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MOSS FLORA OF THE CENTRAL PART OF TUKURINGRA RIDGE (AMUR PROVINCE)

ФЛОРА МХОВ ЦЕНТРАЛЬНОЙ ЧАСТИ ХРЕБТА ТУКРИНГРА (АМУРСКАЯ ОБЛАСТЬ)

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Abstract

The present account bases on the collection of bryophytes made in the western part of Tukuringra Ridge in Amur Province. The studied area includes vicinity of the Pravaya Tynda river valley, where the highest peak of the ridge is situated. This area was not studied for bryophytes earlier. We covered the variety of habitats presented on the territory in all-three altitudinal zones: boreal, subalpine and alpine. The list includes 133 taxa, which is much less than in the other montane areas of Amur Province and Khabarovsk Territory; the reasons why the studied local flora is so poor in number of species are discussed. Six species of mosses are recorded in Amur Province for the first time. Among them *Pseudoleskeella catenulata*, *Sarmentypnum trichophyllum*, and *Schistidium agassizii* are characterized by rather wide distribution ranges but sparse occurrence in southern Russian Far East. For *Bucklandiella laeta, Sphagnum steerei,* and *Ulota* cf. *crispula* newly revealed localities provide the range extension westward. Records of several rare species are also commented.

Резюме

В ходе геоботанической экспедиции были собраны данные о разнообразии мхов центральной части хребта Тукурингра в Амурской области. Исследованная территория включает ближайшие окрестности долины р. Правая Тында, где расположена высочайшая точка хребта; ранее данных о флоре мхов этого района не было. Наше исследование покрывает основное разнообразие представленных здесь местообитаний, из всех трех высотных поясов растительности: горно-таёжного, субальпийского и гольцово-тундрового. Итоговый список видов включает 133 таксона, что намного меньше, чем в других локальных флорах Амурской области и Хабаровского края. Семь видов мхов приводятся для области впервые; среди них *Andreaea alpina*, *Pseudoleskeella catenulata*, *Sarmentypnum trichophyllum* и *Schistidium agassizii* имеют широкие ареалы, но их находки сравнительно редки на юге Дальнего Востока. Для *Bucklandiella laeta, Sphagnum steerei* и *Ulota* cf. *crispula* наши находки существенно расширяют известные ареалы. Также комментируются находки ряда других редких видов.

KEYWORDS: Russian Far East, biodiversity, rare species, cryolithozone

Introduction

The south of the Russian Far East attracts many bryologists, but their attention was mostly focused on the Primorsky and Khabarovsk Territories (Koponen *et al.*, 1978, Bardunov & Cherdantseva, 1982; Cherdantseva & Gambaryan, 1986; Ignatov *et al*., 2000; Pisarenko *et al.*, 2022, and many others) and insular part of the Far East, where many East Asian species penetrate, while the Amur Province is much less covered by bryofloristic studies. In accordance with the database of herbarium specimens of the Moss Flora of Russia, 386 species of mosses are known in the Amur Province (Ivanov *et al.*, 2017), while along with literature data it counts at least 533 species (Cherdantseva *et al.*, 2018 with further additions by Dudov *et al.*, 2022). However, exploration of the area is very uneven, with all available data originated from few protected areas, e.g. Norsky and Zeysky State Nature Reserves (Bezgodov *et al.*, 2013, Dudov *et al*., 2018), Tokinsko-Stanovoy National Park (Dudov *et al.*, 2022), while vast territories of the province, especially its western part, where the highest point of Tukuringra Ridge is situated, remain unsampled for bryophytes.

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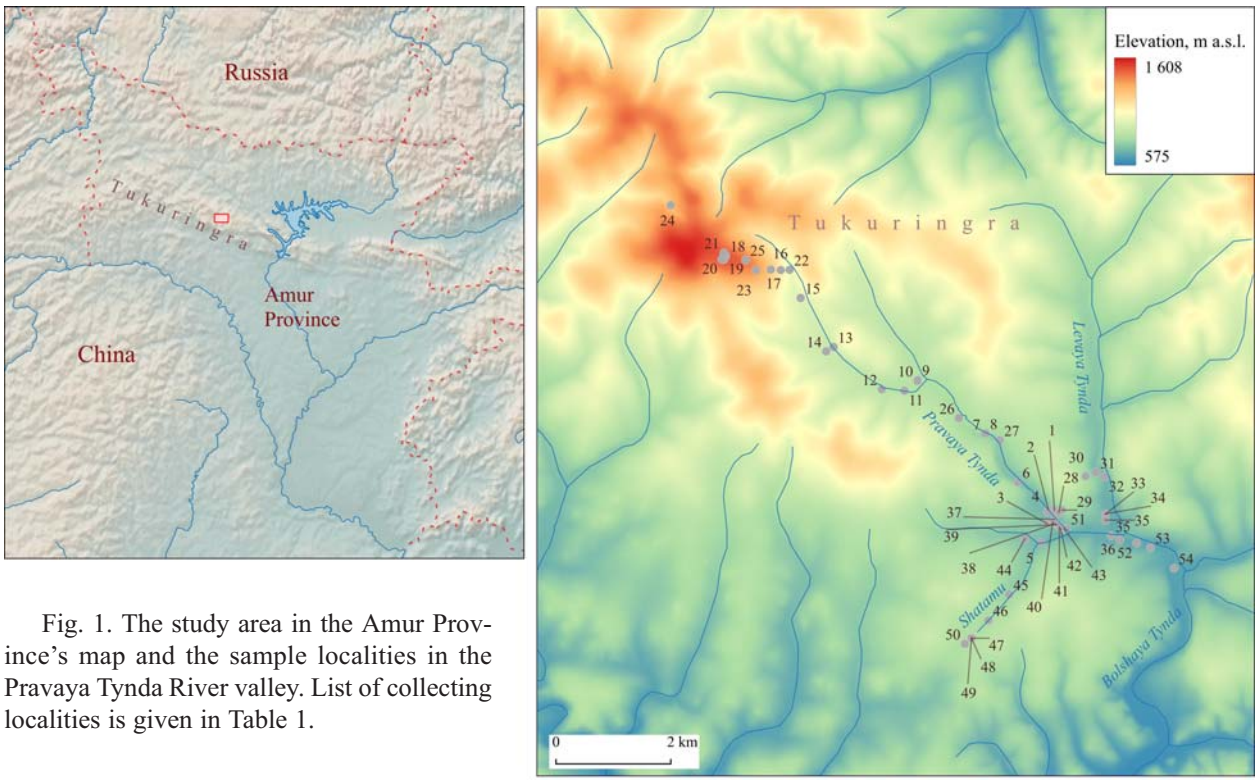

Fig. 1. The study area in the Amur Province's map and the sample localities in the Pravaya Tynda River valley. List of collecting localities is given in Table 1.

The medium-altitude Tukuringra Ridge is a part of Yankan – Tukuringra – Soktakhan – Dzhagdy group of mountain ranges. It extends on 300 km parallel to Stanovoy Range to the south from it in the northern part of the Amur Province. The Zeysky State Nature Reserve is located in the eastern part of the ridge, which contributes to a relatively high level of biodiversity knowledge (Dudov *et al*., 2018). However, the territories located to the west remain difficult to access, which is why there is very little data on them. In 1910, the expedition of N.I. Prokhorov crossed the Tukuringra ridge along the valleys of the Rakinda, Irmakit and Maly Dzheltulak rivers (Prokhorov, 1911). During this expedition, O.I. Kuzeneva collected many bryophytes, identified by V.F. Brotherus and stored in the herbarium of the BIN RAS (LE). The catalog of this collection lists 162 species of bryophytes (Brotherus *et al.*, 1916).

In July 2019, we organized a comprehensive geobotanical expedition to the little-explored central part of the ridge. Our study area is 10 km distanced from N.I. Prokhorov's expedition track and complitely lacks bryological data.This article aims to present the results of moss diversity studies and summarize new bryological findings for this territory.

Materials and Methods

Study area

The studied area is located at 54°19'–54°28' latitude and 25°26'–125°43' longitude. It covers the vicinity of the Pravaya Tynda river valley from its mouth to the headwaters and includes also the highest mountain peak of the Tukuringra Ridge, 1608 m a.s.l., the headwaters of the Malyi Irmakit river, the Shatamu river valley with lake and lower course of Levaya Tynda river valley, 3 km long from its mouth (Fig. 1).

The geological structure of the Tukuringra ridge involves elements of various ages from the Archean to the Cenozoic, with a predominance of deeply metamorphosed Proterozoic rocks, namely biotite, hornblende gneisses and shales with an admixture of amphibolites. Proterozoic and Mesozoic intrusions consisting of granites, granodiorites and diorites are also found. Alluvial deposits are widespread in the river valleys, steep slopes are everywhere covered with boulder screes, and it is noted that hornblende gneisses produce larger rock blocks compared to biotite gneisses. Within our study area, in the vicinity of the Pravaya Tynda river, biotite gneisses dominate; also, a significant part of the mountain peak 1608 m is formed by acidic intrusive rocks (Petruk *et al.*, 2009).

Most of the sample localities fall within the altitude range from 700 to 1500 m above sea level, with separate specimens found to 1608 m a.s.l. The modern topography was formed in the end of the Neogene (Gotvanskij, 1968). The uplift of the horst occurred quickly enough that the river valleys, cutting into the rocks, retained their lines. In general, the topography combines deep v-shaped valleys, steep eroded slopes and almost flat watershed surfaces. Sculptural-accumulative terraces in river valleys are usually covered by slope deposits; in some places the bedrock is exposed. However, in the central part of the ridge there are also minor river valleys with more gently sloped profile, such as the Shatamu River valley.

Climatic and natural conditions vary greatly along

Table 1. List of collecting localities

Amur Province, Tynda District, Tukuringra Range

1 – left side of the valley of the Pravaya Tynda river, 900 m northwest from the confluence of the Shatamu river, middle part of the slope, 54°21’56.7"N, 125°39’20.8"E, 733 m a.s.l., larch birch forest with *Calamagrostis purpurea* and *Vaccinium vitis-idaea*, 16.VII.2019;

2 – *ibid*., above-floodplain terrace of the left bank, 54°21’57.5"N, 125°39’9.2"E, 730 m a.s.l., dwarf-shrub *Sphagnum* bog, 16.VII.2019;

3 – right side of the Pravaya Tynda river valley, gentle slope, rock field, 54°21’41.7"N, 125°39’7.7"E, 741 m a.s.l., lichen-moss larch forest, 16.VII.2019;

4 – valley of the Pravaya Tynda river, 1 km upstream from the confluence of the Shatamu river, pebble alluvium, 54°21’54.5"N, 125°39’7.3"E, 725 m a.s.l., larch forest with *Calamagrostis purpurea* and *Sphagnum*, 16.VII.2019;

5 – Shatamu river valley, the lower reaches, 1 km upstream from its mouth, 54°21’19.9"N, 125°38’57.9"E, 740 m a.s.l., boulders along the riverbed, 16.VII.2019;

6 – valley of the Pravaya Tynda river, 2.5 km upstream from the confluence of the Shatamu river, left side of the valley, 54°22’26.7"N, 125°38’8.1"E, 760 m a.s.l., boulders along the riverbed, 17.VII.2019;

7 – *ibid*., 4.5 km upstream from the confluence of the Shatamu river, left side of the valley, 54°23’19.3"N, 125°36’59.2"E, 820 m a.s.l., larch and spruce mossy forest on rocky slope, 18.VII.2019;

8 – *ibid*., 3 km downstream of the confluence of the Vetvisty stream, steep slope of the left bank, rock field, 54°23’19.8"N, 125°37’0.8"E, 803 m a.s.l., spruce forest, 18.VII.2019;

9 – *ibid*., high bank at the confluence of the Vetvisty stream, 54°24’16.5"N, 125°34’45.2"E, 867 m a.s.l., sparse larch forest with lichens, 18.VII.2019;

10 – *ibid*., 54°24’15.4"N, 125°34’44.5"E, 899 m a.s.l., high eroded slope of the river bank, 18.VII.2019;

11 – valley of the Pravaya Tynda river, 600 m upstream from the confluence of the Vetvisty stream, left side of the valley, 54°24’3.5"N, 125°34’20.3"E, 879 m a.s.l., boulders along the riverbed, 18.VII.2019;

12 – *ibid*., 1.35 km upstream from the confluence of the Vetvisty stream, left side of the valley, 54°24’3.8"N, 125°33’36.5"E, 889 m a.s.l., boulders in riverbed, 18.VII.2019;

13 – *ibid*., in the area of the confluence of the first large right tributary, steep left slope, 70 m from the riverbed, 54°24’48.8"N, 125°31’59.6"E, 975 m a.s.l., spruce forest with larch, *Vaccinium vitis-idaea* and green mosses, 18.VII.2019;

14 – *ibid*., flattened surface of the high right bank, 54°24’43.4"N, 125°31’45.7"E, 941 m a.s.l., *Sphagnum* dwarf-shrub sparse larch forest, 18.VII.2019;

15 – valley of the Pravaya Tynda river, 2 km upstream from the confluence of the first large right tributary, floodplain of the left bank with beds of temporary watercourses, 54°25’42.2"N, 125°30’51.5"E, 1005 m a.s.l., sparse dwarf-shrub larch forest with *Pinus pumila*, 18.VII.2019;

16 – right side of the valley of the Pravaya Tynda river, 3 km upstream from the confluence of the first large right tributary, upper part of the slope, 300 m from the riverbed, 54°26’12.5"N, 125°30’10.4"E, 1129 m a.s.l., spruce forest, 18.VII.2019;

17 – mountain peak in the upper reaches of the Pravaya Tynda River, 3 km upstream of the confluence of the first large right tributary, 700 m from the riverbed, flat area in the upper part of the slope, 54°26’12.4"N, 125°29’51.1"E, 1248 m a.s.l., thickets of *Pinus pumila* with patches of moss-dwarf-shrub tundra, 18.VII.2019;

18 – *ibid*., flattened top surface, 54°26’25.5"N, 125°28’23"E, 1489 m a.s.l., mountain tundra, 18.VII.2019;

19 – *ibid*., 54°26’21.4"N, 125°28’20"E, 1500 m a.s.l., mountain tundra, 18.VII.2019;

20 – *ibid*., 54°26’21.3"N, 125°28’15.3"E, 1504 m a.s.l., mountain tundra, 18.VII.2019;

21 – *ibid*., saddle on top in mountain tundra, 54°26’28.6"N, 125°28’18.8"E, 1498 m a.s.l., alpine bog with mosses and grasses, 18.VII.2019;

22 – valley of the Pravaya Tynda river, right side, 7 km upstream from the confluence of the Vetvisty stream, 54°26’13.3"N, 125°30’27.4"E, 1057 m a.s.l., slope with subalpine communities, 19.VII.2019;

23 – upper reaches of the Pravaya Tynda river, mountain top to the right from the Pravaya Tynda river, 54°26’10.9"N, 125°29’22.7"E, 1387 m a.s.l., rock field above the treeline, 19.VII.2019;

24 – upper reaches of the Malyi Irmakit river, stream valley steep slopes, 54°27’19.3"N, 125°26’31.8"E, 1316 m a.s.l., slope with forest patches and thickets of *Pinus pumila*, 20.VII.2019;

25 – upper reaches of the Pravaya Tynda river, forestless mountain top to the right from the Pravaya Tynda river, in 1,5 km to the west from the riverbed, 54°26’21.9"N, 125°29’1.8"E, 1447 m a.s.l., mountain tundra, 20.VII.2019;

26 – valley of the river Pravaya Tynda, left side, terrace on a slope, 54°23’35.7"N, 125°36’8.1"E, 899 m a.s.l., sparse larch forest, 20.VII.2019;

27 – *ibid*., 3.5 km downstream from the confluence of the Vetvisty stream, middle part of the wet slope with a stream, 54°23’13"N, 125°37’29"E, 810 m a.s.l., mossy spruce forest, 20.VII.2019;

28 – *ibid*., 700 m upstream from the confluence of the Shatamu river, middle part of the slope, 54°21’54.7"N, 125°39’29.6"E, 808 m a.s.l., green moss *Vaccinium vitis-idaea* birch-larch forest, 23.VII.2019;

29 – *ibid*., 3 km downstream from the confluence of the Vetvisty stream, on a higher part of the slope, 54°21’57.6"N, 125°39’35"E, 829 m a.s.l., birch forest with *Calamagrostis purpurea*, 23.VII.2019;

30 – valley of the Levaya Tynda river, 3 km upstream from the confluence of the Pravaya Tynda river, 54°22’37"N, 125°40’17.7"E, 913 m a.s.l., birch-larch forest with green mosses, 23.VII.2019;

31 – *ibid*., on the right bank, 54°22’41.7"N, 125°40’37.1"E, 913 m a.s.l., rock field on a slope with forest, 23.VII.2019;

32 – *ibid*., 2 km upstream from the confluence with the Pravaya Tynda, right bank, 54°22’37,3"N, 125°40’54,5"E, 727 m a.s.l., floodplain forest, 23.VII.2019;

33 – *ibid*., 1 km upstream from the confluence with the Pravaya Tynda, right bank, 54°21’55.3"N, 125°40’59.4"E, 704 m a.s.l., floodplain forest, 23.VII.2019;

34 – *ibid*., 54°21’55.7"N, 125°40’59.5"E, 714 m a.s.l., larch forest with willows, *Calamagrostis purpurea* and *Pyrola*, 23.VII.2019;

35 – *ibid*., high right bank, 54°21’48.7"N, 125°40’59.5"E, 706 m a.s.l., lichen larch forest with shrubs, 23.VII.2019;

35 – interfluve of the Pravaya Tynda and the Levaya Tynda rivers, 400 m from their confluence, 200 m from the river Pravaya Tynda, 54°21’31.1"N, 125°41’12.4"E, 689 m a.s.l., mire with *Carex rostrata*, 23.VII.2019;

36 – valley of the Pravaya Tynda river, near its confluence with the Levaya Tynda, 54°21’27.1"N, 125°41’29.3"E, 692 m a.s.l., stones along the riverbed, 23.VII.2019;

37 – left side of the Pravaya Tynda river valley, 650 m upstream of the confluence of the Shatamu river, depression in place of the old riverbed, 54°21’46.8"N, 125°39’21.8"E, 721 m a.s.l., larch forest with birch shrubs and *Sphagnum* and oppressed trees, 24.VII.2019;

38 – *ibid*., floodplain area on the high left bank, 54°21’42.3"N, 125°39’24"E, 723 m a.s.l., larch forest with *Betula divaricata* and *Calamagrostis purpurea*, 24.VII.2019;

39 – *ibid*., depression in place of the old riverbed, 54°21’40.9"N, 125°39’28.5"E, 724 m a.s.l., mire with open water window, 24.VII.2019;

40 – *ibid*., bar on the left bank, 54°21’44"N, 125°39’18.7"E, 714 m a.s.l., *Calamagrostis purpurea* on the bar, 24.VII.2019;

41 – *ibid*., upper end of an island between the main riverbed and the temporary channel, 54°21’38.6"N, 125°39’31.7"E, 707 m a.s.l., a bar that was recently under water, 24.VII.2019;

42 – *ibid*., middle part of an island between the main riverbed and the temporary channel, 54°21’36.9"N, 125°39’34.3"E, 705 m a.s.l., mossy larch forest, 24.VII.2019;

43 – *ibid*., slope of the left bank, 54°21’36.8"N, 125°39’41"E, 752 m a.s.l., larch forest with *Vaccinium vitis-idaea*, 24.VII.2019;

44 – the valley of the left tributary of the Shatamu River, 1.5 km from its confluence with the Pravaya Tynda river, right bank, terrace above the floodplain, 54°21’23.3"N, 125°38’26.6"E, 759 m a.s.l., logged depression with *Sphagnum*, 26.VII.2019;

45 – valley of the Shatamu river, 3 km from its confluence with the Pravaya Tynda river, terrace above the floodplain on the right side, 54°20’19.7"N, 125°38’1.2"E, 805 m a.s.l., *Sphagnum* bog, 26.VII.2019;

46 – *ibid*., 4 km from its confluence with the Pravaya Tynda river, terrace above the floodplain on the right side, 54°19’49.5"N, 125°37’23.7"E, 843 m a.s.l., *Sphagnum* bog, 26.VII.2019;

47 – near north-east shore of Lake Shatamu, flat surface of the terrace, 54°19’28.6"N, 125°36’52.7"E, 843 m a.s.l., *Sphagnum* bog with hummocks, 26.VII.2019;

48 – *ibid*., flat surface of the low shore, 54°19’28.6"N, 125°36’52.7"E, 850 m a.s.l., sedge-*Sphagnum* mire, 26.VII.2019;

49 – *ibid*., near the water edge, 54°19’28.6"N, 125°36’52.7"E, 850 m a.s.l., sedge mire, 26.VII.2019;

50 – Shatamu river valley, southwest edge of the Shatamu lake, 54°19’21.8"N, 125°36’40.4"E, 851 m a.s.l., *Sphagnum* bog, 28 VII 2019;

51 – valley of the Pravaya Tynda river, near the confluence of the Shatamu river, left side of the valley, terrace above the floodplain, 54°21’37.1"N, 125°39’45.6"E, 720 m a.s.l., larch forest dominated by *Rhododendron tomentosum*, 28.VII.2019;

52 – Bolshaya Tynda river, 500 m downstream from the confluence of the Pravaya Tynda and the Levaya Tynda rivers, 54°21’24.2"N, 125°42’2.2"E, 700 m a.s.l., stones along the riverbed, 28.VII.2019;

53 – *ibid*., 1 km downstream from the confluence of the Pravaya Tynda and Levaya Tynda rivers, 54°21’20"N, 125°42’29.6"E, 693 m a.s.l., rock outcrops on the right side of the valley, 28.VII.2019;

54 – *ibid*., near the confluence of the Ostrovnaya river, 54°20’58.1"N, 125°43’16.6"E, 676 m a.s.l., stones along the riverbed, 28.VII.2019.

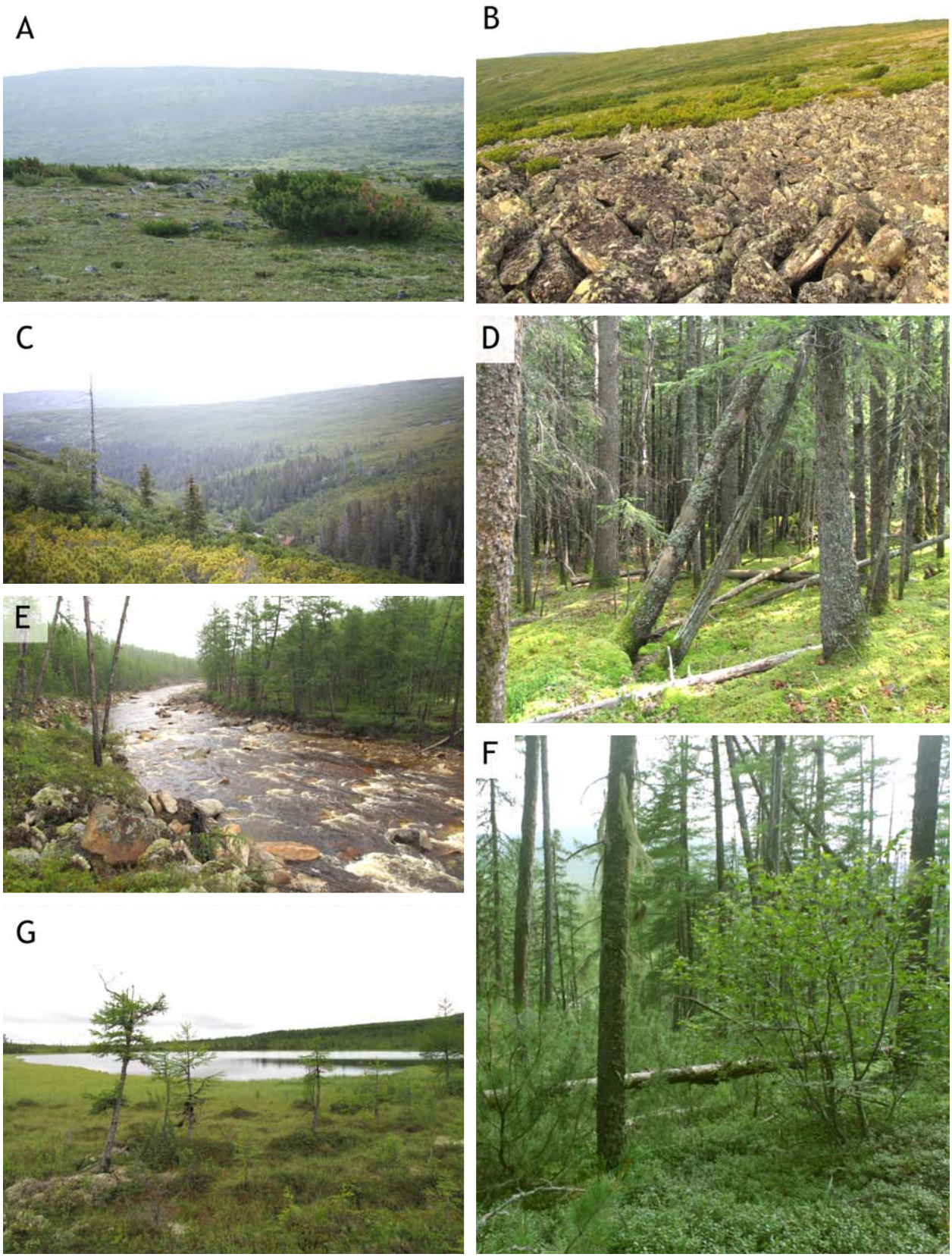

Fig. 2. Several types of habitats in the study area. A: mountain dwarf-shrub-lichen tundra at 1500 m a.s.l.; B: rockfield at 1450 m a.s.l.; C: the upper reaches of the Irmakit River, a community of *Pinus pumila* and *Picea jezoensis* at the forest line; D: spruce forest with *Picea jezoensis*; E: the valley of the Levaya Tynda River, specific floodplain vegetation is not developed; F: widely distributed in the study area background larch forest with *Duschekia fruticosa*, *Pinus pumila*, and *Vaccinium vitis-idaea* dominating on the forest floor; G: *Sphagnum* bog with sparse larch along the shores of Lake Shatamu.

the Tukuringra Ridge: in the central part the continentality of climate increases compared to the eastern one (Vasiljev *et al*., 1985). Despite the harsh cold winters with little precipitation, a summer maximum of precipitation is still manifest and high. In the upper mountain zones, up to 1500 mm of precipitation falls annually. The average annual precipitation in the study area is 864 mm, the average January temperature is –27 °C, while in July it is about +15 °C (Karger *et al.*, 2017). Permafrost has almost continuous distribution in the area (Nekrasov & Klimovskij, 1978), contributing to its bogging.

Central Tukuringra ridge has three altitudinal zones: boreal, or mountain taiga zone (up to 1000–1300 m a.s.l.), subalpine zone (1200–1400 m a.s.l.), and alpine, or mountain tundra zone (above 1400 m a.s.l.). In the upper zone, rockfields (Fig. 2.B) alternate with lichen-dwarf-shrub mountain tundra (Fig. 2.A), and small *Sphagnum*-dominated mires occur in depressions. Coverage of mosses in montane tundra does not exceed 15%; dominant species are *Rhytidium rugosum*, *Polytrichum piliferum*, and various species of *Dicranum*. Mossy tundra mires form in mountain saddles. They consist of large, dense hummocks of *Sphagnum* spp. and *Dicranum elongatum,* with small oval ponds inbetween. The total cover of mosses here reaches 30%; other frequent moss species are *Aulacomnium turgidum*, *Polytrichum strictum*, and *Hylocomiadelphus triquetrus*. On the rockfields of mountain peak very few mosses were collected; even epilithic species are scarcely represented, and epigeous mosses (*Aquilonium plicatulum, Dicranum* spp., *etc*) spontaneously occur between boulders.

The subalpine zone is represented by thickets of *Pinus pumila*[1] (Fig. 2.C), there are also fragments of mountain tundra, and in the lower part of the zone, in places protected from the wind, there are fragments of forest stands. A birch (*Betula ermanii*) elfin woods, which sometimes occur in subalpine zone of the Tukuringra ridge, are absent in the study area. Instead, *Pinus pumila* communities have wide distribution and various composition: with dominance of *Rhododendron tomentosum* or *R. aureum,* or tundra lichens, or green mosses. In the latter case, *Rhytidium rugosum* and *Ptilidium crista-castrensis*, typical for the lower zone, are dominant; *Dicranum* spp. are also present. The steep slopes are occupied by rocky screes. Among the boulders and on their surface, epilithic mosses, such as *Andreaea*, *Bucklandiella*, and *Grimmia,* occur in abundance, and *Dicranum* spp., *Cynodontium* spp., *Pogonatum urnigerum*, *Racomitrium lanuginosum* and sometimes *Sphagnum tescorum* grow on fine soil between boulders. Large boulders in stream beds are almost completely covered with *Andreaea alpina*.

There are two sub-zones in the mountain taiga zone: the upper one is represented by dark coniferous forests of *Picea jezoensis* (Fig. 2.D); it occupies a narrow strip (about 100–150 m in height) at the tree line in the upper reaches of rivers. These forests are characterized by a continuous moss cover (80–95%) with dominance of *Hylocomium splendens*. At places there are patches of *Sphagnum teres* and *S. tescorum*; *Pleurozium schreberi* and *Ptilium crista-castrensis* are subdominant species. Under the spruce canopy an increased humidity is formed, which promotes the abundant development of both epiphytic mosses on tree trunks (*Leucodon pendulus*, *Lewinskya* spp., *Ulota* spp., *Iwatsukiella leucotricha*) and less stenotopic species on rocks, dead wood and trunk bases (*Abietinella abietina*, *Dicranum* spp., *Hypnum cupressiforme*, *Jochenia pallescens*, *Sanionia uncinata*).

The lower sub-zone of the mountain taiga zone is dominated by forests with larch (*Larix gmelinii*), including those mixed with spruce and/or birch (*Betula platyphylla*) (Fig. 2F). Part of the territory has been affected by fires of different years; in such places birch forests or a closed canopy of *Duschekia fruticosa* have developed. In most of these communities, moss cover ranges from 10 to 40%; due to a high diversity of available habitats and substrates, i.e. various elements of microrelief, trunk bases, litter, fallen trees, etc., the diversity of bryophytes found in these communities is high. *Pleurozium schreberi* and *Hylocomium splendens* dominate here, sometimes with an admixture of *Polytrichum commune*, *Sphagnum* spp., and *Dicranum* spp. Other frequent species are *Aulacomnium palustre*, *Aquilonium plicatulum*, *Jochenia pallescens*, *Platygyrium repens*, *Ptilium crista-castrensis*, *Sanionia uncinata*, and *Symblepharis sinensis*. The wetter slopes can also be occupied by spruce forests, where the moss cover is almost continuous (covering 80–95%). It is formed mainly by *Hylocomium splendens* and *Pleurozium schreberi* with an admixture of *Abietinella abietina*, *Ptilium crista-castrensis*, and *Polytrichum commune*; along springs flowing from the slope and in local depressions *Sphagnum rubiginosum* and *S. tescorum* are abundant. *Cynodontium* spp., *Dicranum* spp., *Symblepharis sinensis*, *Thuidium assimile*, *Jochenia pallescens*, *Platygyrium repens*, *Pylaisa polyantha*, *Pylaisiadelpha tenuirostris,* and *Mnium* spp. are found on dead wood and trunk bases, whereas *Leucodon pendulus*, *Neckera* cf. *pennata*, *Lewinskya* spp., *Ulota* spp. grow on trunks and branches, and *Plagiothecium*, *Pogonatum*, *Pohlia* spp., *Schistostega pennata* are found on bare soil covering upturned roots of fallen trees. The coverage of the moss-lichen layer also reaches about 90% in communities of large-block rockfields on slopes with sparse larches. In these communities *Bartramia* spp., *Grimmia* spp., *Hypnum cupresssiforme*, *Sphagnum aongstroemii, etc.* occur. Places where such large boulder screes are covered with spruce forest and descend almost to the river beds along steep slopes, are especially rich in terms of bryoflora (see locality 8 in Table 1).

In river valleys on flat surfaces, i.e. floodplains and above-floodplain terraces, communities range from dense forests similar to those found on slopes to *Sphagnum* bogs with shallow seasonally thawed layer. Valley forests are

[1] – Vascular plants names in accordance with World Flora Online, http://www.worldfloraonline.org/, 12.VI.2024

largely formed by larch with an admixture of birch, and rarely also willows (woody *Salix cardiophylla* and large shrubs *S. divaricata*, *S. udensis*, *S. shwerinii*). In most drained positions, the moss cover in such forests is 20–25%, and its composition is mainly similar to background dense larch slope forests mentioned in the previous paragraph, while in slightly wetter habitats *Climacium dendroides* also occurs here, and the number of epiphytic mosses (*Lewinskya* spp., *Pylaisia* spp., *Zygonon sibiricus*) increases. In boggy valley forests moss coverage is mostly composed of *Sphagnum angustifolium*, *S. riparium*, *S. squarrosum*, *S. tescorum*; it reaches 70–95%. On well-drained flat surfaces and gentle slopes, composed of loose ground with large fragments of rocks, sparse larch forests with lichens are present. In such communities, moss cover is 25–30 %, and their composition is quite diverse, since it includes both forest species and species of screes and subalpine communities. Open spaces of the above-floodplain terraces with closely lying permafrost are occupied by oligotrophic bogs with a continuous moss cover (Fig. 2G), composed of *Sphagnum alaskense*, *S. balticum*, *S. fuscum*, *S. lenense*, *Aulacomnium turgidum*, *Polytrichum strictum*, *Dicranum undulatum*, *D. elongatum* while along the shores of oxbow lakes, depressions along slopes of terraces, as well as along the shores of mire lakes, richer mires with *Aulacomnium palustre*, *Sphagnum angustifolium*, *S. flexuosum*, *S. majus*, *S. riparium*, *Scorpidium* spp., *Sarmentypnum* spp., *Tomentypnum nitens* and windows of open water occur. Other paludal mosses appear here. Also, a significant variety of hygrophilous mosses is present on boulders along river beds (Fig. 2.E), lying near the watercourse or submerged in it, on fine soil between boulders and on exposed ground of river banks.

Collections

Specimens were collected by SD, OR & NG from July 17 to July 27, 2019. Routes were planned in order to study the widest possible number of habitats; mosses were collected both on relevé plots and along routes. Collection of 480 moss specimens from 54 localities was identified by OR, VF, ASh and SD, identification of several specimens was checked and clarified by E.A Ignatova and M.S. Ignatov. The map of the studied localities is given above (Fig. 1), geographical coordinates in the WGS 1984 coordinate system are provided in legend (Table 1).

Species List

The list of species provided below is annotated by rough altitudinal range, numbers of localities and brief characteristics of ecology. Codes of altitudinal zones (AZ) are added in parentheses: 1 for alpine, 2 for subalpine, 3 for boreal, or mountain taiga zone, 3a for the upper boreal subzone of spruce forests. Species known previously from single local flora in Amur Province are marked with "*", whereas species found in Amur Province for the first time are marked with "**". Nomenclature follows Cherdantseva *et al.* (2018) with amendments for recently revised groups of mosses.

Abietinella abietina (Hedw.) M. Fleisch. – [700-1200 m] 8, 16, 34: on rocks and trunk bases in dense spruce and larch forests (AZ: 3).

Amphidium lapponicum (Hedw.) Schimp. – [700 m] 33: on a rock near the river bank (AZ: 3).

A. mougeotti (Bruch & Schimp.) Schimp. – [800 m] 8: on a rock near water in spruce forest (AZ: 3).

***Andreaea alpina* Hedw. – [1300 m] 24: on boulders in the riverbed in subalpine zone (AZ: 3).

A. rupestris Hedw. – [800-1300 m] 7, 9, 24: on boulders in sparse larch forests or on open areas (AZ: 2, 3).

Aquilonium plicatulum (Lindb.) Hedenäs, Schlesak & D. Quandt – [700-1400 m] 1, 8, 16, 23, 26, 29: on trunk bases, boulders and rocks in dense spruce, larch or birch forests, between stone blocks of a rockfield above the treeline (AZ: 1, 2, 3).

* *Arctoa blyttii* (Bruch & Schimp.) Loeske – [800 m] 8: on stones near the water edge in spruce forest along the rocky river bank (AZ: 3).

Aulacomnium palustre (Hedw.) Schwägr. – [700-1000 m] 1, 2, 3, 14, 28, 30, 34, 35, 37, 38, 42, 43, 44: on soil in all types of larch forests, in *Sphagnum* bogs and sedge mires, in subalpine communities (AZ: 2, 3).

A. turgidum (Wahlenb.) Schwägr. – [700-1500 m] 2, 3, 8, 9, 13, 14, 21, 26, 30, 45, 47: on soil, stones and rocks in spruce and larch forests of different types and *Sphagnum* bogs in alpine and subalpine communities (AZ: 1, 2, 3).

* *Bartramia deciduaefolia* Broth. & Yasuda – [900 m] 26: on a vertical cliff in sparse larch forest (AZ: 3).

B. ithyphylla Brid. – [700-800 m] 8, 33: on wet or shaded stones in spruce forests (AZ: 3).

B. pomiformis Hedw. – [900 m] 31: in a shaded niche between boulders on a scree (AZ: 3).

Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen – [700 m] 33: on rocks near the river bank (AZ: 3).

***Bucklandiella laeta* (Besch. & Cardot) Bedn.-Ochyra & Ochyra – [1300 m] 24: on blocks of a scree (AZ: 2).

Ceratodon purpureus (Hedw.) Brid. – [720 m] 51: by the stove in a winter hut (AZ: 3).

Climacium dendroides (Hedw.) F. Weber & D. Mohr – [700 m] 34: on soil in floodplain dense larch forest (AZ: 3).

Cynodontium asperifolium (Lindb. ex Arnell) Paris – [700-900 m] 1, 7, 8, 26: on boulders and trunk bases in spruce and larch forests (AZ: 3).

C. strumiferum (Hedw.) Lindb. – [900-1300 m] 10, 24: on rocks on river banks (AZ: 2, 3).

C. tenellum (Schimp.) Limpr. – [700-1000 m] 11, 12, 13, 53: on rocks near water along the riverbed and on dead wood in spruce forests (AZ: 3).

Dicranella cerviculata (Hedw.) Schimp. – [900-1000 m] 10, 22: on a debris near the water edge, on bare soil of steep eroded slope at riverbank (AZ: 2, 3).

Dicranellopsis crispa (Hedw.) Bonfim Santos, Siebel & Fedosov – [900 m] 12: on stones in riverbed (AZ: 3).

D. subulata (Hedw.) Bonfim Santos, Siebel & Fedosov – [900 m] 12: on stones in riverbed (AZ: 3).

Dicranum bonjeanii De Not. – [1500 m] 21: in a mire in alpine zone (AZ: 1).

D. drummondii Müll. Hal. – [700-900 m] 1, 9: on soil in larch forests, including those with lichens (AZ: 3).

D. elongatum Schleich. ex Schwägr. – [700-1500 m] 1, 9, 15, 18, 21, 29, 47: in sparse larch forests of different types or dense ones mixed with birch, in subalpine zone, mountain tundra and alpine mires (AZ: 1, 2, 3).

D. flagellare Hedw. – [800 m] 8: on a rock in spruce forest (AZ: 3).
D. flexicaule Brid. – [1000-1500 m] 15, 25: in sparse larch forest and mountain tundra (AZ: 1, 2).
D. fragilifolium Lindb. – [700-1200 m] 1, 9, 13, 15, 16, 28: on trunk bases and dead wood in spruce and larch forests (AZ: 3).
D. fuscescens Turner – [700-1200 m] 1, 11, 13, 15, 16, 27, 28, 29, 31, 31, 33: on rocks, dead wood and trunk bases in dense spruce, larch or birch forests (AZ: 3).
D. japonicum Mitt. – [720 m] 38: on trunk bases in dense floodplain larch forest (AZ: 3).
D. majus Turner – [800-1300 m] 8,17: in moss cover in spruce forest and in subalpine communities (AZ: 2, 3).
D. montanum Hedw. – [800-900 m] 8, 12, 31: on rocks near the water, on vertical cliffs and on trunk bases in spruce or larch forests and in open communities (AZ: 3).
D. pacificum Ignatova & Fedosov – [800 m] 8: on boulder in a spruce forest (AZ: 3).
D. polysetum Sw. – [700-900 m] 1, 9, 28, 29, 30, 35, 43: in birch and larch forests, including those with lichens (AZ: 3).
D. schljakovii Ignatova & Tubanova – [1500 m] 19: in mountain tundra (AZ: 1).
D. scoparium Hedw. – [700-900 m] 1, 9, 28, 29: in birch and larch forests, including sparse ones with lichens (AZ: 3).
D. spadiceum J.E. Zetterst. – [900-1500 m] 16, 18, 24, 26: on dead wood, between boulders on a scree, in spruce forest and sparse larch forests, subalpine communities and mountain tundra (AZ: 1, 2, 3).
D. undulatum Schrad. ex Brid. – [700-1000 m] 1, 2, 9, 14, 15, 43, 45, 46: in dense larch forests, *Sphagnum* bog, subalpine communities (AZ: 2, 3).
Ditrichum zonatum (Brid.) F. Lees – [800-900 m] 7, 12: on rocks and boulders along the river (AZ: 3).
Fontinalis perfida Cardot – [700 m] 36: submerged in water among boulders along the riverbed (AZ: 3).
Funaria hygrometrica Hedw. – [720 m] 51: by the stove in the winter hut (AZ: 3).
Grimmia jacutica Ignatova, Bedn.-Ochyra, Afonina & J.Muñoz – [900-1300 m] 24, 31: on bouldres in subalpine communities and on screes (AZ: 3).
G. longirostris Hook. – [600-900 m] 7, 8, 30, 51, 54: on boulders and rocks in spruce and birch-larch dense forests, and on rocks along riverbeds. (AZ: 3)
G. pilifera P. Beauv. – [700-900 m] 31, 53: on boulders and rocks on screes and rocky slopes (AZ: 3).
Hedwigia czernyadjevae Ignatova, Ignatov & Fedosov – [800-820 m] 7, 8: on rocks in spruce forests along the rocky river bank (AZ: 3).
H. kuzenevae Ignatova & Ignatov – [800-900 m] 7, 26: on boulders and rocks in spruce forest and sparse larch forest with lichens (AZ: 3).
Homomallium incurvatum (Schrad. ex Brid.) Loeske – [800 m] 8: on bark of *Duschekia fruticosa*, in spruce forest (AZ: 3).
Hygrohypnella ochracea (Turner ex Wilson) Ignatov & Ignatova – [740 m] 5: on boulders along the riverbed (AZ: 3).
H. polaris (Lindb.) Ignatov & Ignatova – [700-800 m] 6, 8: submerged in water along the riverbed or on boulders near the water edge in spruce forests (AZ: 3).
Hylocomiadelphus triquetrus (Hedw.) Ochyra & Stebel – [1500 m] 21: in alpine bog (AZ: 1).
Hylocomium splendens (Hedw.) Schimp. – [700-1200 m] 1, 8, 13, 14, 15, 16, 27, 28, 29, 30, 34: in moss cover in spruce, larch or birch dense forests (AZ: 3).
Hypnum cupressiforme Hedw. – [900-1200 m] 16, 26, 31: on boulders, rocks and trunk bases in spruce and dense larch forests of mountain taiga zone, in subalpine communities and on screes in boreal zone (AZ: 2, 3).
Isopterygiopsis catagonioides (Broth.) Ignatov & Ignatova – [700-820 m] 7, 8, 26, 33: on boulders and rocks in spruce forests along the rocky river bank and in sparse larch forest with lichens (AZ: 3).
Iwatsukiella leucotricha (Mitt.) W.R. Buck & H.A. Crum – [900-1200 m] 15, 16, 26: on spruce twigs, on boulders and rocks in spruce and larch forests (AZ: 3).
Jochenia pallescens (Hedw.) Hedenäs, Schlesak & D.Quandt – [700-1200 m] 1, 8, 13, 16, 28, 30, 38: on boulders, trunk bases and rocks in spruce and dense larch forests (AZ: 3).
Leptobryum pyriforme (Hedw.) Wilson – [720 m] 51: near stove in a winter hut (AZ: 3).
Leucodon pendulus Lindb. – [800-1200 m] 8, 13, 16, 27: on spruce bark and boulders in spruce forests (AZ: 3).
Lewinskya elegans (Schwägr. ex Hook. & Grev.) F. Lara, Garilleti & Goffinet – [700-1000 m] 4, 8, 13, 27, 28: on spruce trunks and twigs, on dead wood in spruce and dense larch forests, on slopes and floodplains (AZ: 3).
L. sordida (Sull. & Lesq.) F. Lara, Garilleti & Goffinet – [700-800 m] 1, 32, 34: on bark of deciduous trees in dense larch forests on slopes and in floodplains (AZ: 3).
L. transcaucasica Eckstein, Garilleti & F.Lara – [800-1200 m] 8, 16, 28: on spruce bark, on birch trunk (*Betula ermanii*) or on dead wood in dense mossy larch and spruce forests (AZ: 3).
Mnium lycopodioides Schwägr. – [800 m] 8: on spruce trunk base in spruce forest (AZ: 3).
M. spinulosum Bruch & Schimp. – [800 m] 27: on spruce trunk base in spruce forest (AZ: 3).
Neckera oligocarpa Bruch – [700-800 m] 8, 53: on boulders and rocks in spruce forests, along the rocky river bank (AZ: 3).
N. pennata Hedw. – [800-1000 m] 8, 13, 27: on spruce bark in spruce forests (AZ: 3).
Niphotrichum panshii (Müll. Hal.) Bedn.-Ochyra & Ochyra – [700-800 m] 8, 40: on boulders and sand along river banks (AZ: 3).
**Oligotrichum falcatum* Steere – [1300 m] 24: on a boulder in the stream in subalpine zone (AZ: 2).
Oncophorus virens (Hedw.) Brid. – [800 m] 28: on dead wood in mossy birch-larch forest (AZ: 3).
Plagiothecium denticulatum (Hew.) Schimp. – [1000 m] 13: on bare soil in a niche in spruce forest (AZ: 3).
P. svalbardense Frisvoll – [800-1000 m] 1, 7, 8, 13, 30: on bare soil in a niche or on boulders in spruce, dense larch and birch forests (AZ: 3).
Platygyrium repens (Brid.) Schimp. – [700-1000 m] 7, 13, 26, 27, 29, 30, 38: on boulders and rocks, on larch, on spruce twigs, on trunk bases in spruce, birch and larch forests (AZ: 3).
Pleurozium schreberi (Willd. ex Brid.) Mitt. – [700-1200 m] 1, 2, 3, 4, 8, 9, 14, 15, 16, 26, 27, 28, 29, 30, 31, 34, 35, 37, 38, 42, 43: in moss cover in different larch, birch and spruce forests, *Sphagnum* bogs and in subalpine communities (AZ: 2, 3).
Pogonatum dentatum (Menzies ex Brid.) Brid. – [800-1300 m] 8, 13, 24: on rocks near the water, on bare soil in a niche or between boulders of a scree in spruce forests along the river, on screes (AZ: 2, 3).
P. urnigerum (Hedw.) P. Beauv. – [700 m] 34, 41: on soil along river banks, in forests and in open habitats (AZ: 3).

Pohlia cruda (Hedw.) Lindb. – [700-800 m] 8, 26: in shaded niche between boulders, on wet rock in sparse larch forest and in spruce forest along the river bank (AZ: 3).

P. elongata Hedw. – [700-900 m] 8, 10, 12, 26, 33: on boulders, rocks near the water and on steep eroded slopes along river banks, in dense larch and spruce forests (AZ: 3).

P. longicollis (Hedw.) Lindb. – [700 m] 33: on rocks along the riverbed (AZ: 3).

P. nutans (Hedw.) Lindb. – [700-1000 m] 8, 9, 13, 15, 49, 51: on bare soil, dead wood, in moss cover in sparse larch forests with lichens and in spruce forests, subalpine communities, on sedge mires (AZ: 2, 3).

P. proligera (Kindb. ex Breidl.) Lindb. ex Arnell – [1050 m] 22: on debris near the water, along the riverbed (AZ: 3a).

* *P. vexans* (Limpr.) H. Lindb. – [900 m] 12: on rocks along the riverbed (AZ: 3a).

Polytrichum commune Hedw. – [700-1000 m] 1, 2, 3, 8, 13, 15, 28, 30, 34, 37, 38, 39, 42, 43, 44 in spruce, dense larch and birch forest on slopes and on floodplains, *Sphagnum* bog, subalpine communities (AZ: 2, 3).

P. jensenii I. Hagen – [700 m] 52: on rocks at the base of a slope (AZ: 3).

P. juniperinum Hedw. – [700-1500 m] 9, 18, 35, 37: on soil in sparse larch forest with lichens and boggy larch forests and in mountain tundra (AZ: 1, 3).

P. longisetum Sw. ex Brid. – [850 m] 49: in sedge mires (AZ: 3).

P. piliferum Hedw. – [900-1500 m] 19, 20, 26: on soil in sparse larch forests and mountain tundra (AZ: 1, 3).

P. strictum Menzies ex Brid. – [700-1500 m] 2, 3, 13, 14, 21, 38, 41, 44, 45, 46, 47: in spruce forests, sparse larch boggy forests, on *Sphagnum* bogs, in subalpine communities, on alpine mire (AZ: 1, 2, 3).

***Pseudoleskeella catenulata* (Brid. ex Schrad.) Kindb. – [800-820 m] 7, 8: on boulderss and rocks among other mosses in spruce forest along the rocky river bank (AZ: 3).

Ptilium crista-castrensis (Hedw.) De Not. – [700-1300 m] 1, 3, 4, 8, 9, 13, 14, 15, 16, 17, 28, 29, 30, 34, 42, 43: in moss cover in spruce, larch and birch dense forests of different types, in subalpine communities (AZ: 2, 3).

Pylaisia polyantha (Hedw.) Bruch, Schimp. & W. Gümbel – [800-1000 m] 8, 13: on bark of a spruce or *Duschekia fruticosa* in spruce forests (AZ: 3).

P. steerei (Ando & Higuchi) Ignatov – [700-720 m] 32, 34: on bark of willows along river banks, in dense floodplain larch forest (AZ: 3).

Pylaisiadelpha tenuirostris (Bruch & Schimp. ex Sull.) W.R. Buck – [700-820 m] 1, 8, 27, 29, 38: on trunk bases, spruce bark and on boulders in spruce, dense larch and birch forests (AZ: 3).

Racomitrium lanuginosum (Hedw.) Brid. – [1300 m] 24: on a scree in subalpine zone (AZ: 2).

Rhabdoweisia crispata (Dicks.) Lindb. – [800 m] 8: on a boulder in spruce forest (AZ: 3).

Rhytidium rugosum (Hedw.) Kindb. – [700-1500 m] 8, 17, 18, 19, 20, 43: in spruce and dense larch forests, in subalpine communities, mountain tundra (AZ: 1, 2, 3).

Sanionia uncinata (Hedw.) Loeske – [700-1200 m] 1, 13, 14, 15, 16, 29, 38, 45: in moss cover, on boulders in spruce, larch and birch forests, boggy sparse larch forest, subalpine communities, *Sphagnum* bogs (AZ: 2, 3).

Sarmentypnum exannulatum (Schimp.) Hedenäs – [700-900 m] 2, 10, 49: in waterlogged depressions in *Sphagnum* bog, sedge mires, along river banks (AZ: 3).

***S. trichophyllum* (Warnst.) Hedenäs – [900 m] 12: on rocks under the water along river banks (AZ: 3).

***Schistidium agassizii* Sull. & Lesq. – [700 m] 52: on boulders in the water along the riverbed (AZ: 3).

S. marginale H.H. Blom, Bedn.-Ochyra & Ochyra – [800-900 m] 8, 11: on wet rocks along river banks (AZ: 3).

S. pulchrum H.H. Blom – [700 m] 33: on rocks along river banks (AZ: 3).

* *S. tenuinerve* Ignatova & H.H. Blom – [820 m] 7: on wet boulders along river banks (AZ: 3).

Schistostega pennata (Hedw.) F. Weber & D. Mohr – [800-1000 m] 13, 27: on bare soil in niches in spruce forests (AZ: 3).

Scorpidium revolvens (Sw.) Rubers – [700-900 m] 5, 8, 49: on boulders near the water edge, in moss cover along river banks and in sedge mires (AZ: 3).

Sphagnum alaskense R.E. Andrus & Janssens – [700-1500 m] 21, 44, 45, 47: in *Sphagnum* bogs of boreal zone and alpine mires (AZ: 1, 3).

S. angustifolium (Russow) C.E.O. Jensen – [700-900 m] 2, 4, 9, 42, 44, 45: in *Sphagnum* bogs, sparse larch forests on terraces (AZ: 3).

S. aongstroemii C. Hartm. – [800-900 m] 11, 31, 49: on rocks near the river banks, between boulders of a scree, and in moss cover in sedge mires, or rocky slopes (AZ: 3).

S. balticum (Russow) C.E.O. Jensen – [700-900 m] 44, 45, 46, 47, 49: in *Sphagnum* bogs and sedge mires (AZ: 3).

S. capillifolium (Ehrh.) Hedw – [800-900 m] 9: in sparse larch forests with lichens (AZ: 3).

S. compactum DC. – [1500 m] 21: in alpine mire (AZ: 1).

S. flexuosum Dozy & Molk. – [725 m] 39: in mesotrophic mire (AZ: 3).

S. fuscum (Schimp.) H. Klinggr. – [800-1000 m] 14, 45, 46, 47: in *Sphagnum* bogs and waterlogged sparse larch forests (AZ: 3).

S. lenense H. Lindb. ex Pohle – [700-1500 m] 2, 14, 15, 21, 35, 45, 46, 47: in moss cover, sometimes on dead wood in S*phagnum* bogs, sedge mires and boggy sparse larch forests, subalpine communities and in alpine mires (AZ: 1, 2, 3).

**S. majus* (Russow) C.E.O. Jensen – [850 m] 48, 49: in moss cover or submerged in shallow water in sedge mires (AZ: 3).

S. orientale L.I. Savicz – [850 m] 48: in waterlogged depression, submerged in shallow water in sedge mire (AZ: 3).

S. riparium Ångstr. – [700-1200 m] 3, 4, 10, 35, 44, 49, 50: in moss cover, in waterlogged depressions and even submerged in water in larch forests in river valleys, in spruce forests, in sedge mires (AZ: 3).

S. rubellum Wilson – [840 m] 47: in *Sphagnum* bog (AZ: 3).

S. rubiginosum Flatberg – [1300 m] 24: between boulders of a scree in subalpine zone (AZ: 2).

S. squarrosum Crome – [725 m] 4: in boggy dense floodplain larch forest (AZ: 3).

***S. steerei* R.E. Andrus – [1500 m] 21: in alpine bog (AZ: 1).

S. talbotianum R.E. Andrus – [730 m] 2: in *Sphagnum* bog (AZ: 3).

S. teres (Schimp.) Ångstr. – [700-1000 m] 8, 10, 11, 13, 39, 41: in moss cover, on wet rocks near the stream in spruce forests, along the river banks, in mesotrophic mires (AZ: 3).

S. tescorum Flatberg – [700-1200] 4, 13, 15, 26: in spruce or larch forests (AZ: 3).

Stereodon holmenii (Ando) Ignatov & Ignatova – [700 m] 53: on vertical rock in a niche along river bank (AZ: 3).

Straminergon stramineum (Dicks. ex Brid.) Hedenäs – [800-1000 m] 8, 12, 15: on rocks near the stream and in water-

logged depressions in spruce forests, sparse waterlogged larch forests and along the river banks (AZ: 3).

Symblepharis sinensis (I. Hagen) Fedosov, M. Stech & Ignatov – [700-1000 m] 1, 8, 13, 38: on dead wood or trunk bases in spruce, dense larch and birch-larch forests (AZ: 3).

Tetraphis pellucida Hedw. – [720 m] 51: on a trunk base in dense larch forest (AZ: 3).

Tetraplodon angustatus (Hedw.) Bruch & Schimp. – [720 m] 51: on organic substrate in dense larch forest (AZ: 3).

Thuidium assimile (Mitt.) A. Jaeger – [800 m] 27: on a spruce trunk base in spruce forest (AZ: 3).

Tomentypnum nitens (Hedw.) Loeske – [700-800 m] 2, 43: in moss cover in *Sphagnum* bogs, in larch forests (AZ: 3).

****Ulota** cf. *crispula* Bruch – [800 m] 8: on a bark (*Duschekia fruticosa*) in spruce forest (AZ: 3).

U. curvifolia (Wahlenb.) Sw. – [800-1100 m] 8, 22, 26: on boulders and rocks in spruce forests, along river valleys and in sparse larch forests (AZ: 3).

U. rehmannii Jur. – [800-1000 m] 8, 15: on bark of *Duschekia fruticosa* and on spruce twigs in spruce forests, in subalpine communities (AZ: 2, 3).

U. reptans Mitt. – [1130 m] 16: on a birch (*Betula ermanii*) in spruce forest (AZ: 3a).

Warnstorfia fluitans (Hedw.) Loeske – [800-900 m] 11, 12: on rocks near the water along river bank (AZ: 3).

Zygodon sibiricus Ignatov, Ignatova, Z.Iwats. & B.C.Tan – [700-750 m] 32, 34: on bark of *Salix cardiophylla* in dense larch forests in floodplains (AZ: 3).

DISCUSSION

Our moss collection from the central part of Tukuringra Ridge consists of 133 species, including 52 species mentioned by Brotherus *et al.* (1916) for the expedition route of 1911 year. Thus, 81 species are newly reported for the central part of the Tukuringra Ridge and 110 species listed by Brotherus *et al.* (1916) are absent in our collection.

Six species of mosses are newly recorded for Amur Province. Among them, *Bucklandiella laeta* was previously found in Khabarovsk and Primorsky Territories, Kuril Islands and Kamchatka (Cherdantseva *et al*., 2018; Afonina *et al*., 2022), and the Badzhal Range in the Khabarovsk territory was previously considered as the western limit of its distribution (Pisarenko *et al*., 2022). *Pseudoleskeella catenulata* is a calciphilous moss with wide Holarctic range; in the Asian part of Russia, it sporadically occurs in montane regions in Taimyr, southern Siberia, Yakutia, Chukotka, Kamchatka, and the south of the Far East (Fedosov *et al*., 2011; Ivanov *et al.*, 2017, Ignatov *et al*., 2022, *etc.*). It was unexpected to find this species in the area with so acidic bedrock composition, but maybe at bases of wet rocky slopes the soil waters may bear additional base nutrition. *Sarmentypnum trichophyllum* is a species with a circumpolar range, it is found sporadically in Eastern Siberia and the Far East. The closest localities are on the Tokinsky Stanovik Range (Dudov *et al.*, 2022), then in Khabarovsk Territory, Zabaikalskiy Territory (Ivanov *et al*., 2017) and Sakhalin (Cherdantseva *et al.*, 2018). *Schistidium agassizii* is a predominantly montane holarctic species. It sporadically occurs in Asian Russia, but data from the southern part of the Far East are practically absent, with the exception of one record for the Upper Bureya River in the Khabarovsk Territory (Ignatov *et al*., 2000), which was omitted by Cherdantseva *et al*. (2018). *Sphagnum steerei* has predominantly Arctic and Pacific distribution; it occurs in *Sphagnum*-dominated bogs and mountain tundras of in Anabar Plateau, Yakutia, Magadan Province and Sakhalin (Maksimov, 2007; Ivanov *et al*.,2017). Our record was made far to the south and west from the boundaries of the main known range of this species in Russia. At the moment, the distribution and taxonomic status of specimens referred here to *Ulota* cf. *crispula* according to Fedosov & Ignatova (2018) remains unclear. *Ulota crispula,* as understood by Caparros *et al*. (2016), has an amphiatlantic range, while the specimens superficially resembling it from Kamchatka Peninsula, Khabarovsk Territory, Sakhalin and the Kuril Islands (Fedosov & Ignatova, 2018; Pisarenko *et al*., 2022) may represent a separate species. This taxon is newly recorded from the Amur Province. *Andreaea alpina* was previously known in the southern Russian Far East only from south Kuril Islands (Cherdantseva *et al*., 2018, as *A. obovata* Thed.), and there is no records from Amur Province in the database of Moss Flora of Russia (Ivanov *et al*., 2017). It was reported for Tokinsky Stanovik Range by Brotherus *et al.* (1916) without marking it as new (Dudov *et al*., 2022). In general, this species sporadically occurs in east Siberian and north Far Eastern mountains (Ivanov *et al*., 2017, Afonina *et al*., 2022).

Due to recent taxonomic revisions, some species shifted from broad interpretations to narrower ones and some new species have appeared. Specimens' definitions and references in publications of such taxa could be out of date and inadequate in reflecting their actual distribution, so there is a rather high probability that they were overlooked on a significant part of their range. For instance, *Dicranum schljakovii* described in 2015 by Ignatova *et al.* (2015) is spread along mountain areas of southern Siberia, Yakutia and Russian Far East; it was reported for Zeysky Reserve and Tokinsko-Stanovoy National Park (Dudov *et al.*, 2018, 2022), while its earlier records could have been referred to the other *Dicranum* species from the *Muehlenbeckia* section. According to the latest data (Shkurko *et al.*, 2023), *Sphagnum talbotianum* unites a significant part of the Asian specimens, previously referred to *S. rubellum* (or synonymized species *S. andersonianum* R.E. Andrus) and *S. warnstorfii* Russow. It is widely distributed in Asian part of Russia, including Amur Province. *Symblepharis sinensis* is a very common moss previously known in the region as *Oncophorus wahlenbergii*, *O. elongatus*, or *Symblepharis elongata* (for details see Long & Hedenäs, 2020).

Moss flora of Zeysky Nature Reserve includes 310 species (Dudov *et al*., 2018), but only 144 of them occur above 700 m a.s.l., which was the lower limit of our area. On the other hand, Pisarenko *et al*. (2022) collected 313

species of mosses within the compact area with nearly the same altitudinal range in Badzhal Range. In Tokinsky Stanovik Range, where highlands are widespread and most of collections were made above 1000 m a.s.l., 338 moss species were found (Dudov *et al*., 2022). Therefore, middle and upper altitudinal zones of Tukuringra Range can be considered as relatively poor in diversity of mosses. Partly this can be explained by weaker collection effort: only one collection point above 700 m was visited in Zeysky Reserve, while collection from vicinity of Pravaya Tynda River is much smaller than those from Badzhal and Tokinsky Stanovik. Among 30 species from the Brotherus *et al.* (1916)' list which we did not find, some indeed may have been accidentally missed (*Bucklandiella sudetica*, *Calliergonella lindbergii*, *Polytrichastrum alpinum*).

Noteworthy is the lack of species of genera *Plagiomnium* and *Brachythecium* in our collection, despite they are usually large and easy to discern. On the one hand, this can be associated with insufficient survey of suitable habitats, or it may indicate at least a low frequency of occurrence of these species in the habitats of the area. In Zeysky Reserve species of this genus *Plagiomnium* were not recorded above 700 m a.s.l., which agrees with their predominant association with hemiboreal forests. From eight *Brachythecium* species in Zeysky Reserve, only three species were recorded above 700 m a.s.l. Taking into account the insufficient survey of our area, this fact may indicate at least the low frequency of occurrence of these species and the rarity of suitable habitats.

In total, 10 species absent in our list but mentioned by Brotherus *et al*. (1916) were found in Zeysky Reserve only below 700 m a.s.l. and 13 were not found there (*Stereodon callichrous*, some *Sphagnum* species). Different representation of the genus *Sphagnum* in Brotherus *et al*. (1916)' and our list of species probably originated due to major shifts in species concepts in this genus, which took place during last decades, and the plants which were referred to *Stereodon callichrous* by Brotherus, also may represent a different species, known as *S. holmenii*. At the same time, many widespread calciphilous species, which largely contribute to bryodiversity of mountain areas, are missed in our list, probably due to natural reason, i.e. lack of suitable ecotopes. In Zeysky Reserve these species mostly concentrate in lower altitudinal zone, where calcareous rock outcrops occur. However, several rather frequent in boreal zone of Zeysky Reserve calciphites, such as *Encalypta ciliata* and *Eurhynchiastrum pulchellum,* are also absent in our collection.

Similar reasoning may explain the absence of *Bryum pseudotriquetrum* (also mentioned by Brotherus *et al.*, 1916 as found at altitude of 1500 m a.s.l.), *Paludella squarrosa*, *Helodium blandowii*, *Meesia triquetra* and *M. uliginosa.* These species were not collected in Zeysky reserve but present on Tokinsky Stanovik Range in upper altitudinal zones. Whereas in the eastern part of Tukuringra Ridge there are no significant areas with mires at upper altitudes due to orographic reasons (river valleys are narrow, slopes are steep and strait, permafrost is absent or rare), in the studied area lack of these mosses may be explained by acidic composition of bedrocks, which have led to dominance of *Sphagnum* in variety of bog communities. *Calliergon cordifolium* is indeed rather rare in the mountains of continental part of Russian Far East, being largely confined to lower altitudinal zone. In general poor composition of moss floras in continental montane areas composed of acidic rocks with leading position in species lists occupied by representatives of Sphagnaceae (*Sphagnum*), Dicranaceae (*Dicranum*), Mielichhoferiaceae (*Pohlia*), and Grimmiaceae and very weak representation of Bryaceae, Pottiaceae, Amblystegiaceae and several other groups, largely contributing to the diversity of Holarctic moss floras was shown by Fedosov (2018) based on the analysis of distribution of moss biodiversity in Anabar Plateau.

We also found six species rare in Amur Province, with several known localities. *Arctoa blyttii, Bartramia deciduaefolia, Oligotrichum falcatum* and *Schistidium tenuinerve* were previosly known in Amur Province from Tokinsky Stanovik Range (Dudov *et al*., 2022). *Pohlia vexans* was known only from the Norsky Nature Reserve (Bezgodov *et al*., 2013). *Sphagnum majus* was known in the Amur Province from one site in middle the part of the Zeya River basin (Gambaryan, 1981). In general, data on the distribution of this species in Eastern Siberia and the Far East are very scarce, in contrast to the European part of Russia and Western Siberia, where this species is widespread (Ivanov *et al.*, 2017).

Thus, our results significantly expand the ranges of several species newly recorded for the Amur Province, and also increase the completeness of collections for a number of rare and interesting bryophyte species, which are important in the context of further studies of the bryophyte flora of the Russian Far East.

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