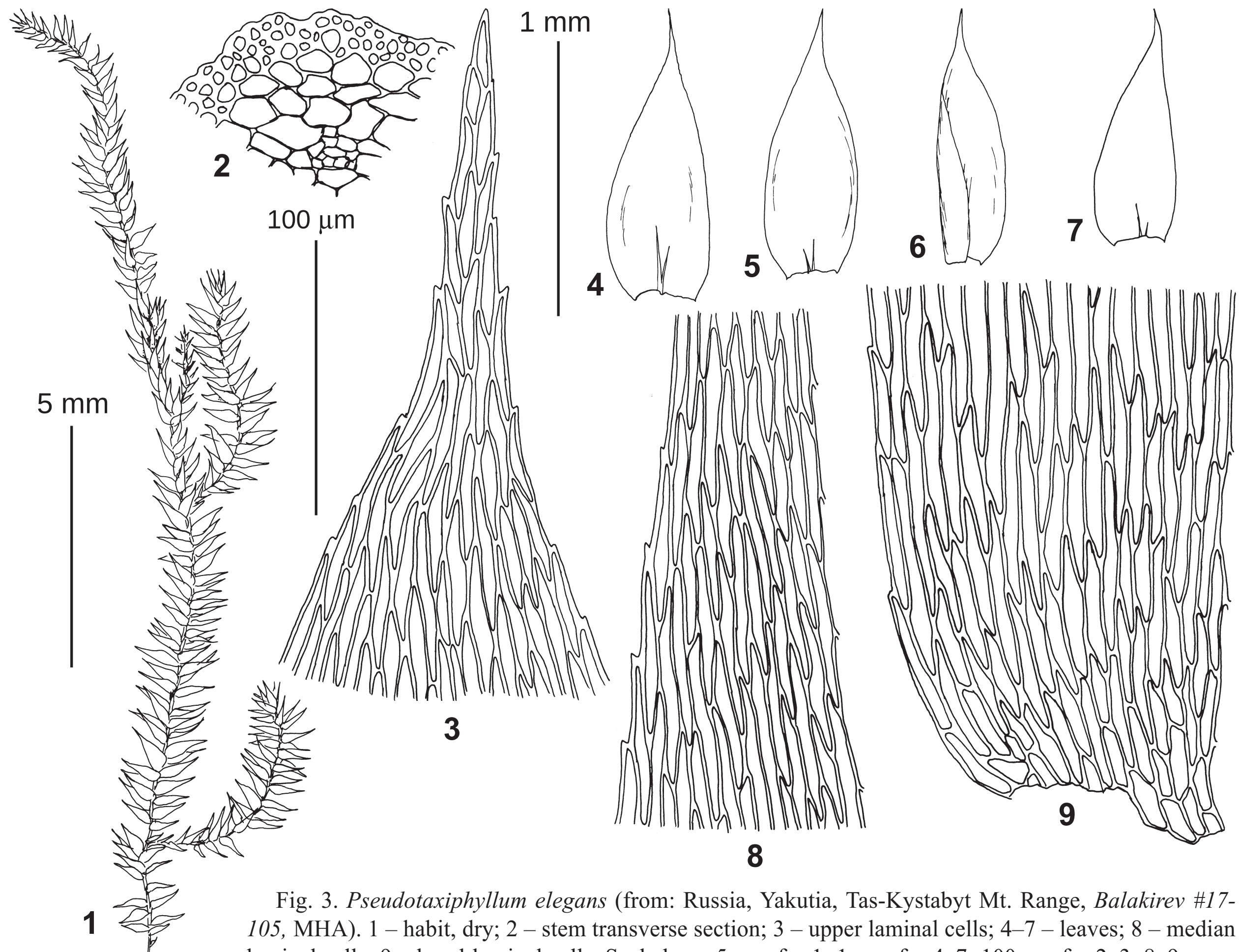

Fig. 3. *Pseudotaxiphyllum elegans* (from: Russia, Yakutia, Tas-Kystabyt Mt. Range, *Balakirev #17-105,* MHA). 1 – habit, dry; 2 – stem transverse section; 3 – upper laminal cells; 4–7 – leaves; 8 – median laminal cells; 9 – basal laminal cells. Scale bars: 5 mm for 1; 1 mm for 4–7; 100 µm for 2–3, 8–9.

Steppe communities are widespread on slopes to Indigirka River in its upper and middle course and along some its tributaries. They occupy SW and SE faced steep slopes of more than 12–15°. Most vascular species occurring here are related to the Mongol-Dahurian flora. At the same time, ca. 50% of xerophytic species have a relationship to North American prairie flora (Yurtsev, 1981). Typical steppes are combined here with petrophytic steppes and meadow-steppe communities. Sites with sheep's fescue & forb; forb, sheep's fescue & wormwood; bluegrass & forb and, rarely, sod grass steppes are represented in the valley of river Nera. There are also rootstock grass steppes formed by *Agropyron jacutorum,* which occasionally dominates at places. Another characteristic community with domination of *Helictotricheta krylovii* is also present here. Some xeric mosses, *i.e.*, *Pterygoneurum kozlovii, P. ovatum,* and *P. subsessile* grow in various types of steppes. In rocky steppes occupying high and very steep slopes, such rare mosses as *Indusiella thianschanica, Hedwigia emodica,* and *Aloina rigida* are found.

Species List

Species diversity is presented in Table 3, where the available data on altitudinal distribution are summarized. The abundance in collecting localities is also estimated.

Discussion

In total, 162 species of mosses were revealed in our collections from Ust-Nera region. This diversity is rather poor, which is probably caused by the absence of calcareous bedrocks in this area. It is comparable with the local moss flora of Mus-Khaya Mt. (180 species, Ignatova *et al.*, 2011), Yana-Adycha Plateau (173 species, Isakova, 2010), and Suntar-Khayata Reserve (208 species, Ivanova *et al.*, 2016); 52 species were collected in xeric landscapes in the middle course of Indigirka River (Afonina *et al.*, 1979). At the same time, in Yakutia moss diversity substantially increases in areas where limestone, dolomite and schist rocks are common. Thus, in Ust-Maya District 253 species were revealed (Ignatov *et al.*, 2001), while the list of mosses of Khangalassky District, in the middle course of Lena River with limestone cliffs along its banks, comprises 232 species (Ivanova *et al.*, 2017).

Despite of low overall diversity, a number of noteworthy records were made in Yst-Nera region.

Xeric species are diverse, although not abundant, and most of them were collected only once of few times: *Grimmia tergestina*, *Syntrichia caninervis*, *Schistidium tenerum*, *Hilpertia velenovskyi, Pterygoneuron subsessile, P. kozlovii*, and *Indusiella thianschanica*. They

Table 3. Species diversity in Ust-Nera area, with altitudinal disctribution and abundance in eigth collecting localities, shown in Fig. 1 and Table 1. Abbreviation: fr– frequent; sp – sporadic; r rare; un – unique.

	alt, m	1	2	3	4	5	6	7	8
Abietinella abietina	460-1600	p	p	p	p	p		p	sp
Aloina rigida	630-785	r		r	r				
Amblystegium serpens	900			sp					
Amphidium mougeotii	1600					r			
Andreaea rupestris	1280-1600					sp			
Arctoa fulvella	1270-1600					r			
Aulacomnium palustre	500-700	fr							
Aulacomnium turgidum	460-1600	fr		fr		sp			
Barbula convoluta	515-670	sp							sp
Barbula unguiculata	515	r							
Bartramia ithyphylla	520-1550					sp	sp		
Blindia acuta	1280					r			
Brachytheciastrum trachypodium	460-1600	r				sp			sp
Brachythecium mildeanum	515	r							
Brachythecium cirrosum	1540					r			
Bryoerythrophyllum recurvirostrum	650-1100	sp	sp						sp
Bryum amblyodon	650-1500					r			r
Bryum argenteum	585-775	sp							sp
Bryum caespiticium	570-900			sp				sp	
Bryum creberrimum	515-1100	r	r						
Bryum cryophilum	1450					r			
Bryum pseudotriquetrum	1300					sp			
Bryum sibiricum	1100		r						
Bucklandiella microcarpa	1600					r			
Callialaria curvicaulis	515	r							
Calliergon giganteum	570							sp	
Calliergon richardsonii	515						r		
Calliergonella lindbergii	515	r					r		
Campylium stellatum	515						sp		
Ceratodon purpureus	460-1200	sp	fr	fr	fr	sp		fr	fr
Cinclidium subrotundum	900			r					
Conostomum tetragonum	1300-1450					sp			
Coscinodon hartzii	520-785				sp		r		
Cynodontium tenellum	460-900	r		r					
Dicranella crispa	515-1270	sp				sp			
Dicranella grevilleana	980				un				
Dicranella schreberiana	515-900	r		r					
Dicranella subulata	1280					r			
Dicranum acutifolium	515	sp							
Dicranum bardunovii	900-1600			r		r			
Dicranum elongatum	600-1300	sp		sp		sp			
Dicranum groenlandicum	900-1270			r		r			
Dicranum laevidens	1270					r			
Dicranum spadiceum	1270-1600					sp			
Dicranum undulatum	900			sp					
Didymodon icmadophilus	460-900	sp		sp					sp
Didymodon rigidulus	630								r
Didymodon validus	460-900	sp		sp	sp			sp	sp
Distichium capillaceum	900-1600			r		sp			
Ditrichum pusillum	515	r							
Drepanocladus aduncus	515	sp							
Drepanocladus sordidus	515	sp							
Encalypta alpina	775	un							
Encalypta pilifera	600-670	un							sp
Encalypta procera	1250					un			
Eurhynchiastrum pulchellum	1540					r			
Flexitrichum flexicaule	900			r					
Flexitrichum gracile	1600					r			
Funaria hygrometrica	515-900	sp		sp					

Table 3 (continued)		1	2	3	4	5	6	7	8
Grimmia anodon	460-640	r							r
Grimmia donniana	1270-1600					sp			
Grimmia fuscolutea	1270					un			
Grimmia incurva	600-1600	r				r			
Grimmia jacutica	600-1500	r				sp			
Grimmia longirostris	585-900	sp		sp					sp
Grimmia tergestina	650				r				
Grimmia torquata	1600					r			
Hedwigia emodica	650								r
Hilpertia velenovskyi	650								un
Hygrohypnella polaris	570-1300					sp		sp	
Hylocomium splendens var. obtusifolium	1100-1580		fr			fr			
Hylocomnium splendens	900	fr		fr				fr	fr
Hymenoloma crispulum	1270-1600					r			
Hypnum cupressiforme	600-1600	r				sp			
Indusiella thianschanica	640								un
Isopterigyopsis muelleriana	1350-1435					r			
Izopterygiopsis pulchella	785				r				
Kiaeria blyttii	1280					r			
Kiaeria starkei	1280					r			
Leptobryum pyriforme	515-900	sp		sp					sp
Loeskypnum badium	900			r					
Lyellia aspera	1300-1450					r			
Mielichhoferia asiatica	520						r		
Mielichhoferia elongata	520						r		
Mnium lycopodioides	1600					r			
Mnium spinulosum	1540					r			
Myrella julacea	1270					r			
Neckera oligocarpa	650								r
Niphotrichum panschii	1270					r			
Oligotrichum falcatum	1260-1300					r			
Oligotrichum hercynicum	1600					un			
Oncophorus virens	1300					r			
Orthothecium chryseon	1500					r			
Orthotrichum anomalum	600-650								sp
Orthotrichum iwatsukii	900			r					
Philonotis fontana	1320-1450					r			
Philonotis tomentella	900-1265			r		sp			
Plagiomnium curvatulum	900-1280	sp	sp	un		r			
Plagiothecium berggrenianum	1580					r			
Plagiothecium laetum	1350-1480					r			
Pogonatum dentatum	515-1280	sp				sp	sp		
Pogonatum urnigerum	1100-1500		sp			sp			
Pohlia andrewsii	515	un							
Pohlia beringiensis	1270-1280					r			
Pohlia cruda	1300					sp			
Pohlia crudoides	1300-1490					sp			
Pohlia drummondii	1270-1600					sp			
Pohlia filum	500-1300	r				r			
Pohlia longicollis	1600					r			
Pohlia nutans	1270-1600					sp			
Pohlia wahlendbergii	1300					r			
Polytrichastrum alpinum	600-1600	r				sp			
Polytrichastrum septentrionale	1545					r			
Polytrichum hyperboreum	1260					r			
Polytrichum jensenii	515						sp		
Polytrichum juniperinum	600-1260					r			
Polytrichum piliferum	900-1300	sp		sp		sp			
Polytrichum strictum	515	sp							
Pseudoleskeella rupestris	1540					r			
Pseudoleskeella tectorum	600								r

Table 3. (continued)		1	2	3	4	5	6	7	8
Pseudotaxiphyllum elegans	600	un							
Psilopilum cavifolium	515-1500	sp				sp			
Pterygoneurum kozlovii	585-650	r							r
Pterygoneurum ovatum	630-700								r
Pterygoneurum subsessile	585	r							
Racomitrium lanuginosum	1280-1600					sp			
Rhizomnium andrewsianum	1300					r			
Rhytidium rugosum	460-1600	fr		fr		fr			
Saelania glaucescens	1350					r			
Sanionia uncinata	515-1600	fr	fr	fr	fr	fr			
Schistidium obscurum	1600					un			
Schistidium pulchrum	460-1270	sp		sp	sp	sp		sp	sp
Schistidium scabripilum	900			sp					
Schistidium tenerum	600-775	sp							sp
Scorpidium revolvens	900			r					
Sphagnum aongstroemii	900-1275			sp		sp			
Sphagnum arcticum	515						un		
Sphagnum beringiense	500-560	sp							
Sphagnum compactum	900			r					
Sphagnum fimbriatum	515-570	sp					sp	sp	
Sphagnum girgensohnii	900			sp					
Sphagnum imbricatum	515						sp		
Sphagnum jensenii	515						r		
Sphagnum magellanicum	515						sp		
Sphagnum orientale	515-900	r		sp			sp		
Sphagnum squarrosum	500-515	sp					sp		
Sphagnum subfulvum	515						r		
Sphagnum teres	900			r					
Sphagnum tundrae	570-1270					r		r	
Sphagnum warnstorfii	520-1010	sp			sp				
Stereodon holmenii	1540					r			
Stereodon vaucheri	600-775	sp							sp
Straminergon stramineum	900-1270			sp		sp			
Syntrichia caninervis	650-690								r
Syntrichia ruralis	460-1600	sp		sp		sp			sp
Tetraplodon angustatus	515	r							
Tomentypnum nitens	515-1600	sp		fr		sp		fr	
Tortella alpicola	570							un	
Tortella fragilis	460-900	r		r					
Tortula acaulon	460-775	r		r					r
Tortula mucronifolia	650-1100		r						r
Trichodon cylindricus	515	sp							
Warnstorfia exanullata	515-1500				sp	sp	sp		

grow on south-facing slopes, where the common species on soil are *Tortula acaulon, Ceratodon purpureus, Syntrichia ruralis*, *Encalypta pilifera*, *Bryum argenteum*, while on rocks *Grimmia anodon*, *Didymodon validus*, *Stereodon vaucheri,* and *Hedwigia emodica* were found.

The most interesting among these finding is perhaps *Hilpertia velenovskyi*, known from only five other localities in Russia (Kabardino-Balkaria, Altai Republic, Anabar Plateau and two places in Yakutia (Tattinsky District in Central Yakutia and Yana-Adycha Plateau). Other species are known in steppe vegetation in Yakutia, southern Taimyr and continental Alaska (Murray, 1990). Previous studies on the banks of Indigirka River near In'yali River mouth yielded in finding of *Pseudocrossidium hornschuhianum, Pterygoneuron kozlovii* and *Syntrichia pagorum* (Afonina *et al.*, 1979). A similar compex of interesting species was revealed in Yana-Adycha moss flora: *Hilpertia velenovskyi, Pterygoneuron kozlovii, Syntrichia caninervis*, and *Fabronia ciliaris* (Isakova, 2010). Xeric mosses revealed by Ivanova *et al.* (2017) in Central Yakutia include *Indusiella thianschanica, Jaffueliobryum latifolium, Syntrichia pagorum*, *Microbryum davallianum,* and *Pterygoneurum kozlovii*. Also *Hilpertia velenovskyi, Indusiella thianschanica, Jaffueliobryum latifolium, Pterygoneurum kozlovii, Tortella densa* and *Microbryum starckeanum* were recorded on Anabar Plateau in southern Taimyr (Fedosov *et al.*, 2011).

Mires occupy large areas in flood valleys of Indigirka and Nera Rivers (Fig. 2B, E). Such ***hygrophilous species*** as *Tomentypnum nitens, Aulacomnium palustre, Sanionia uncinata, Warnstorfia exannulata*, and *Scorpidium revolvens* are common there. As much as 13 species

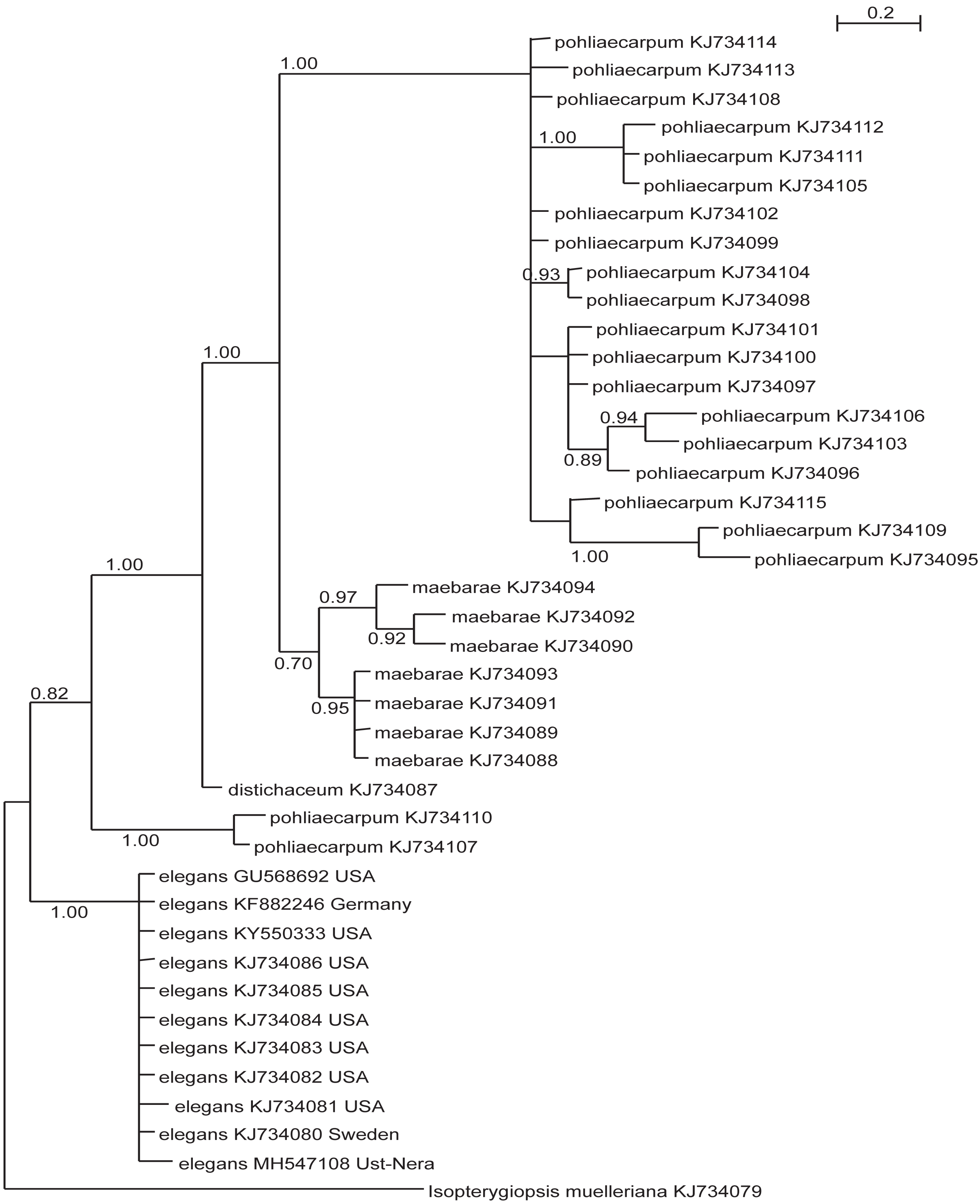

Fig. 4. Bayesian phylogenetic tree of *Pseudotaxiphyllum*, indicating position of the Ust-Nera specimen in *P. elegans*. The latter was compared with the data for the nuclear internal transcribed spacer available in GenBank. Laboratory protocol was essentially the same as in previous moss studies, described in detail by, e.g., Gardiner *et al.* (2005). Sequences were aligned by Clustal and modified manually using BioEdit 7.0 (Hall, 1999). Bayesian analysis was conducted in MrBayes (Huelsenbeck & Ronquist, 2001) using the GTR+G model as selected by MrModeltest2.3 (Nylander, 2004). The Bayesian analysis ran for 10,000,000 generations with sampling every 1000 generations. Three simultaneous runs were used. Stationarity was assessed by confirming that the average standard deviation of split frequencies was below 0.01 and by graphing the log likelihood scores. MN547108 is a new sequence of the specimen: Russia, Yakutia, Tas-Kystabyt Mt. Range, *Balakirev #17-105,* MHA.

of *Sphagnum* were collected in the study area; among them *S. beringiense* and *S. orientale* from sect. *Subsecunda* were abundant in mesotrophic mires. The former species was only recently discovered in Russia (Maksimov *et al.*, 2016), though it turned to be rather common in NE Asia, with the westernmost locality in southern Taimyr; it was previously not recognized from *S. contortum*, which is likely absent in Asia. *Sphagnum fimbriatum*, *S. squarrosum* and *S. magellanicum* are also abundant in flood valley mires, and *S. arcticum, S. jensenii* and *S. subfulvum* are rarer. Steep slopes with mountain tundra favor *S. aongstroemii.*

.***Mountain tundra species*** were collected on open W-faced slope of Taas-Kystabyt Mt. Range (Fig. 1) at altitudes 1260–1600 m. The slope is steep and forestless, with a small brook and tundra communities alternated with numerous rock outcrops and rock-fields, and with peculiar weathered cliffs at ridge top (Fig. 2F), called 'Kisilyakhi' ('standing people') in Yakutian language. In total, 83 species were collected in this locality. Five species of *Grimmia* were found, including *G. fuscolutea*, a species very rare in Russia, known only from four disjunct localities in Caucasus, Altai, Baikal Lake area, and Kamchatka (Ignatova & Muños, 2017). Family Polytrichaceae is also well represented, including *Polytrchum hyperboreum, P. juniperinum, Polytrichastrum alpinum, P. septentrionale, Oligotrichum falcatum, O. hercynicum, Psilopilum cavifolium, Pogonatum dentatum, P. urnigerum*, and *Lyellia aspera*. Among six species of *Pohlia*, three bulbiferous species, *P. beringiensis, P. filum* and *P. drummondii* were found. Finding of *Plagiothecium berggrenianum*, a species until recently considered as having strictly Arctic distribution, adds one more locality outside Arctic zone: it was recently recorded in Ust-Maya District (Ignatov *et al*., 2001), Mus-Khaya Mt. area (Ignatova *et al.*, 2011) and in Suntar-Khayata Reserve (Ivanova *et al*., 2016). However, most interesting and unexpected collection is *Pseudotaxiphyllum elegans.* This species was collected in northern spurs of Taas-Kystabyt Mt. Range in close vicinity of Ust-Nera Settlement, at ca. 600 m a.s.l., in crevices between rocks; this finding deserves special discussion.

Pseudotaxiphyllum elegans is widely distributed in oceanic and suboceanic areas of Eurasia and North America (along both Atlantic and Pacific coasts), and it was also reported from Argentina and New Zealand (Hodgetts, 2015; Smith, 2004; Schofield, 2014). In Russia it was earlier known in Chukotka (Afonina, 2004), Kamchatka (Chernyadjeva, 2012), Commander Islands (Fedosov *et al*., 2012) and in two localities in southern Far East: Tardoki-Yani Mt. in Khabarovsk Territory (Fedosov *et al.*, 2016) and Sikhote-Alinsky Nature Reserve in Primorsky Territory (Cherdantseva, 2002). This species is characterized by axillary brood bodies, which however are absent in the Yakutian plants. Due to this reason, and also because of the occurrence in unltracontinental area, the identity of this specimen was checked with molecular markers (Fig. 4). Results from this study clearly indicate that the Yakutian specimen belongs to this species. No one substitution or indel in the ITS1–2 region, one of the most varaible fragments used for moss phylogenetics at species level, is revealed, as compared with ten accessions from both Europe and North America.

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