Botanica Pacifica. A journal of plant science and conservation. 2021. 10(1): 37–51
DOI: 10.17581/bp.2021.10106

RESEARCH PAPER

A contribution to the syntaxonomic diversity of the Tazovsky Peninsula, Arctic Russia

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Manuscript received: 07.12.2020
Review completed: 04.03.2021
Accepted for publication: 20.03.2021
Published online: 24.03.2021

ABSTRACT

Syntaxonomic diversity of the vegetation in the southern tundra subzone of the Tazovsky Peninsula is represented by six associations, three subassociations and three variants. Four associations (*Dicrano maji–Salicetum lanatae* Khitun **ass. nov. hoc loco**, *Sphagno girgensohnii–Betuletum nanae* Khitun **ass. nov. hoc loco**, *Empetro subholarctici–Eriophoretum vaginati* Khitun **ass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae* Khitun **ass. nov. hoc loco**), the three subassociations (*Hierochloo alpinae–Hylocomietum splendentis empetretosum subholarctici* Khitun **subass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae typicum* Khitun **subass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae caricetosum chordorrhizae* Khitun **subass. nov. hoc loco**) and the three variants are described for the first time. A high degree of similarity was found between vegetation of the Tazovsky Peninsula and vegetation of the southern part of the Gydansky Peninsula (the typical tundra subzone). They have four of six associations in common, whereas with the northern part of the typical tundra there is only one association in common.

Keywords: the Arctic, the Tazovsky Peninsula, tundra, mires, vegetation classification, syntaxonomy

РЕЗЮМЕ

Телятников М.Ю., Хитун О.В., Чернядьева О.В., Кузьмина Е.Ю., Ермохина К.А. К синтаксономическому разнообразию Тазовского полуострова, российская Арктика. Синтаксономическое разнообразие южных тундр северо-восточной части Тазовского полуострова представлено 6 ассоциациями, 3 субассоциациями и 3 вариантами, из которых 4 ассоциации (*Dicrano maji–Salicetum lanatae* Khitun **ass. nov. hoc loco**, *Sphagno girgensohnii–Betuletum nanae* Khitun **ass. nov. hoc loco**, *Empetro subholarctici–Eriophoretum vaginati* Khitun **ass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae* Khitun **ass. nov. hoc loco**), 3 субассоциации (*Hierochloo alpinae–Hylocomietum splendentis empetretosum subholarctici* Khitun **subass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae typicum* Khitun **subass. nov. hoc loco**, *Eriophoro leiocarpi–Caricetum rotundatae caricetosum chordorrhizae* Khitun **subass. nov. hoc loco**) и 3 варианта описаны впервые. Выявлено высокое сходство растительности района исследований с растительностью южной части типичных тундр Гыданского полуострова (4 из 6 описанных ассоциаций общие) и низкое сходство с растительностью северной части типичных тундр того же полуострова (общей является всего 1 ассоциация).

Ключевые слова: Арктика, Тазовский полуостров, тундры, болота, классификация растительности, синтаксономия

There have been a limited number of vegetation studies on the Tazovsky Peninsula. The first such surveys date back to Govorukhin's (1933) inventory of reindeer summer pastures and Nikolaeva's (1941) description of shrub vegetation, both based on dominant approach methodology. An important contribution to the study of the regional vegetation was the creation of the map "Vegetation of the West Siberian Plain" (Il'ina1976) followed by the legend issued as a separate book (Il'ina et al. 1985). However, this book and the map provide only general information, also based on dominant approach. Since 1986, a few studies of zonal differentiation of the plant cover, focused primarily on flora, were carried out on the Tazovsky and Gydansky Peninsulas (e.g., Rebristaya et al. 1989, Khitun 1989, 1998, 2005). The latest research in the area was mainly devoted to the anthropogenic transformation of vegetation, which follows the local gas-oil industry development (e.g., Valeyeva & Moskovchenko 2008, Moskovchenko et al. 2016, 2017).

Our study is the first application of the floristic-sociological (Braun-Blanquet) approach to the classification of vegetation of the Tazovsky Peninsula. It is also our contribution to the Arctic Vegetation Archive international project (Walker et al. 2018; https://avarus.space).

The aim of our study is to classify southern tundra subzone vegetation and identify syntaxonomic diversity in the northwest of the Tazovsky Peninsula.

Study area

Geology and topography. The Tazovsky Peninsula, as well as the Gydansky Peninsula, lies in the north of the West Siberian Plain. The terrain is formed by the 200 to 250 m thick layer of fine-grained Quaternary sedimentary depo-

sits. The geomorphology reflects the Pleistocene – Holocene marine transgressions and regressions. Overall, five geomorphological levels (terraces) are distinguished in the West Siberian Arctic. At the study site, the 3rd marine terrace with an elevation 30 to 45 m above sea level (a.s.l.) is present (Ogorodnov et al. 1971). The topography is represented by flat gently rolling watershed hills dissected by water tracks and meandering streams. Lakes and wetlands are numerous both in riverine valleys and on poorly drained areas of lower watershed hills. The region lies entirely within the zone of continuous permafrost and therefore the area shows many cryogenic features, such as nonsorted circles and earth hummocks, ice-wedge polygons, high-centered polygonal tundra-mire complexes, thermokarst lakes and drained thermokarst basins, locally called "khasyrei". Deep ravines form at the edges of the terrace starting from the ice wedge thaw. Sandy and loamy deposits predominate in the study area. On the watersheds formed by sandy deposits, areas of eroded sand lacking vegetation (sometimes rather extended) appear due to deflation. A consequence of waterlogging of soils is accumulation of the thick peat horizons, which is the most general characteristic of subarctic tundra in West Siberia (Khitun 2005).

Climate. The area belongs to the arctic belt in the Region of the Atlantic influence (Antonov et al. 1986). Cyclonic circulation causes large diurnal amplitudes of air temperature, high frequency of strong winds and cloudy sky, as well as relatively intense precipitation (Simonov 1977). According to: https://weatherarchive.ru/Pogoda/Yamburg (28.06.2020) mean annual air temperature in Yamburg (the closest station to the study site, see Fig. 1) for the period from 2014 to 2019 is -5.9°C. The mean July temperature is +13.1°C; mean January temperature is -22.9°C. Precipitation in this region is 330–380 mm, of which 75 % falls during summer and autumn (Ogorodnov et al. 1971).

Zonal position and general overview of vegetation. The study area is located within the southern tundra subzone (Gorodkov 1935, Chernov & Matveyeva 1997), which is also called the southern hypoarctic tundra subzone (Yurtsev 1994) and it coincides with subzone E, or the low-shrub subzone on the Circumpolar Arctic Vegetation Map (CAVM Team 2003). In the system of geobotanical division of the Arctic by Aleksandrova (1980), the subarctic tundra is divided into three belts (in contrast to the mentioned above schemes with only two subdivisions) and the study area belongs to the southern belt of the subarctic tundra subzone, at its border with the middle belt. We compare our associations with those distinguished previously on the Gydansky Peninsula (Telyatnikov et al. 2019) in the typical tundra subzone (Gorodkov 1935, Chernov & Matveyeva 1997). The latter is also called the northern hypoarctic tundra (Yurtsev 1994) and it coincides with subzone D, or the erect dwarf shrub subzone (CAVM Team 2003). According to the system of Aleksandrova (1980) that study was carried out in the northern belt of the subarctic tundra subzone. Hereafter we use the abbreviations: STS, southern tundra subzone; TTS, typical tundra subzone.

The characteristic feature of vegetation in the STS is the predominance of low deciduous shrubs, primarily *Betula nana* and to a lesser extent *Salix glauca* and *S. lanata*, in zonal communities on watershed hills. Erect dwarf shrubs *Vaccinium uliginosum* subsp. *microphyllum*, *V. vitis-idaea* subsp. *minus*, *Ledum palustre* subsp. *decumbens* are present and abundant in the majority of communities except those that are permanently waterlogged. Tall (up to 2.5 m) willow thickets (*Salix lanata*, *S. glauca*, *S. phylicifolia*) with herbaceous understory occupy the relatively steep slopes of hollows and lake basins and riparian habitats. Lower (1–1.5 m) willow thickets with developed herb–moss understory usually grow at the bottom of wider hollows. Alder (*Alnus fruticosa*) in the studied locality was found rarely, as solitary shrubs on slopes. Oligotrophic hypoarctic and boreal species dominate in all types of vegetation in this subzone. Proper arctic species grow either in snowbeds (*Ranunculus nivalis*, *Salix polaris*, *S. arctica*) or on the edges of exposed, wind-blown hilltops (*Armeria maritima*, *Hierochloë alpina*, *Salix nummularia*, *Pachypleurum alpinum*).

Various variants of low- and dwarf-shrub dominated tundra with a well-developed lichen-moss ground layer are widespread on watershed hills with a better drainage.

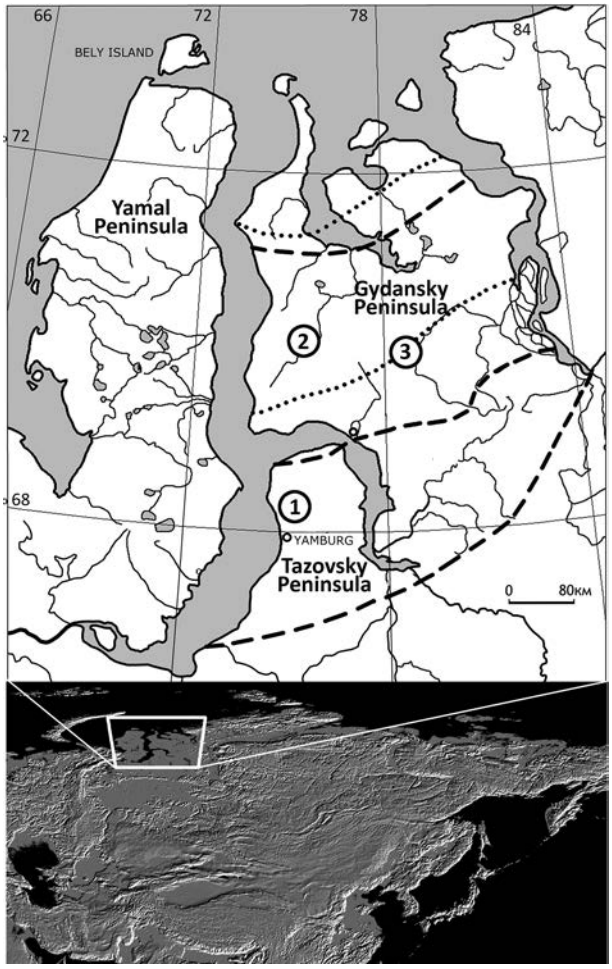


Figure 1 Study sites (circled numbers): 1 – upper reaches of the Verkhnyaya Yareiyakha River; 2 – Lake Parisento surroundings; 3 – basin of the Tanama River middle reaches. Our field-work revealed that the boundaries of the TTS should be essentialy shifted northwards compare to their position in Yurtsev (1994): dashed lines – borders as in Yurtsev (1994); dotted lines – borders according to Khitun (2005), Telyatnikov et al. (2019) and Telyatnikov et al. (in print)

Dwarf birch-*Sphagnum* spp. communities with very dense shrub layers populate the slope edges of low watershed hills and lake terraces. *Betula nana* + *Ledum palustre* s. l. + *Eriophorum vaginatum* communities with thick moss mats cover large flat-centered polygons (30 to 40 cm high) in the tundra–mire complexes, which are common on the lower watersheds with a poorer drainage. Sedge (*Carex rotundata*, *Eriophorum angustifolium*) – moss mires occur in the troughs between the polygons. Sedge-moss mires dominated by *Carex rotundata* and *C. chordorrhiza*, cover the bottoms of drained thermokarst basins, whereas *Carex concolor* dominated communities with or without a moss layer occupy more saturated habitats, along water tracks and streams. Psammophytic communities with abundant grasses, herbs and dwarf shrubs grow on various eroded steep sandy slopes.

MATERIAL AND METHODS

Sampling and data analysis

The study site is located approximately 35 km to the north of Yamburg settlement, in the upper reaches of the Verkhnyaya Yareiyakha River at 68°13'N 75°12'E (Fig. 1, site 1). Olga Khitun conducted vegetation sampling between 27 July and 8 August 2017. Plots locations were subjectively chosen in areas of homogenous vegetation in visually different communities along several transects established in the area. Plot sizes varied from 25 to 100 m^2. In total, 65 relevés were sampled, 37 of which are used in this paper. Between 8 July and 7 August 2017, Olga Khitun carried out similar investigations at two sites in the southern part of the TTS on the Gydansky Peninsula: in the surroundings of the Parisento Lake, 70°06'N 75°36'E (Fig. 1, site 2) and in the basin of the Tanama River middle reaches, 69°56'N 78°50'E (Fig. 1, site 3). At those sites, 215 relevés were sampled, 75 of them are used in another publication (Telyatnikov et al. in press). However, initially all relevés were analysed together in MegaTab (see below), and 19 relevés from the Gydansky Peninsula are considered here because they belong to synataxa common for both subzones.

We use the modified Braun-Blanquet cover-abundance scale (Mirkin & Naumova 1998) to score the cover of each species: 1 < 1 %; 2 = 1–5 %; 3 = 6–10 %; 4 = 11–25 %; 5 = 26–50 %; 6 = 51–75 %; 7 = 76–100 %. At each relevé, we recorded the complete species composition (including mosses and lichens) and cover-abundance scores for each species. The percentage cover of major plant growth forms was visually estimated. Canopy height, thickness of moss layer and depth of soil organic horizons were measured with a ruler. Soil texture was estimated according to Bogolubov et al. (2001) after digging small soil pits. Coordinates and altitude of plots were taken with Garmin eTrex 10.

We classified the vegetation according to the Braun-Blanquet sorted-table method (Westhoff & van der Maarel 1978). The relevés were entered in the TURBOVEG database (Hennekens & Schaminée 2001), thereafter a sorted table was derived in the MegaTab program (Hennekens 1996) and a dichotomous hierarchy of groups of relevés was constructed using the TWINSPAN program (Hill 1979) and transformed by M.Yu. Telyatnikov into a hierarchy of syntaxa. At this stage, we identified diagnostic (character), differential and constant species; we discarded transitional, between syntaxa, relevés.

Nomenclature

The nomenclature of the described syntaxa is in accordance with the International Code of Phytosociological Nomenclature (Theurillat et al. 2021). Diagnostic species of the class *Loiseleurio procumbentis–Vaccinietea* Eggler ex Schubert 1960, are given in accordance with "Vegetation of Europe…" (Mucina et al. 2016) and the paper of Ermakov (2012). Diagnostic species of the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946 are cited after Lavrinenko & Lavrinenko (2015) and also "Vegetation of Europe…" (Mucina et al. 2016) and of the class *Scheuchzerio–Caricetea nigrae* (Nordh. 1936) Tx. 1937 – after Lavrinenko et al. (2016).

The nomenclature of the species followed Sekretareva (2004) for vascular plants, Ignatov et al. (2006) for mosses, , Potemkin & Sofronova (2009) for liverworts and Esslinger (2016) for lichens.

The synoptic table presents syntaxa with their constancy class in each community: + = present in 1 to 10 % of records; I = 11–20 %; II = 21–40 %; III = 41–60 %; IV = 61–80 %; V = 81–100 %.

In the description of nomenclatural type relevés (holotypes), to avoid the repetition of headings and long names of localities throughout this paper we write in the following order:

1) relevé number in the table and, in parentheses, in the database, for example, 3(276);

2) table No (T1 for Table 1 or T2 for Table 2);

3) region is Yamal-Nenets Autonomous Area (YaNAA);

4) locality is indicated by number as in Figure 1 (1, VerkhnyayaYareiyakha; 2, Parisento; 3, Tanama);

5) coordinates (latitude, N and longitude, E);

6) elevation, m above sea level (a.s.l.);

7) plot surface area (m^2, most commonly it was 100 m^2).

This is followed by the information about habitat (topography, soil, cover of growth forms); date of observation (ddmmyyyy); author; and, finally, list of species in the typus relevé with cover abundance scores.

RESULTS

Dwarf shrub tundra in relatively dry wind-exposed habitats

We placed tundra communities of relatively dry habitats in the class *Loiseleurio procumbentis–Vaccinietea* Eggler ex Schubert 1960, order *Deschampsio flexuosae–Vaccinietalia myrtilli* Dahl 1957 and alliance *Loiseleurio–Arctostaphylion* Kalliola ex Nordhagen 1943.

The *Loiseleurio procumbentis–Vaccinietea* includes dwarf shrub vegetation on dry acidic habitats with thin snow cover in alpine and arctic regions of the northern hemisphere. Diagnostic species of the class are: *Alectoria ochroleuca*, *Aulacomnium turgidum*, *Betula nana*, *Cladonia bellidiflora*, *C. stellaris*, *Diphasiastrum alpinum*, *Flavocetraria cucullata*, *F. nivalis*, *Hierochloë alpina*, *Huperzia arctica*, *Lycopodium annotinum* subsp. *pungens*, *L. clavatum* subsp. *monostachyon*, *Ochrolechia frigida*, *Pedicularis*

lapponica, *Stereocaulon paschale*, *Sphaerophorus globosus*, *Vaccinium vitis-idaea* subsp. *minus*, *V. uliginosum* subsp. *microphyllum*.

The *Deschampsio flexuosae–Vaccinietalia myrtilli* includes dwarf shrub or low shrub dominated tundra vegetation of the Arctic and mountain tundra of the northern Eurasia and the islands and archipelagos of the Arctic Ocean. Diagnostic species of the order are: *Betula nana*, *Carex arctisibirica*.

The *Loiseleurio–Arctostaphylion* includes mountain and lowland tundra of northern Eurasia, Svalbard, Island and Greenland. Diagnostic species of the alliance are *Alectoria ochroleuca* and *Flavocetraria nivalis*. Within this alliance, we place two variants and one subassociation of the association described earlier.

Hierochloo alpinae–Hylocomietum splendentis (Table 1, rel. 1–14; Table 3)

Diagnostic species: *Hierochloë alpina*, *Polytrichum hyperboreum*, *Alectoria ochroleuca*;

Differential species: *Festuca ovina*, *Luzula confusa*, *Salix nummularia*, *Bryocaulon divergens*, *Flavocetraria nivalis*, *Bryoria nitidula*, *Racomitrium lanuginosum*.

Distribution and ecology. This association is described from the northern part of the TTS on the Gydansky Peninsula (Telyatnikov et al. 2019). These communities occupy dry, often slightly convex, marginal parts of the hilltops and adjacent upper parts of slopes with shallow snow accumulation.

Structure and composition. Such communities in Russian literature are commonly called "spotted" tundra because they have complex horizontal structure including small patches of bare ground surrounded by vegetated rims and small troughs. Communities have a sparse upper layer (up to 20 cm high) of grass straw and closed ground layer formed by prostrate dwarf shrubs and cryptogams. The cover values vary between 25 and 55 % of dwarf shrubs, 20 to 60 % of lichens and 30 to 70 % of mosses (Telyatnikov et al. 2019).

Hierochloo alpinae–Hylocomietum splendentis empetretosum subholarctici **subass. nov. hoc loco** (Table 1, rel. 1–14; Table. 3, Fig. 2A)

Differential species: *Empetrum subholarcticum*, *Arctous alpina*, *Calamagrostis neglecta*.

Holotypus: 3 (276); T1; YaNAA; 1; 68°12'25.8"N 75°13'25.5"E; 47; 100.

Relevé. Well-drained marginal part of the hilltop with expressed polygonal cracks; dry nonsorted circles and small earth hummocks are almost completely overgrown with vegetation. Inclination 2°. Aspect 202°. Soil: the dark brown peaty humus organic horizon is 1–2 cm thick and the mineral horizon is light yellowish-brown with a sandy texture. The cover of lichens is 70 %, of mosses 30 %, shrubs 15 %, dwarf-shrubs 10 %, herbs 15 %. 04.08.2017. O.V. Khitun.

List of species: *Alectoria ochroleuca* 5, *Polytrichum hyperboreum* 4, *Bryocaulon divergens* 4, *Betula nana* 4, *Cladonia stygia* 3, *Calamagrostis neglecta* 3, *Carex arctisibirica* 3, *Dicranum elongatum* 3, *Polytrichum juniperinum* 3, *Alectoria nigricans* 2, *Bryoria nitidula* 2, *Cladonia gracilis* s. l. 2, *Cetraria islandica* 2, *Flavocetraria cucullata* 2, *Hierochloë alpina* 2, *Ochrolechia frigida* 2, *Pogonatum dentatum* 2, *Salix glauca* 2, *Vaccinium uliginosum* subsp. *microphyllum* 2, *Arctous alpina* 1, *Aulacomnium turgidum* 1, *Bistorta elliptica* 1, *B. vivipara* 1, *Cladonia arbuscula* 1, *C. chlorophaea* 1, *C. cornuta* 1, *C. pleurota* 1, *Cetraria laevigata* 1, *C. aculeata* 1, *Eriophorum vaginatum* 1, *Empetrum subholarcticum* 2, *Festuca ovina* 2, *Flavocetraria nivalis* 1, *Gymnomitrion coralloides* 1, *Sphenolobus minutus* 1, *Ledum palustre* subsp. *decumbens* 2, *Luzula confusa* 1, *Pedicularis labradorica* 1, *Pertusaria panyrga* 1, *Pleurozium schreberi* 1, *Poa alpigena* 1, *Pohlia* sp. 1, *Salix nummularia* 1, *S. pulchra* 1, *Vaccinium vitis-idaea* subsp. *minus* 1.

Distribution and ecology. The communities of the subass. *empetretosum subholarctici* occur in the STS on the Tazovsky Peninsula and in the southern part of the TTS on the Gydansky peninsula. They occupy well-drained parts of watersheds such as the edges of hilltops, the upper parts of hill slopes and river terraces; at altitudes varying between 24 and 57 m a.s.l. Compared to the association, in subassociation the cover of shrubs and lichens is higher, and the cover of herbs, dwarf shrubs and mosses is lower.

The subassociation splits into two variants.

Variant ***typicum*** (Table 1, rel. 1–6; Table 3; Fig. 2A)

Differential species are the same as for the subassociation.

Distribution and ecology. These communities occur in the STS on the Tazovsky Peninsula on well-drained parts of watersheds and upper parts of their slopes with an inclination of 1 to 15° and within an altitude range of 43 to 57 m. The microtopography is polygonal with flat polygons 15 to 20 m in diameter divided by cracks of approximately 0.5 m in width. The organic horizons range in thickness from 2 to 3 cm and consist of dark brown mucky peat; the underlying mineral ground is yellow sand or sandy loam.

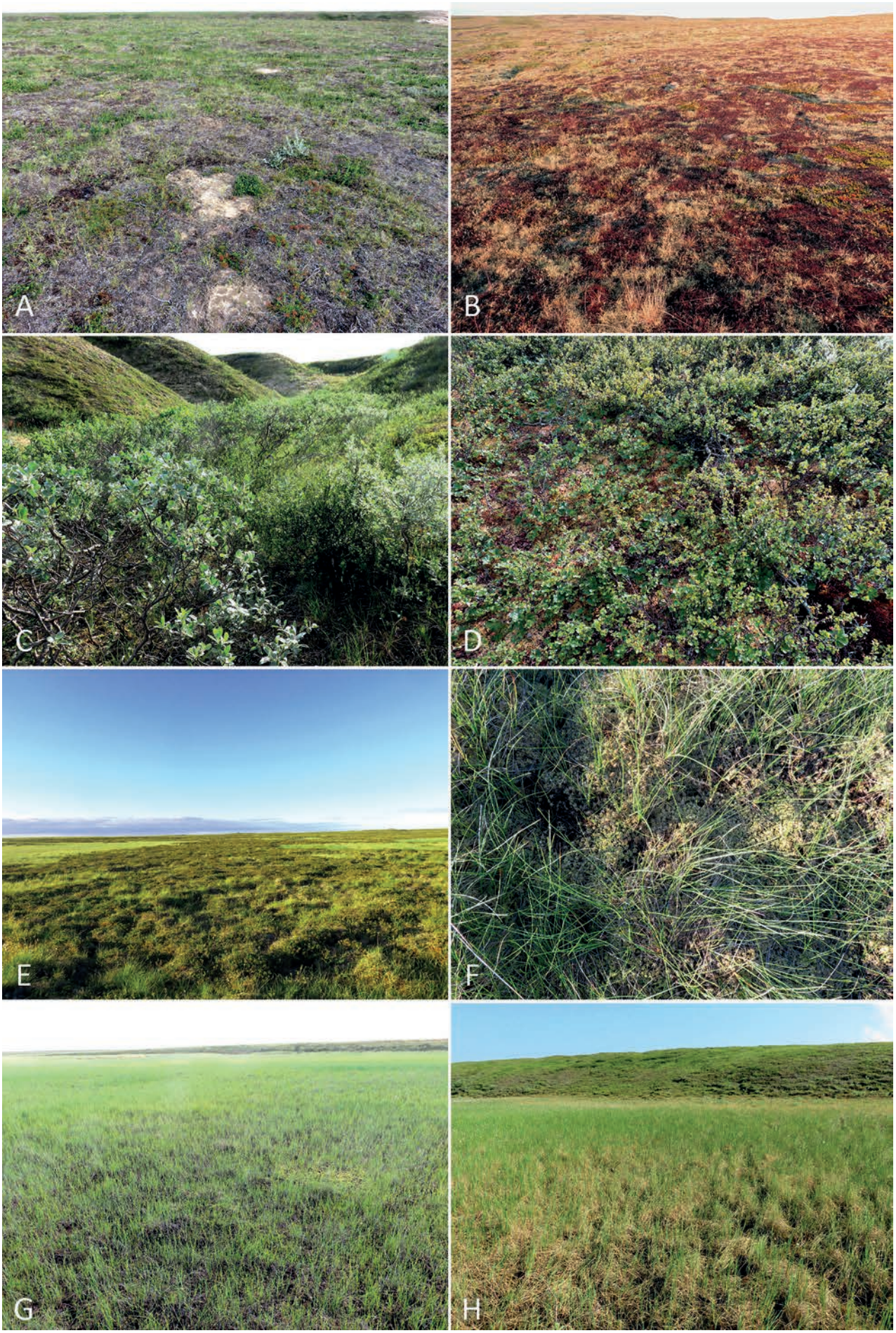
Structure and composition. These communities have two vertical strata. Low shrubs, predominantly dwarf birch, (15 to 25 %, rarely 5 %) and herbs, predominantly *Calamagrostis neglecta* and *Carex arctisibirica*, (10 to 25 %) form a sparse evenly distributed overstory, usually 10 to 15 cm height. The dwarf shrub–cryptogam understory is closed, with lichens cover of 70 to 90 % that serves as a background for mosses (up to 35 %) and separate patches (5 to 10 %) of prostrately growing in this conditions dwarf shrubs such as *Ledum palustre* subsp. *decumbens*, *Vaccinium uliginosum* subsp. *microphyllum*, *V. vitis-idaea* subsp. *minus*. *Alectoria ochroleuca* and *Cladonia stygia* are the most abundant among the lichens, and *Polytrichum hyperboreum* and *Dicranum elongatum* are predominant among the mosses.

Variant ***Aconogonon ochreatum*** (Table 1, rel. 7–14; Tabl. 3; Fig. 2B)

Differential species: *Tanacetum bipinnatum*, *Aconogonon ochreatum*, *Carex quasivaginata*, *Campanula rotundifolia*.

Distribution and ecology. These phytocoenoses occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula. They occupy windswept marginal parts of watershed hills and the upper

Figure 2 Photographs of the described plant communities on the Tazovsky Peninsula. A – *Hierochloo alpinae–Hylocomietum splendentis* subass. *empetretosum subholarctici* var. *typicum* on well-drained part of the watershed hill; B – *Hierochloo alpinae–Hylocomietum splendentis* subass. *empetretosum subholarctici* var. *Aconogonon ochreatum* on the gentle convex slope of the watershed hill; C – *Dicrano maji–Salicetum lanatae* on the bottom of the hollow at the watershed hillslope; D – *Sphagno girgensohnii–Betuletum nanae* on the lake terrace; E – *Empetro subholarctici–Eriophoretum vaginati* on the polygons in tundra–mire complex on the flat low watershed; F – *Eriophoro leiocarpi–Caricetum rotundatae* subass. *typicum* in the wet trough between polygons of tundra–mire complex; G – *Eriophoro leiocarpi–Caricetum rotundatae* subass. *caricetosum chordorrhizae* on the bottom of the drained lakebed; H – *Carici stantis–Warnstorfietum exannulatae* var. *Warnstorfia sarmentosa* on the bottom of the wet hollow in the watershed hill slope


A
B
C
D
E
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G
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Table 1. Associations *Hierochloo alpinae–Hylocomietum splendentis* (var. *typicum* – **A**, and var. *Aconogonon ochreatum* – **B**), *Dicrano maji–Salicetum lanatae* (**C**), *Sphagno girgensohnii–Betuletum nanae* (**D**) and *Empetro subholarctici–Eriophoretum vaginati* (**E**)

SYNTAXON CODE	A	B	C	D	E	A	B	C	D	E
Locality	T	T	T	T	T					
Cover total, %:	90	95	90	95	100					
Cover shrubs, %	25	20	15	5	20					
Cover dwarf shrubs, %	5	10	10	10	5					
Cover lichens, %	70	70	70	80	90					
Cover mosses,%	35	15	35	10	5					
Cover herbs, %	25	15	15	10	5					
Height shrubs (cm)	5	15	15	10	20					
Aspect (°)	360	135	202	202	270					
Inclination of slope (°)	1	1	2	15	5					
Altitude (m a.s.l.)	53	57	47	44	47					
Total number of species	30	27	44	32	42					
Number of vascular plants species	9	10	19	17	15					
Number of lichen species	13	13	17	11	12					
Number of moss species	8	4	8	4	4					
Relevé nr: in the database	233	235	276	277	290					
In the table	1	2	**3***	4	5					
Number of relevés						6	8	6	3	9
Diagnostic species of ***Hierochloo alpinae–Hylocomietum splendentis***										
Hierochloë alpina (L-V)	3	2	2	1	·					
Polytrichum hyperboreum	4	3	4	3	3					
Alectoria ochroleuca (L-A, L-V)	5	5	5	1	6					
Differential species of ***Hierochloo alpinae–Hylocomietum splendentis***										
Festuca ovina	1	·	2	2	·					
Luzula confusa	·	1	1	1	1					
Salix nummularia	·	·	1	1	·					
Bryocaulon divergens	1	1	4	·	4					
Flavocetraria nivalis (L-A, L-V, Rc-De)	1	·	1	1	1					
Bryoria nitidula	·	1	3	·	1					
Racomitrium lanuginosum (Sh)	·	·	·	·	·					
Differential species in subass. ***empetretosum subholarctici*** and var. ***typicum***										
*Empetrum subholarctic*um	2	2	2	2	1					
Arctous alpina	2	·	2	2	·					
Calamagrostis neglecta	4	3	3	·	2					
Differential species in var. ***Aconogonon ochreatum***										
Tanacetum bipinnatum	·	·	·	·	·					
Aconogonon ochreatum	·	·	·	·	·					
Carex quasivaginata	·	·	·	·	·					
Campanula rotundifolia	·	·	·	·	·					
Differential species in ***Dicrano maji–Salicetum lanatae***										
Carex stans	·	·	·	·	·					
Dicranum majus	·	·	·	·	·					
Polemonium acutiflorum	·	·	·	·	·					
Aulacomnium palustre (O-S)	·	·	·	·	·					
Differential species in ***Sphagno girgensohnii–Betuletum nanae***										
Sphagnum girgensohnii	·	·	·	·	·					
Polytrichum commune	·	·	·	·	·					
Differential species in.***Empetro subholarctici-Eriophoretum vaginati***										
Cladonia stellaris (L-V)	1	4	·	4	1					
Sphagnum lenense	·	·	·	·	·					
Diagnostic combination of species in alliance ***Rubo chamaemori–Dicranion elongati*** (Rc-De)										
Cetraria islandica	1	1	2	4	·					
Cladonia stygia	3	5	3	5	5					
Dicranum elongatum	3	3	3	2	3					
Ledum palustre subsp. *decumbens*	·	3	2	2	2					
Diagnostic species in class ***Salicetea herbaceae*** (Sh)										
Salix polaris	·	·	·	·	·					
Carex lachenalii	·	·	·	·	·					
Conostomum tetragonum	·	·	·	·	·					
Pohlia drummondii	·	·	·	·	·					
Ranunculus nivalis	·	·	·	·	·					
Ranunculus pygmaeus	·	·	·	·	·					
Sibbaldia procumbens	·	·	·	·	·					
Diagnostic species in order ***Deschampsio flexuosae–Vaccinietalia myrtilli*** (D-V)										
Carex arctisibirica	·	3	3	3	3					
Diagnostic species in class ***Loiseleurio procumbentis–Vaccinietea*** (L-V)										
Betula nana (D-V, O-S, Rc-De)	4	4	4	4	4					
Vaccinium uliginosum subsp. *microphyllum* (O-S, Rc-De)	·	1	2	3	1					
Flavocetraria cucullata	3	3	2	1	4					
Vaccinium vitis-idaea subsp. *minus* (Rc-De)	1	1	1	1	2					
Aulacomnium turgidum	1	·	1	·	3					
Huperzia arctica (O-S)	·	·	·	·	·					
Lycopodium annotinum subsp. *pungens*	·	·	·	·	·					
Ochrolechia frigida	·	·	2	·	·					
Sphaerophorus globosus	·	·	·	·	·					
Cladonia bellidiflora	·	·	·	·	·					
Diphasiastrum alpinum	·	·	·	·	·					
Lycopodium clavatum subsp. *monostachyon*	·	·	·	·	·					
Pedicularis lapponica	·	·	·	·	·					
Stereocaulon paschale	·	·	·	·	·					

Table 1 Continued.

SYNTAXON CODE	A	B	C	D	E	A	B	C	D	E
Diagnostic species in class ***Oxycocco–Sphagnetea*** (O-S)										
Andromeda polifolia subsp. *pumila* (Rc-De)	· · · · · · · 1 · · · · · · · · · · · · · · 2 1 1 · · 1 ·	·	I 1	·	·	III 1
Eriophorum vaginatum	· · 1 · 1 · · · · · · · · · · · · · · · · · 1 · 3 2 3 6 3 4 3 5 6	II 1	·	·	II 1	V 4
Polytrichum strictum (Rc-De)	· 4 · · · · · 3 · · · ·	·	·	·	II 4	I 3
Rubus chamaemorus (Rc-De)	· · · · · · · · · · · · · · · · 4 · · · · 3 3 4 5 3 3 2 4 3 4 4 4	·	·	I 4	V 3	V 4
Sphagnum balticum	· 5 5 · 4 5 · 5 · 3	·	·	·	·	IV 5
Sphagnum capillifolium	· 3 · · · · · ·	·	·	·	·	I 3
Sphagnum compactum	· 4 · ·	·	·	·	·	I 4
Sphagnum fuscum	· 4 5 · · · · ·	·	·	·	·	II 4
Sphagnum russowii	· · · · · · · · · · · · · · · · 3 · · · · · · · · · · · · · · · ·	·	·	I 3	·	·
Other species										
Alectoria nigricans	· · 2 · 1 · · · · · 1 · · 3 · · · · · · · · · · · · · · · · · 1 ·	II 1	II 2	·	·	I 1
Antennaria villifera	· · · · · · · · 1 · · 1 · 1 1 · · · · · · · · · · · · · · · · ·	·	III 1	II 1	·	·
Arctocetraria andrejevii	· · · · · · · · · · · · 4 · · · · · 5 2 · · · · · · · · · · · ·	·	I 4	II 4	·	·
Armeria scabra	· · · · · · 1 1 1 1 ·	·	III 1	·	·	·
Bistorta elliptica	· · 1 · · · · 1 · · · · 1 1 · · · · · · · · · · · · · · · · · ·	I 1	II 1	II 1	·	·
Bistorta vivipara	· · 1 · · · · 1 1 1 · 1 · · 1 3 2 1 1 · · · · · · · · · · · · ·	I 1	III 1	V 2	·	·
Bryum sp.	· · · · 1 · · · · · · · · · · 1 1 · · · · · · · · · · · · · · ·	I 1	·	II 1	·	·
Calamagrostis holmii	· · · · · · · 2 · 1 · · · · · · 1 · · · · · · · · · · · · · · ·	·	II 2	I 1	·	·
Cetraria aculeata	· · 1 1 · · · 1 · · · · 1 · · · · · · · · · · · · · · · · · · ·	II 1	II 1	·	·	·
Cetraria laevigata	· · 1 1 1 · · · · 1 1 3 1 1 · · · · · · · 1 · 1 1 1 1 1 3 3 3 3	III 1	IV 2	·	II 1	V 3
Cetrariella delisei	· · · · · · · · 4 4 · · · 1 · 1 · 1 5 3 · · · · · · · · · · · ·	·	II 4	IV 3	·	·
Cladonia amaurocraea	1 1 · · · 1 · · · 1 · · · 1 · · · · · · · 1 · 3 3 3 1 5 3 5 1 1	III 1	II 1	·	II 1	V 3
Cladonia arbuscula	4 4 1 3 1 1 · · 1 1 4 1 1 4 · · · · · · · · 1 1 1 · · · · · 1 1	V 3	IV 3	·	II 1	III 1
Cladonia cenotea	· · · · 1 · · · · · · · · · · · · · · · · 1 · 1 · · · · · 1 1	I 1	·	·	II 1	II 1
Cladonia chlorophaea	1 · 1 · 1 · · 2 · · · · 1 1 1 1 · · · · · · · 1 · · 1 · · · · 1	III 1	II 1	III 1	·	II 1
Cladonia coccifera	1 · · · · · · 2 2 1 · · 1 · · · 1 · · · · · · · · · · · · · ·	I 1	III 2	I 1	·	·
Cladonia cornuta	· · 1 · 1 · 3 3 1 · · 1 · · · · 1	II 1	·	·	IV 3	II 1
Cladonia cyanipes	· 1 · · · · 1 · · · 3 ·	·	·	·	II 1	II 3
Cladonia gracilis s.l.	1 1 2 · · · · 1 · · · 1 1 · 1 1 · 3 1 3 · · · · · · · · 1 · · 1	III 1	II 1	IV 2	II 3	II 1
Cladonia pleurota	· · 1 1 1 3 · 1 · 1 · · 1 · · · · 1	IV 2	·	·	II 1	II 1
Cladonia subfurcata	· 1 · · · · · · 3 · 1 1 1 · 1 · 1 ·	I 1	I 3	·	·	III 1
Cladonia sulphurina	· 1 · · · · · 1 1	·	·	·	·	II 1
Cladonia uncialis	· 1 · · 1 · · · 2 1 ·	II 1	II 2	·	·	·
Dicranum laevidens	· 3 · · · · · 3 · · · · 3 4 · 3 ·	·	·	I 3	II 3	III 3
Equisetum arvense subsp. *boreale*	· · · 2 · 1 1 1 · 3 2 2 1 · 3 4 3 2 1 1 · · · · · · · · · · · ·	II 2	IV 2	V 3	II 1	·
Eriophorum angustifolium	· · · · 1 · · · · · · · · · 1 1 1 · · 1 · · · · · · · 1 · · · ·	I 1	·	III 1	II 1	I 1
Festuca rubra subsp. *arctica*	· · · · · · · 1 1 1 · · · · · · · · 1 · · · · · · · · · · · · ·	·	II 1	I 1	·	·
Gymnomitrion corallioides	· · 1 · · · 1 · · · 1 · 2 3 · · · · · · · · · · · · · · · · · ·	I 1	II 2	·	·	·
Hylocomium splendens	· · · · · · · · 4 ·	·	I 4	V 2	V 4	I 1
Orthocaulis binsteadii	· 1 · · 1 1 ·	III 1	·	·	·	II 1
Pachypleurum alpinum	· · · · · · · 1 1 1 ·	·	II 1	I 1	·	·
Peltigera scabrosa	· ·	·	·	IV 2	IV 2	·
Pertusaria dactylina	· · · · 1 ·	I 1	I 1	·	·	I 1
Petasites frigidus	· ·	·	·	III 2	·	·
Pleurozium schreberi	· · 1 ·	I 1	I 1	II 1	IV 3	II 2
Poa alpigena	· · 1 1 · · · 1 1 1 ·	II 1	II 1	III 1	II 1	·
Poa arctica	· ·	·	·	I 2	II 1	I 1
Pogonatum dentatum	1 · 2 1 · · 1 2 · 1 1 · 1 · · · · · · · · · · · · · · · · · · ·	III 1	IV 1	·	·	·
Pohlia nutans	1 ·	I 1	I 1	II 1	·	·
Polytrichum juniperinum	· · 3 · 3 ·	II 3	I 1	I 1	II 1	II 2
Polytrichum piliferum	· · · · · · 1 2 · 3 ·	I 1	III 3	·	·	·
Ptilidium ciliare	· · · 1 · · · 1 · 3 ·	I 1	II 2	IV 1	V 1	II 1
Pyrola minor	· ·	·	·	III 1	·	·
Ranunculus propinquus	· ·	·	·	III 2	·	·
Salix glauca	1 1 2 · 1 1 · 1 · 1 1 ·	V 1	II 1	IV 3	IV 2	·
Salix lanata	· · · · · · · · · 1 ·	·	I 1	V 5	II 1	I 1
Salix pulchra	1 · 1 · 1 · · · · 2 ·	III 1	I 2	I 1	·	I 1
Sanionia uncinata	· ·	·	II 1	V 5	II 3	II 1
Sphenolobus minutus	1 1 1 · 1 ·	IV 1	II· 1	I 1	II 1	III 1
Stellaria peduncularis	· ·	·	II 1	III 1	·	·
Stereocaulon alpinum	· ·	·	II 2	I 1	·	·
Thamnolia vermicularis	1 1 · 1 · 1 · 2 · 1 · · 1 1 · · · · · · · · · · · · · · · · · 3	IV 1	III 1	·	·	I 3
Tofieldia coccinea	· · · 1 ·	I 1	II 1	I 1	·	·
Trisetum spicatum	· · · 1 · · · 1 · · · 1 ·	I 1	II 1	I 1	·	·
Veratrum lobelianum	· ·	·	·	IV 2	·	·
Viola epipsiloides	· ·	·	·	III 2	·	·

Note. Single occurrence: *Alopecurus alpinus* 17(1); *Arctagrostis latifolia* 5(1); *Artemisia borealis* 7(1); *A. tilesii* 16(1), 17(1); *Astragalus alpinus* subsp. *arcticus* 17(1); *Calamagrostis lapponica* 4(1), 22(1); *C. neglecta* subsp. *groenlandica* 4(2), 6(1); *Carex aquatilis* 22(3); *C. rariflora* 18(1), 30(1); *C. rotundata* 5(1), 29(1); *Cerastium jenisejense* 17(1); *Corallorrhiza trifida* 17(1); *Dryas octopetala* subsp. *subincisa* 7(2), 8(2); *Dupontia fischeri* 15(1); *Eremogone polaris* 13(1); *Eriophorum russeolum* subsp. *leiocarpum* 25(1); *E. russeolum* subsp. *russeolum* 15(2); *E. scheuchzeri* 16(1); *Hedysarum hedysaroides* subsp. *arcticum* 17(1); *Juncus biglumis* 9(1); *J. trifidus* 13(1); *Lagotis minor* 8(1), 17(1); *Luzula multiflora* subsp. *frigida* 18(1), 19(1); *L. wahlenbergii* 15(1); *Lychnis sibirica* subsp. *samojedorum* 7(1); *Myosotis asiatica* 17(1); *M. palustris* 19(1); *Oxyria digyna* 10 (1), 17(1); *Parnassia palustris* subsp. *neogaea* 17(1); *Pedicularis compacta* 17(1); *P. hirsuta* 8(1); *P. interioroides* 16(1), 17(1); *P. labradorica* 3(1), 18(1); *Pinguicula vulgaris* 25(1); *Polemonium boreale* 7(1), 14(1); *Pyrola rotundifolia* 9(1); *Rumex acetosa* subsp. *pseudoxyria* 13(1); *R. graminifolius* 7(1); *Salix arctica* 16(1); *S. lapponum* 19(1); *S. myrtilloides* 5(1); *S. phylicifolia* 19(2), 22(1); *S. reptans* 17(1), 26(1); *Saxifraga cernua* 17(1); *S. hieracifolia* 16(1); *S. nelsoniana* 17(1); *Solidago lapponica* 13(1), 18(1); *Trisetum sibiricum* subsp. *litorale* 17(1); *Trollius asiaticus* 17(1); *Valeriana capitata* 8(1). **Lichens:** *Arthrorhaphis alpina* 10(1); *Asahinea chrysantha* 10(1); *Cetraria nigricans* 6(1),13(1); *Cladonia deformis* 23(1); *C. macrophylla* 30 (1); *C. verticillata-vulcani* 6(1), 13(1); *Dactylina arctica* 5(1), 10(1); *Icmadophila ericetorum* 23(1); *Lobaria linita* 8(1); *Peltigera aphthosa* 22(1), 31(1); *P. leucophlebia* 8(1), 17(1); *P. malacea* 13(1), 22(1); *P. rufescens* 8(1); *Pertusaria panyrga* 3(1); *Protopannaria pezizoides* 8(1); *Stereocaulon* sp. 18(4). **Mosses:** *Brachythecium* sp. 15(1); *B. turgidum* 16(1), 17(1); *Bryum pseudotriquetrum* 16(1), 17(1); *Calliergon cordifolium* 18(1); *Straminergon stramineum* 15(3); *Ceratodon purpureus* 1(1); *Climacium dendroides* 8(1); *Dicranum acutifolium* 10(3); *D. spadiceum* 8(3), 9(1); *Distichium capillaceum* 1(1); *Kiaeria glacialis* 9(4); *Oncophorus wahlenbergii* 5(1), 15(1); *Paludella squarrosa* 15(3); *Plagiomnium cuspidatum* 16(1), 17(1); *Pohlia* sp. 3(1), 10(1); *Polytrichastrum alpinum* 30(1); *Polytrichum jensenii* 28(3), 29(1); *P. longisetum* 5(1).

Author: O.V. Khitun. **Localities:** Yamal-Nenets Autonomous Area. **T** – the Tazovsky Peninsula, upper reaches of the Verkhnyaya Yareiyakha (Fig. 1, site 1): **1** – 68°13'10.2" 75°12'47.7", 31.07.2017; **2** – 68°13'12.5" 75°12'52.3", 31.07.2017; **3** – 68°12'25.8" 75°13'25.5", 04.08.2017; **4** – 68°12'25.3" 75°13'25.1", 04.08.2017; **5** – 68°12'32.7" 75°13'39.7", 06.08.2017; **6** – 68°12'06.8" 75°13'49.2" 06.08.2017; **11** – 68°12'24.9" 75°13'24.5" 04.08.2017; **12** – 68°12'24.8" 75°13'24.2", 04.08.2017; **13** – 68°12'23.0" 75°13'23.2", 04.08.2017; **14** – 68°12'05.0" 75°13'08.8", 04.08.2017; **18** – 68°12'23.3" 75°13'23.5", 04.08.2017; **19** – 68°12'23.1" 75°13'22.6", 04.08.2017; **20** – 68°13'30.3" 75°13'25.0", 02.08.2017; **21** – 68°14'17.2" 75°14'48.8", 03.08.2017; **22** – 68°14'18.4" 75°14'45.4", 03.08.2017; **23** – 68°13'11.0" 75°12'49.5", 31.07.2017; **24** – 68°13'20.6" 75°13'07.3", 02.08.2017; **25** – 68°13'27.8" 75°13'20.3", 02.08.2017; **26** – 68°13'29.6" 75°13'23.6", 02.08.2017; **27** – 68°13'15.5" 75°13'21.1", 02.08.2017; **28** – 68°13'22.6" 75°13'10.5", 02.08.2017; **29** – 68°13'14.5" 75°13'48.1", 02.08.2017; **30** – 68°13'13.2" 75°14'31.0", 02.08.2017; **31** – 68°14'03.4" 75°14'25.1", 03.08.2017; G1 – the Gydansky Peninsula, basin of the Tanama River middle reaches (Fig.1, site 3): **7** – 69°56'45.9" 78°50'44.4", 14.07.2017; **G2 – the** Gydansky Peninsula, Lake Parisento surroundings (Fig.1, site 2): **8** – 70°05'26.0" 75°34'54.6", 21.07.2017; **9** – 70°06'02.7", 75°36'39.0", 22.07.2017; **10** – 70°05'45.4", 75°38'08.7", 23.07.2017; **15** – 70°05'21.6", 75°38'44.6", 24.07.2017; **16** – 70°04'60.0", 75°41'56.2", 25.07.2017; **17** – 70°02'17.1", 75°43'37.6", 27.07.2017. *** – nomenclatural type**.

Table 2. Associations *Eriophoro leiocarpi–Caricetum rotundatae* (subass. *typicum* – **F**, subass. *caricetosum chordorrhizae* – **G**) and *Carici stantis–Warnstorfietum exannulatae* (**H**)

SYNTAXON CODE	F									G								H					F	G	H
Locality	G1	G1	G2	G2	G2	T	T	T	T	T	G1	G2	T	T	T	T	T	G1	G2	G2	G2	T			
Cover total, %:	90	100	100	100	100	100	100	100	90	100	90	100	100	100	100	100	100	95	90	90	100	100			
Cover shrubs, %	1	–	–	5	1	10	–	5	1	1	1	1	1	–	–	5	–	1	–	–	–	–			
Cover dwarf shrubs, %	10	–	–	5	–	–	–	5	1	1	5	–	1	–	–	1	–	–	–	–	–	–			
Lichens, %	–	–	–	1	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
Mosses, %	70	40	90	90	90	100	90	100	70	100	35	95	100	90	100	100	80	50	55	70	40	100			
Herbs, %	40	45	50	80	80	85	85	50	65	90	50	90	80	65	80	80	100	50	55	80	50	15			
Height shrubs (cm)	10	–	–	10	10	20	–	35	30	20	15	15	25	–	–	15	–	10	–	–	–	–			
Aspect (°)	–	135	–	338	–	–	90	180	–	135	180	–	–	–	–	–	–	–	360	–	–	90			
Inclination of slope (°)	0	1	0	1	0	0	1	2	0	2	1	0	0	0	0	0	0	0	1	0	0	1			
Altitude (m a.s.l.)	17	24	30	20	34	52	44	48	45	38	17	30	51	51	54	53	54	21	25	26	21	44			
Total number of species	11	14	13	21	16	22	5	10	8	18	17	18	12	7	9	13	8	14	12	10	8	4			
Number of vascular plant species	7	7	5	10	6	7	3	7	6	9	8	8	8	5	5	7	6	8	6	2	4	1			
Number of lichens species	–	–	–	4	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
Number of moss species	4	7	8	7	10	5	2	3	2	9	9	10	4	2	4	6	2	6	6	8	4	3			
Relevé nr.: in the database	49	87	191	204	207	239	249	253	243	289	8	189	261	262	263	267	268	2	135	143	175	250			
Relevé nr.: in the table	1	2	3	**4***	5	6	7	8	9	10	11	12	**13***	14	15	16	17	18	19	20	21	22			
Number of relevés																							9	8	5
Differential species in ***Eriophoro leiocarpi-Caricetum rotundatae*** and subass. ***typicum***																									
Carex rotundata (Cr)	4	5	5	5	5	5	7	4	6	5	5	6	6	3	3	3	5	·	·	·	·	·	V 6	V 5	·
Eriophorum russeolum subsp. *leiocarpum*	3	2	2	3	5	5	3	5	3	4	3	·	2	2	·	·	5	·	3	2	·	·	V 4	IV 4	II 3
Polytrichum jensenii (Cr)	3	3	3	3	1	3	1	2	·	3	2	3	2	·	1	3	·	3	·	·	·	·	V 3	IV 3	I 4
Luzula wahlenbergii	·	·	1	1	1	·	1	1	·	·	·	1	1	·	·	·	2	·	·	·	·	·	III 1	II 2	·
Differential species in subass. ***caricetosum chordorrhizae***																									
Carex chordorrhiza (S-C)	3	·	·	·	·	3	·	·	·	·	3	2	1	5	6	1	4	4	·	·	·	·	II 3	V 5	I 4
Carex rariflora (Cr, Sp)	·	2	3	·	3	·	·	·	·	1	2	4	2	3	3	6	3	·	3	·	·	·	II 3	V 4	I 3
Sphagnum aongstroemii	·	·	·	5	·	·	·	·	·	3	·	3	5	5	5	·	·	·	·	·	·	·	I 5	IV 5	·
Differential species in ass. ***Carici stantis–Warnstorfietum exannulatae***																									
Warnstorfia exannulata (De)	·	3	3	·	4	·	·	·	·	3	1	·	·	·	6	·	·	4	4	5	4	3	II 4	II 5	V 4
Straminergon stramineum (De, S-C)	·	·	1	1	1	·	·	·	·	·	·	·	·	·	·	3	·	·	3	1	3	·	II 1	I 3	IV 3
Differential species in var. ***Warnstorfia sarmentosa***																									
Warnstorfia sarmentosa (De)	·	·	·	·	·	·	·	·	·	·	·	3	·	·	·	·	·	3	3	3	3	3	·	I 3	V 3
Differential combination of species in suballiance ***Caricenion rariflorae*** (Cr)																									
Eriophorum russeolum subsp. *russeolum* (Sb)	·	1	·	·	·	3	·	·	·	4	·	·	·	·	1	1	·	1	3	·	·	·	II 3	II 3	II 2
CDiagnostic species in alliance ***Sphagnion baltici*** (Sb)																									
Sphagnum balticum (Cr)	3	3	5	5	4	5	7	7	5	4	3	·	3	·	·	·	·	·	·	·	·	·	V 6	II 4	·
Diagnostic species in alliance ***Drepanocladion exannulati*** (De) and class ***Scheuchzerio–Caricetea nigrae*** (S-C)																									
Aulacomnium palustre	·	·	2	·	2	·	·	·	·	2	2	2	·	·	·	·	·	·	·	1	·	·	II 2	II 2	I 1
Carex stans	3	3	3	1	3	·	·	·	·	·	·	1	·	1	1	·	·	5	5	7	3	·	III 3	II 1	IV 6
Comarum palustre (De)	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	3	1	·	·	·	·	·	I 4	I 1
Eriophorum angustifolium	1	·	·	4	·	3	·	·	·	3	·	·	·	·	·	·	·	2	·	·	5	·	II 4	I 4	II 5
Paludella squarrosa	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	3	5	·	·	·	·	II 5
Sphagnum fallax	·	·	·	·	·	·	·	·	·	·	·	5	·	·	·	·	·	·	·	·	·	·	·	I 6	·
S. lindbergii (Cr, Sb, Sp)	·	·	·	·	·	·	·	·	·	3	·	·	·	·	·	·	·	·	·	·	·	·	·	I 4	·
S. majus	·	·	·	·	·	·	·	·	·	·	·	·	·	·	3	·	·	·	·	·	·	·	·	I 4	·
S. obtusum	·	·	3	·	·	·	·	·	·	5	·	·	·	·	·	4	6	·	·	·	·	7	I 3	II 5	I 7
S. russowii	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	I 1	·
S. squarrosum	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	6	4	·	·	·	·	·	·	II 5	·
S. warnstorfii	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	3	·	·	·	·	·	·	·	I 4	·
Other species																									
Andromeda polifolia subsp. *pumila*	3	·	·	·	·	·	·	1	·	1	3	·	1	·	·	1	·	·	·	·	·	·	II 3	III 2	·
Aulacomnium turgidum	·	·	·	1	1	·	·	·	·	·	2	·	·	·	·	1	·	·	·	·	·	·	II 1	II 2	·
Betula nana	1	·	·	3	1	3	·	3	1	1	1	1	1	·	·	3	·	·	·	·	·	·	IV 2	IV 2	·
Calliergon cordifolium	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	1	1	·	·	I 1	II 1
Dicranum laevidens	·	·	·	2	2	2	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	II 2	I 1	·
Drepanocladus aduncus	·	3	·	·	3	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	II 3	·	·
Eriophorum vaginatum	·	1	·	2	·	·	·	·	·	·	·	1	·	·	·	·	·	1	·	·	·	4	II 2	I 1	II 3
Flavocetraria cucullata	·	·	·	1	·	2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	II 2	·	·
Scorpidium revolvens	1	2	·	·	·	·	·	·	·	·	3	·	·	·	·	·	·	3	·	·	·	·	II 2	I 3	I 3
Pedicularis interioroides	·	1	·	·	·	·	·	·	·	·	1	1	·	·	·	·	·	·	·	·	·	·	I 1	II 1	·
Salix myrtilloides	·	·	·	·	·	1	·	·	1	1	·	·	1	·	·	1	·	1	·	·	·	·	II 1	II 1	I 1
Sanionia uncinata	·	·	·	1	4	3	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	II 3	·	I 1
Sphagnum compactum	·	3	3	·	4	·	·	·	5	·	·	·	·	·	·	·	·	·	·	·	·	·	III 4	·	·
S. lenense	·	3	4	·	·	5	·	4	·	·	·	1	·	·	·	·	·	·	·	·	·	·	III 5	I 1	·

Note. Single occurrence: *Caltha arctica* 19(1), 21(1); *Dupontia fischeri* 19(1), 21(1); *Empetrum subholarcticum* 9(1); *Ledum palustre* subsp. *decumbens* 4(1), 10(1); *Pedicularis lapponica* 11(1); *Rubus chamaemorus* 4(2), 8(2); *Salix pulchra* 18(1); *Vaccinium uliginosum* subsp. *microphyllum* 8(1), 9(1); *V. vitis-idaea* subsp. *minus* 4(3); **lichens**: *Cetraria islandica* 6(1); *C. laevigata* 6(1); *Cladonia cenotea* 6(1); *C. chlorophaea* 6(1); *C. cornuta* 6(1); *C. cyanipes* 6(1); *C. deformis* 6(1); *C. gracilis s.l.* 6(1); *C. stygia* 6(1); *C. subfurcata* 4(1); *Peltigera scabrosa* 4(1); *Thamnolia vermicularis* 4(1); **mosses**: *Dicranum elongatum* 12(4); *D. groenlandicum* 12(1); *D. majus* 20(3); *Pohlia drummondii* 18(01); *Polytrichum juniperinum* 11(1); *Rhizomnium andrewsianum* 18(1); *R. pseudopunctatum* 19(2); *Sphagnum girgensohnii* 10(4); *S. perfoliatum* 13(5), 14(6); *S. steerei* 1(5), 11(3); *S. tundrae.*

Author: Khitun O.V. **Locality:** Yamal-Nenets Autonomous Area. **T** – the Tazovsky Peninsula, upper reaches of Verkhnyaya Yareiyakha River (Fig. 1, site 1): **6** – 68°13'16.9" 75°13'00.5", 02.08.2017; **7** – 68°13'15.2" 75°13'25.6", 02.08.2017; **8** – 68°13'14.0" 75°14'06.7", 02.08.2017; **9** – 68°13'25.7" 75°13'16.3" 02.08.2017; **10** – 68°12'27.2" 75°14'16.4", 06.08.2017; **13** – 68°14'13.7" 75°14'36.4", 03.08.2017; **14** – 68°14'11.0" 75°14'30.2", 03.08.2017; **15** – 68°14'01.4" 75°14'25.5", 03.08.2017; **16** – 68°13'53.3" 75°14'59.7", 03.08.2017; **17** – 68°13'52.7" 75°14'50.0", 03.08.2017; **22** – 68°13'15.2" 75°13'35.5", 02.08.2017; **G1** – the Gydansky Peninsula, basin of the Tanama River middle reaches (Fig.1, site 3): **1** – 69°56'56.0" 78°49'22.2", 15.07.2017; **2** – 69°57'36.9" 78°45'55.8", 18.07.2017; **11** – 69°58'07.8" 78°47'58.7", 11.07.2017; **18** – 69°58'17.3" 78°48'05.9", 10.07.2017; **G2** – the Gydansky Peninsula, Lake Parisento surroundings (Fig.1, site 3): **3** –70°05'03.8" 75°41'22.0", 25.07.2017; **4** – 70°05'11.8" 75°40'16.8", 26.07.2017; **5** –70°05'13.6" 75°39'55.2", 26.07.2017; **12** –70°05'02.7" 75°41'32.4", 25.07.2017; **19** – 70°05'45.1" 75°38'09.6", 23.07.2017; **20** – 70°05'39.4" 75°38'38.8", 23.07.2017; **21** –70°04'52.1" 75°43'03.3", 25.07.2017. *** – nomenclatural type**.

parts of their steep slopes with various aspects, at elevations between 24 and 39 m a.s.l. The soil organic horizon is poorly developed, peaty, 1–3 cm thick; the underlying mineral ground is sand.

Structure and composition. The sparse (10 to 25 %) upper layer of shrubs (*Betula nana*, usually 1–10 %) and herbs is usually up to 10 cm height. *Carex arctisibirica*, *Hierochloë alpina*, *Festuca ovina*, *Aconogonon ochreatum*, *Tanacetum bipinnatum* and *Equisetum arvense* subsp. *boreale* are the most abundant herbs. The dwarf shrub-cryptogam ground layer is well-developed, 1–3 cm thick, dominated by lichens (20–80 %) and mosses (5–35 %), with patches of prostrate dwarf shrubs such as *Arctous alpina*, *Empetrum subholarcticum*, *Salix nummularia* (up to 35 %). *Flavocetraria cucullata*, *Thamnolia vermicularis*, *Cetraria islandica*, *Cladonia arbuscula* prevail among lichens. *Polytrichum hyperboreum*, *P. piliferum* and *Racomitrium lanuginosum* are abundant among mosses.

Low shrub communities in mesic habitats

***Dicrano maji–Salicetum lanatae* ass. nova hoc loco** (Table 1, rel. 15–19; Table 3; Fig. 2C)

Low willow thickets with horsetail and moss understorey we do not refer yet to any higher syntaxonomical unit. By their composition and structure, they are transitional between three classes: snowbed vegetation *Salicetea herbaceae* Br.-Bl. 1948, dwarf shrub tundra *Loiseleurio procumbentis–Vaccinietea* Eggler ex Schubert 1960 and sedge mires *Scheuchzerio–Caricetea nigrae* (Nordh. 1936) Tx. 1937.

Differential group of species of this association are: *Carex stans*, *Dicranum majus*, *Polemonium acutiflorum*, *Aulacomnium palustre*.

Holotypus: 18 (281); T1; YaNAA; 1; 68°12'23.3"N 75°13'23.5"E; 36; 100.

Relevé. The relevé was taken at the bottom of a hollow between two outreaches of watershed hill with a smooth surface, with an inclination of 1 ° and an aspect of 292 °. The cover of mosses is 45 %, herbs 30 %, shrubs 20 %, dwarf shrubs 10 % and lichens 50 %. Soil organic horizon is dark brown mucky peat 15–20 cm thick, underlained by dark yellow sandy loam. 04.08.2017. O.V. Khitun.

List of species: *Arctocetraria andrejevii* 5, *Cetrariella delisei* 5, *Polytrichum commune* 4, *Stereocaulon* sp. 4, *Betula nana* 3, *Cladonia gracilis* s. l. 3, *Carex stans* 3, *Dicranum majus* 3, *Hylocomium splendens* 3, *Peltigera scabrosa* 3, *Salix lanata* 3, *S. polaris* 3, *Sanionia uncinata* 3, *Calamagrostis neglecta* 2, *Equisetum arvense* subsp. *boreale* 2, *Viola epipsiloides* 2, *Antennaria villifera* 1, *Aulacomnium palustre* 2, *Bistorta elliptica* 1, *B. vivipara* 1, *Calliergon cordifolium* 1, *Carex lachenalii* 1, *C. rariflora* 1, *Diphasiastrum alpinum* 1, *Festuca ovina* 1, *Ledum palustre* subsp. *decumbens* 1, *Luzula multiflora* subsp. *frigida* 1, *Lycopodium annotinum* subsp. *pungens* 1, *Pedicularic labradorica* 1, *Poa alpigena* 1, *Polemonium acutiflorum* 1, *Ptilidium ciliare* 1, *Pyrola minor* 1, *Salix glauca* 1, *Sibbaldia procumbens* 1, *Solidago lapponica* 1, *Sphagnum girgensohnii* 1, *Tanacetum bipinnatum* 1, *Trisetum spicatum* 1, *Vaccinium uliginosum* subsp. *microphyllum* 1, *Veratrum lobelianum* 2.

Distribution and ecology. These phytocoenoses occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula within an elevation range from 9 to 36 m a.s.l. They grow on slopes of watershed hills (inclination of 1 to 20°) and on flat bottoms of hollows with slightly hummocky nanotopography. Soil organic horizon is mucky peat underlained by sand or sandy loam.

Structure and composition. The stands have three vertical strata. The overstory is 60 to 180 cm high, formed by hypoarctic-montane willow species (*Salix glauca*, *S. lanata*) and *Betula nana* and its cover varies from 20 to 90 %. The field layer is 15 to 20 cm high, formed by herbs and varies in cover from sparse to closed (10–70 %). Herbs are distributed unevenly under the willow canopy, concentrating in open parts. *Equisetum arvense* dominates, *Poa alpigena*, *Polemonium acutiflorum*, *Viola epipsiloides* and *Carex stans* are common but not abundant. Dwarf shrub–moss ground layer is closed. Moss cover reaches 90 %; *Sanionia uncinata*, *Hylocomium splendens* and *Dicranum majus* dominate. Lichens and dwarf shrubs (*Salix polaris* and *Vaccinium uliginosum* subsp. *microphyllum*) are not abundant (5–15 %).

Peat-moss vegetation in moist habitats

Tussock tundra dominated by *Eriophorum vaginatum* is assigned to the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946, order *Sphagnetalia medii* Kästner et Flössner 1933 and alliance *Rubo chamaemori–Dicranion elongati* O. Lavrinenko et I. Lavrinenko 2015.

The *Oxycocco-Sphagnetea* comprises dwarf shrub, sedge and peat-moss vegetation of the Holarctic ombrotrophic bogs, fens and wet heaths. Diagnostic species include *Andromeda polifolia* subsp. *pumila*, *Aulacomnium palustre*, *Betula nana*, *Huperzia arctica*, *Eriophorum vaginatum*, *Polytrichum strictum*, *Rubus chamaemorus*, *Sphagnum balticum*, *S. capillifolium*, *S. compactum*, *S. fuscum*, *S. russowii. Vaccinium uliginosum* subsp. *microphyllum*.

The *Sphagnetalia medii* is represented by *Sphagnum*-dominated bog communities occurring in suboceanic and continental regions, and in the mountains in the northern hemisphere. Diagnostic species are the same as for the class.

The *Rubo chamaemori–Dicranion elongati* includes dwarf shrub, cloudberry, moss, lichen communities on oligotrophic subarctic peatlands, including palsa bogs and high-centered polygons. Differential combination of species includes *Andromeda polifolia* subsp. *pumila*, *Betula nana*, *Rubus chamaemorus*, *Ledum palustre* subsp. *decumbens*, *Vaccinium vitis-idaea* subsp. *minus*, *V. uliginosum* subsp. *microphyllum*, *Dicranum elongatum*, *Polytrichum strictum*, *Flavocetraria nivalis*, *Cetraria islandica*, *Cladonia arbuscula* and *C. rangiferina*. *Cladonia stygia* was for a long time considered as a form of *C. rangiferina*, but now they are trated as different species (Ahti & Hyvönen 1985) and in the studied locality we found predominantely *Cladonia stygia*.

We distinguished two associations.

***Sphagno girgensohnii–Betuletum nanae* ass. nova hoc loco** (Table 1, rel. 20–22; Table 3; Fig. 2D)

Differential species: *Empetrum subholarcticum*, *Calamagrostis neglecta*, *Sphagnum girgensohnii*, *Polytrichum commune*.

Holotypus: 21 (257); T1; YaNAA; 1; 68°14'17.2"N 75°14'48.8"E; 55; 100.

Relevé. The relevé is located on the lake's terrace with slightly hummocky surface, with an inclination 1° and an aspect 225°. Soil organic horizon is dark brown mucky peat, 10 cm thick, underlain by sandy loam. The cover of mosses is 100%, of shrubs 80 %, dwarf shrubs 10 %, herbs 25 %, lichens 20 %. 03.08.2017. O.V. Khitun.

List of species: *Betula nana* 7, *Hylocomium splendens* 5, *Sphagnum girgensohnii* 5, *Cetraria islandica* 4, *Aulacomnium turgidum* 3, *Dicranum laevidens* 3, *Polytrichum commune* 3, *Rubus chamaemorus* 3, *Vaccinium vitis-idaea* subsp. *minus* 3, *Cladonia cornuta* 2, *Flavocetraria cucullata* 2, *Salix glauca* 2, *Sphenolobus minutus* 1, *Cetraria laevigata* 1, *Cladonia cenotea* 1, *C. cyanipes* 1, *C. pleurota* 1, *C. stygia* 1, *Calamagrostis neglecta* 1, *Cladonia amaurocraea* 1, *Empetrum subholarcticum* 1, *Eriophorum vaginatum* 1, *Festuca ovina* 1, *Ledum palustre* subsp. *decumbens* 1, *Peltigera malacea* 1, P. *scabrosa* 1, *Poa arctica* 1, *Polytrichum juniperinum* 1, *Ptilidium ciliare* 1, *Vaccinium uliginosum* subsp. *microphyllum* 1.

Distribution and ecology. These communities occur in the STS on the Tazovsky Peninsula at the sites with relatively deep snow cover: flat or gently sloping parts of lakes' terraces or on the edges of steep lee slopes with solifluction features in the upper parts of ravines. The soil organic horizon is 10–15 cm thick and consists of dark brown mucky peat; the mineral horizons are dark yellow with sandy loam texture.

Structure and composition. The canopy of *Betula nana* is almost closed, 70–80 %, and is 35–80 cm high. The herbal layer is 10 cm high, sparse, with predominance of *Rubus chamaemorus* and *Calamagrostis neglecta*. In the ground layer moss cover reaches 100 %, cover of lichens is 20 to 40 % and of dwarf shrubs is 5–10 %. *Sphagnum girgensohnii* dominates in the moss carpet, while *Hylocomium splendens* is less abundant. *Cetraria islandica* and *Cladonia cornuta* are the most abundant lichens and *Vaccinium vitis-idaea* subsp. *minus* is the most abundant dwarf shrub.

***Empetro subholarctici–Eriophoretum vaginati* ass. nova hoc loco** (Table 1, rel. 23–31; Table 3; Fig. 2E)

Differential species: *Alectoria ochroleuca*, *Empetrum subholarcticum*, *Cladonia stellaris*, *Sphagnum lenense*.

Holotypus: 27 (248); T1; YaNAA; 1; 68°13'15.5"N 75°13'21.1"E; 47; 100.

Relevé. The stand occurs on the gentle slope of the watershed with an inclination 1° and an aspect 22°. The surface is

slightly hummocky and tussocky. Soil organic horizon is peaty, 17 cm thick, underlained by loam. The cover of lichens and mosses is 90 % and 65 % respectively, the cover of herbs and shrubs is 30 and 20 %. 02.08.2017. O.V. Khitun.

List of species: *Cladonia amaurocraea* 5, *C. stygia* 5, *Sphagnum balticum* 5, *Ledum palustre* subsp. *decumbens* 4, *Rubus chamaemorus* 4, *Alectoria ochroleuca* 3, *Dicranum laevidens* 3, *Eriophorum vaginatum* 3, *Flavocetraria nivalis* 3, *Polytrichum strictum* 3, *Sphagnum lenense* 3, *Carex arctisibirica* 2, *Andromeda polifolia* subsp. *pumila* 1, *Calamagrostis neglecta* 1, *Cetraria islandica* 1, *C. laevigata* 1, *Cladonia stellaris* 1, *Dicranum elongatum* 1, *Empetrum subholarcticum* 1, *Vaccinium uliginosum* subsp. *microphyllum* 1, *Vaccinium vitis-idaea* subsp. *minus* 1.

Distribution and ecology. These phytocoenoses occur on high centered polygons in the polygonal tundra-mire complexes on the flat tops of watersheds (43 to 52 m a.s.l.) on the Tazovsky Peninsula. Polygons are 5 to 25 m in diameter, 20 to 40 cm high and have a hummocky surface. Soil organic horison is peaty, 20 to 30 cm thick, underlain by sandy loam.

Structure and composition. These communities have two vertical strata. The overstory with cover of 15 to 70 % is 10 to 15 cm high; it is formed by evenly distributed graminoids and herbs, *Rubus chamaemorus* and *Eriophorum vaginatum* being most common, sometimes with low shrubs (5 to 15 %). The dwarf shrub, lichen, moss ground layer is well-developed and closed. Mosses are the most abundant between hummocks and lichens on the hummocks. Dwarf shrubs (15–30 %) are evenly distributed, *Ledum palustre* subsp.*decumbens* is the most abundant, *Vaccinium uliginosum* subsp. *microphyllum*, *V. vitis-idaea* subsp. *minus*, *Empetrum subholarcticum* are common but less abundant. *Sphagnum balticum* and *Dicranum elongatum* dominate among mosses, *Alectoria ochroleuca*, *Cetraria islandica*, *C. laevigata*, *Cladonia amaurocraea*, *C. stygia* and *Flavocetraria cucullata* are the most abundant among lichens.

Sedge-moss vegetation in wet habitats

Sedge-moss mires and bogs we assign to the class *Scheuchzerio–Caricetea nigrae* (Nordh. 1936) Tx. 1937, order *Scheuchzerietalia palustris* Nordh. 1936, two alliances *Sphagnion baltici* Kustova 1987 ex Lapshina 2010, *Drepanocladion exannulati* Krajina 1933 and one suballiance *Caricenion rariflorae* Lavrinenko, Matveyeva et Lavrinenko 2016.

The class *Scheuchzerio–Caricetea nigrae* comprises oligo-mesotrophic and mesotrophic bogs and intermediate mires rich in mosses and sedges. Diagnostic species of the class present in the study area are *Carex chordorrhiza*, *C. stans*, *Comarum palustre*, *Eriophorum angustifolium*, *Paludella squarrosa*, *Sphagnum fallax*, *S. lindbergii*, *S. majus*, *S. obtusum*, *S. russowii*, *S. squarrosum*, *S. warnstorfii* and *Straminergon stramineum*.

Table 3 Synoptic table of associations in the southern tundra subzone on the Tazovsky Peninsula (Syntaxa codes – see Tables 1 and 2; among "others" species with constancy < II are not included).

SYNTAXON CODE	A	B	C	D	E	F	G	H
Number of relevés	6	8	6	3	9	9	8	5
Diagnostic species in ass. ***Hierochloo alpinae–Hylocomietum splendentis***								
Hierochloë alpina (LV)	V 2	V 2	·	·	·	·	·	·
Polytrichum hyperboreum	V 4	IV 3	I 1	·	·	·	·	·
Alectoria ochroleuca (LV)	V 5	II 4	·	·	V 1	·	·	·
Differential species in ass. ***Hierochloo alpinae–Hylocomietum splendentis***								
Festuca ovina	IV 2	V 2	II 1	II 1	·	·	·	·
Luzula confusa (Sh)	V 1	IV 1	I 1	·	·	·	·	·
Salix nummularia	III 2	IV 3	·	·	·	·	·	·
Bryocaulon divergens	V 4	II 4	·	·	III 1	·	·	·
Flavocetraria nivalis (LV)	V 1	II 3	·	·	II 2	·	·	·
Bryoria nitidula	IV 2	I 1	·	·	I 1	·	·	·
Racomitrium lanuginosum (Sh)	II 2	II 2	·	·	·	·	·	·
Differential species in subass. ***empetretosum subholarctici*** and var. ***typicum***								
Empetrum subholarcticum	V 2	V 3	I 1	V 1	V 1	I 1	·	·
Arctous alpina	IV 2	V 3	I 1	·	·	·	·	·
Calamagrostis neglecta (S-C)	IV 3	IV 2	III 2	V 1	II 1	·	·	·
Differential species in var. ***Aconogonon ochreatum***								
Tanacetum bipinnatum	·	V 2	III 1	·	·	·	·	·
Aconogonon ochreatum	I 1	V 2	·	·	·	·	·	·
Carex quasivaginata (S-C)	·	IV 1	·	·	·	·	·	·
Campanula rotundifolia	·	IV 1	I 1	·	·	·	·	·
Differential species in ass. ***Dicrano maji–Salicetum lanatae***								
Carex stans (S-C)	·	I 1	IV 4	II 1	·	III 3	II 1	IV 5
Dicranum majus	·	·	V 3	·	·	·	·	I 3
Polemonium acutiflorum	·	I 1	V 1	·	·	·	·	·
Aulacomnium palustre ((O-S, S-C)	·	·	IV 2	II 1	·	II 2	II 2	I 1
Differential species in ass. ***Sphagno girgensohnii-Betuletum nanae***								
Sphagnum girgensohnii	·	·	II 2	V 6	·	·	I 5	·
Polytrichum commune	·	·	II 4	V 4	I 3	·	·	·
Differential species in ass. ***Empetro subholarctici-Eriophoretum vaginati***								
Cladonia stellaris (LV)	IV 4	II 4	·	II 1	V 3	·	·	·
Sphagnum lenense	·	·	·	·	IV 4	III 4	I 1	·
Dif-sp. in ass. ***Eriophoro medii-Caricetum rotundatae*** and subass. ***typicum***								
Carex rotundata	I 1	·	·	·	I 1	V 6	V 5	·
Eriophorum medium	·	·	·	·	I 1	V 4	IV 4	II 3
Polytrichum jensenii	·	·	·	·	II 3	V 3	IV 3	I 4
Luzula wahlenbergii	·	·	I 1	·	·	III 1	II 1	·
Differential species in subass. ***caricetosum chordorrhizae***								
Carex chordorrhiza (S-C)	·	·	·	·	·	II 3	V 5	I 4
Carex rariflora	·	·	I 1	·	I 1	II 3	V 4	I 3
Sphagnum aongstroemii	·	·	·	·	·	I 5	IV 5	·
Differential species in ass. ***Carici stantis–Warnstorfietum exannulatae***								
Warnstorfia exannulata	·	·	·	·	·	II 4	II 5	V 4
Straminergon stramineum (S-C)	·	·	I 3	·	·	II 1	I 3	III 3
Differential species in var. ***Warnstorfia sarmentosa***								
Warnstorfia sarmentosa	·	·	·	·	·	·	I 3	V 3
Diagnostic species in class ***Salicetea herbaceae*** (Sh)								
Salix polaris	·	II 2	V 3	·	·	·	·	·
Carex lachenalii	·	I 1	IV 2	·	·	·	·	·
Ranunculus nivalis	·	·	III 1	·	·	·	·	·
Diagnostic species in class ***Loiseleurio procumbentis–Vaccinietea*** (LV)								
Aulacomnium turgidum	III 2	II 1	III 1	V 3	II 1	II 1	II 2	·
Betula nana (LV, O-S)	V 4	V 3	IV 2	V 7	IV 3	IV 2	IV 2	·
Flavocetraria cucullata	V 3	V 3	I 1	II 3	V 3	II 2	·	·
Vaccinium uliginosum subsp. *microphyllum*	IV 2	V 3	III 2	V 1	V 2	II 1	·	·
Vaccinium vitis-idaea subsp. *minus*	V 1	IV 2	II 1	V 3	IV 2	I 3	·	·
Diagnostic species in class ***Oxycocco-Sphagnetea*** (O-S)								
Andromeda polifolia subsp. *pumila*	·	I 1	·	·	III 1	II 3	III 2	·
Eriophorum vaginatum	II 1	·	·	II 1	V 4	II 2	I 1	II 3
Rubus chamaemorus	·	·	I 4	V 3	V 4	II 2	·	·
Sphagnum balticum	·	·	·	·	IV 5	V 6	II 3	·
S. compactum	·	·	·	·	I 5	III 4	·	·
Diagnostic species in class ***Scheuchzerio–Caricetea nigrae*** (S-C)								
Eriophorum angustifolium	I 1	·	III 1	II 1	I 1	II 3	I 4	II 4
Other species:								
Antennaria villifera	·	II 1	II 1	·	·	·	·	·
Armeria scabra	·	III 1	·	·	·	·	·	·
Bistorta vivipara	I 1	III 1	V 2	·	·	·	·	·
Carex arctisibirica	V 3	IV 2	I 1	II 3	II 2	·	·	·
Cetraria islandica	IV 2	V 3	I 1	V 4	IV 2	I 1	·	·
C. laevigata	III 1	IV 1	·	II 1	V 3	I 1	·	·
Cetrariella delisei	·	II 4	IV 3	·	·	·	·	·
Cladonia amaurocraea	III 1	II 1	·	II 1	V 3	·	·	·
C. arbuscula	V 3	IV 3	·	II 1	III 1	·	·	·
C. chlorophaea	III 1	II 1	III 1	·	II 1	I 1	·	·
C. coccifera	I 1	III 2	I 1	·	·	·	·	·
Cladonia cornuta	II 1	·	·	IV 3	II 1	I 1	·	·
C. gracilis s.l.	III 1	II 1	IV 2	II 3	II 1	I 1	·	·
C. pleurota	IV 2	·	·	II 1	II 1	·	·	·
C. stygia	V 4	II 4	·	IV 4	V 5	I 1	·	·
C. subfurcata	I 1	I 3	·	·	III 1	I 1	·	·
Dicranum elongatum	V 3	II 1	·	·	IV 3	·	I 5	·
D. laevidens	·	·	I 3	II 3	III 3	II 3	I 1	·
Equisetum arvense sunsp. *boreale*	II 2	IV 2	V 3	II 1	·	·	·	·
Hylocomium splendens	·	I 4	V 2	V 4	I 1	·	·	·
Ledum palustre subsp. *decumbens*	IV 2	IV 2	II 1	V 1	V 4	I 1	I 1	·

Table 3. Continued.

SYNTAXON CODE	A	B	C	D	E	F	G	H
Orthocaulis binsteadii	III 1	·	·	·	II 1	·	·	·
Peltigera scabrosa	·	·	IV 2	IV 2	·	I 1	·	·
Petasites frigidus	·	·	III 2	·	·	·	·	·
Pleurozium schreberi	I 1	I 1	II 1	IV 3	II 2	·	·	·
Poa alpigena	II 1	II 1	III 1	II 1	·	·	·	·
Pogonatum dentatum	III 1	IV 1	·	·	·	·	·	·
Polytrichum piliferum	I 1	III 3	·	·	·	·	·	·
Ptilidium ciliare	I 1	II 2	IV 1	V 1	II 1	·	·	·
Pyrola minor	·	·	III 1	·	·	·	·	·
Ranunculus propinquus	·	·	III 2	·	·	·	·	·
Salix glauca	V 1	II 1	IV 3	IV 2	·	·	·	·
S. lanata	·	I 1	V 5	II 1	I 1	·	·	·
S. pulchra	III 1	I 1	I 1	·	I 1	·	·	I 1
Sanionia uncinata	·	II 1	V 5	II 3	II 1	II 3	·	I 1
Stellaria peduncularis	·	II 1	III 1	·	·	·	·	·
Thamnolia vermicularis	IV 1	III 1	·	·	I 3	I 1	·	·
Veratrum lobelianum	·	·	IV 2	·	·	·	·	·
Viola epipsiloides	·	·	III 2	·	·	·	·	·

The *Scheuchzerietalia palustris* comprises wet ombrotrophic and minerotrophic communities in depressions in bogs, swamps and mires occurring on peaty soil with high water table. Diagnostic species: *Carex rariflora* and *Sphagnum lindbergii*.

The *Sphagnion baltici* comprises vegetation of wet depressions in bogs and intermediate mires dominated by oligotrophic *Sphagnum*-mosses in continental parts of the boreal zone in the Holarctic. Diagnostic species are: *Sphagnum balticum*, *S. lindbergii* and *Eriophorum russeolum* (Lavrinenko et al. 2016). The alliance is represented by suballiance *Caricenion rariflorae*, comprising vegetation of swamps and depressions in polygonal bogs and palsas dominated by oligotrophic *Sphagnum*-mosses in the tundra zone of the East European and probably West Siberian sectors of the Arctic. Differential combination of species includes *Carex rariflora*, *C. rotundata*, *Eriophorum russeolum*, *Sphagnum balticum*, *S. lindbergii* and *Polytrichum jensenii* (Lavrinenko et al. 2016).

We describe one new association and two subassociations in this suballiance.

Eriophoro leiocarpi–Caricetum rotundatae (Table 2, rel. 1–17; Table 3)

Differential species: *Carex rotundata*, *Eriophorum russeolum* subsp. *leiocarpum*, *Polytrichum jensenii*, *Luzula wahlenbergii*.

Holotypus: 4 (204); T2; YaNAA; 2; 70°05'11.8" 75°40'16.8" E; 20; 100.

Relevé. The community occurs in the water track channel on the gentle slope. The cover of mosses is 90 %. The cover of graminoids is 80 %, shrubs and dwarf shrubs 5 % each. Soils are peaty, moist, with 15–20 cm thick organic horizon underlained by sandy loam. 26.07.2017. O.V. Khitun.

List of species: *Carex rotundata* 5, *Sphagnum aongstroemii* 5, *S. balticum* 5, *Eriophorum angustifolium* 4, *Betula nana* 3, *Dicranum laevidens* 2, *Eriophorum russeolum* subsp. *leiocarpum* 3, *E. vaginatum* 3, *Polytrichum jensenii* 3, *Vaccinium vitis-idaea* subsp. *minus* 3, *Aulacomnium turgidum* 1, *Carex stans* 1, *Cladonia subfurcata* 1, *Flavocetraria cucullata* 1, *Ledum palustre* subsp. *decumbens* 1, *Luzula wahlenbergii* 1, *Peltigera scabrosa* 1, *Rubus chamaemorus* 1, *Sanionia uncinata* 1, *Straminergon stramineum* 1, *Thamnolia vermicularis* 1.

Distribution and ecology. These communities occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula. They occupy lake depressions, drained lakebeds, wet hollows between watershed hills, wet troughs on the watershed hills. The soils are waterlogged, with peat horizons 20 to 30 cm thick underlained by sandy loam or clay loam.

Structure and composition. The stands are rather homogenous, formed by hygrophitic graminoids and predominantly *Sphagnum* mosses. The layer of graminoids in these communities is up to 80 cm high, with the cover of 40 to 85 %. *Carex rotundata*, *Eriophorum russeolum* subsp. *leiocarpum* and *Luzula wahlenbergii* are the most abundant. Hygrophytic mosses (*Sphagnum balticum* and *Polytrichum jensenii* predominate) form a thick carpet with 40 to 100 % cover. Rarely small patches of dwarf shrubs are present on the moss pads (*Andromeda polifolia* subsp. *pumila*, *Ledum palustre* subsp. *decumbens*).

***Eriophoro leiocarpi–Caricetum rotundatae typicum* subass. nov. hoc loco** (Table 2, rel. 1–9; Table 3; Fig. 2F)

Differential species are the same as for the association.

Distribution and ecology. These phytocoenoses occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula within the altitude range of 17 to 52 m a.s.l. on the drained lakebeds, on low poorly drained watersheds, in troughs of polygonal tundra-mire complexes.

***Eriophoro leiocarpi–Caricetum rotundatae caricetosum chordorrhizae* subass. nov. hoc loco** (Tabl. 2, rel. 10–17; Tabl. 3; Fig. 2G)

Differential species: *Carex chordorrhiza*, *C. rotundata*, *C. rariflora* and *Sphagnum aongstroemii*.

Holotypus: 13 (261); T2; YaNAA; 1; 68°14'13.7"N 75°14'36.4"E; 51; 100.

Relevé. The stand grows on drained lakebed with a rather even surface. The cover of mosses is 100 %, graminoids 80 %, shrubs and dwarf shrubs 1 % each. Soils are peaty and wet, with organic horizon 20–25 cm thick, underlained by sandy loam. 03.08.2017. O.V. Khitun.

List of species: *Carex rotundata* 6, *Sphagnum aongstroemii* 5, *Sphagnum perfoliatum* 5, *Sphagnum balticum* 3, *Carex rariflora* 2, *Eriophorum russeolum* subsp. *leiocarpum* 2, *Polytrichum jensenii* 2, *Andromeda polifolia* subsp. *pumila* 1, *Betula nana* 1, *Carex chordorrhiza* 1, *Luzula wahlenbergii* 1, *Salix myrtilloides* 1.

Distribution and ecology. These communities occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula. They occupy drained lakebeds, seldom occur in troughs of polygonal complexes on the lower watersheds. They were recorded within the altitude range of 17 to 54 m a.s.l.

Structure and composition. Two vertical strata are clearly distinguished in this community: an upper layer of hygrophitic sedges (*Carex rotundata*, *C. chordorrhiza*, *C rariflira*) 20 to 30 cm high with cover 50 to 100 %, and a closed ground layer (100 %) formed by hygrophitic mosses *Polytrichum jensenii* and *Sphagnum aongstroemii*.

The alliance *Drepanocladion exannulati* comprises non-calcyphytic fens dominated by mosses (*Warnstorfia exannulata* and *W. sarmentosa*) and with a sparse sedge cover (*Eriophorum polystachion*, *E. scheuchzeri*, *Carex cinerea*, *C. lachenalii*, *C. rariflora*, *C. rostrata*). Communities of this alliance occur in boreal and arctic regions as well as in alpine areas in Central and Southern Europe. Diagnostic species include *Comarum pa-*

lustre, *Straminergon stramineum*, *Warnstorfia exannulata*, *W. sarmentosa*. In the study area this alliance is represented by the variant of the association *Carici stantis–Warnstorfietum exannulatae* Lavrinenko, Matveyeva et Lavrinenko 2016, described earlier in the East European Arctic (Lavrinenko et al. 2016).

Carici stantis–Warnstorfietum exannulatae Lavrinenko, Matveyeva et Lavrinenko 2016

Differential combination of species includes *Carex stans*, *Warnstorfia exannulata* and *Straminergon stramineum*.

Total vegetation cover is 80–100%. Sedges and solitary willows form the canopy up to 30 cm high, with the cover from 35 to 95 %. The ground moss layer varies from 1 % to almost closed. These stands occupy paludified depressions on watersheds, low marine terraces and floodplains. The soils are peaty, underlained by gleyed mineral horizons. Association is present in the TTS and STS of the East European Arctic (Lavrinenko et al. 2016). We describe a variant of this association below.

Carici stantis–Warnstorfietum exannulatae* var. *Warnstorfia sarmentosa (Tabl. 2, rel 18-22; Tabl. 3; Fig. 2H).

Differential species: *Warnstorfia sarmentosa*.

Distribution and ecology. These communities occur in the southern part of the TTS on the Gydansky Peninsula and in the STS on the Tazovsky Peninsula. They were recorded within an altitude range of 21 to 44 m a.s.l. in waterlogged habitats at the bottoms of hollows between hills, on drained lakebeds or in thermocarst thaw troughs on watersheds. The soils with approximately 15 cm thick peat horizon, water-soaked, on sandy deposits.

Structure and composition. The stands have two vertical layers: *Carex stans* dominates in the upper one, which height is 30–35 cm and cover up to 80 %; *Warnstorfia exannulata*, *W. sarmentosa* and *Straminergon stramineum* are predominant in the ground layer which cover varies from 40 to 100 %.

Overview of the syntaxonomical diversity of the Tazovsky Peninsula and the prodromus of vegetation

For the first time, for the STS on the Tazovsky Peninsula, the syntaxonomic diversity is described, including 6 associations, 3 subassociations and 3 variants. Among them 4 associations, 3 subassociations and 3 variants are nov. hoc. loco. The subass. *Hierochloo alpinae–Hylocomietum splendentis empetretosum subholarctici* with 2 variants the *typicum* and the *Aconogonon ochreatum* are wide-spread and occupy the most drained parts of the watershed hills and their edges. The association *Dicrano maji–Salicetum lanatae* is common in the study area but occupy relatively small areas on the slopes of watersheds and hollows between them. The association *Sphagno girgensohnii–Betuletum nanae* was relatively rarily found, mainly on the gently sloping lake terraces. The tussock tundra *Empetro subholarctici–Eriophoretum vaginati* and the sedge-*Sphagnum* mires *Eriophoro leiocarpi–Caricetum rotundatae* are the parts of polygonal tundra-mire complexes on the flat watersheds. The sedge-moss fens (subass. *Carici stantis–Warnstorfietum exannulatae warnstorfietosum sarmentosae*) in lake depressions and hollows betwen hills are rather common in the area.

A hyerarchy of the syntaxonomical system of vegetation of the Tazovsky Peninsula is represented in the following prodromus:

Class
Order
Alliance
Suballiance
Association
Subassociation
Variant

Loiseleurio procumbentis–Vaccinietea Eggler ex Schubert 1960
Deschampsio flexuosae–Vaccinietalia myrtilli Dahl 1957
Loiseleurio–Arctostaphylion Kalliola ex Nordhagen1943
Hierochloo alpinae–Hylocomietum splendentis Telyatnikov et al. 2019
empetretosum subholarctici Khitun **subass. nov. hoc loco**
typicum Khitun **var. nov. hoc loco**
Aconogonon ochreatum Khitun **var. nov. hoc loco**
? Unknown class
? Unknown order
? Unknown alliance
Dicrano maji–Salicetum lanatae Khitun **ass. nov. hoc loco**
Oxycocco-Sphagnetea Br.-Bl. et Tx. ex Westhoff et al. 1946
Sphagnetalia medii Kästner et Flössner 1933
Rubo chamaemori–Dicranion elongati O. Lavrinenko et I. Lavrinenko 2015
Sphagno girgensohnii–Betuletum nanae Khitun **ass. nov. hoc loco**
Empetro subholarctici–Eriophoretum vaginati Khitun **ass. nov. hoc loco**
Scheuchzerio–Caricetea nigrae (Nordh. 1936) Tx. 1937
Scheuchzerietalia palustris Nordh. 1936
Sphagnion baltici Kustova 1987 ex Lapshina 2010
Caricenion rariflorae Lavrinenko, Matveyeva et Lavrinenko 2016
Eriophoro leiocarpi–Caricetum rotundatae Khitun **ass. nov. hoc loco**
typicum Khitun **subass. nov. hoc loco**
caricetosum chordorrhizae Khitun **subass. nov. hoc loco**
Drepanocladion exannulati Krajina 1933
Carici stantis–Warnstorfietum exannulatae Lavrinenko, Matveyeva et Lavrinenko 2016
Warnstorfia sarmentosa Khitun **var. nov. hoc loco**

DISCUSSION

In the STS on the Tazovsky Peninsula we found the same tendencies as in the southern part of the TTS on the Gydansky Peninsula. (Telyatnikov et al., in press). As expected, spotted dwarf shrub-moss tundras with notable participation of forbs (subass. *Luzulo tundricolae–Hylocomietum splendentis empetretosum subholarctici*), which are characteristic for the zonal habitats in the northern part of the TTS on the Gydansky Peninsula, are absent on Tazovsky. On the Tazovsky Peninsula, dwarf birch dominated communities with an abundance of erect dwarf shrubs, sedge (*Carex arctisibirica*) and well-developed lichen-moss ground layer with rare frost boil spots occupy zonal habitats on loamy grounds (Khitun 1989). However, in the studied locality sandy grounds were absolutely predominant, therefore we collected not enought relevés corresponding strictly to this zonal type to describe it here. Instead, psammophitic variants of such communities were present. We assigned them to the earlier described association *Hierochloo alpinae–Hyloco-*

mietum splendentis. These phytocoenoses grow on the better drained parts of watershed hills with shallow peaty horizon.

On the poorly drained parts of watershed hills on sandy loams or loams, where peaty horizon is rather thick, tussock tundras occur (ass. *Empetro subholarctici–Eriophoretum vaginati*). In the southern part of the TTS in the central part of the Gydansky Peninsula tussock tundra is widespread and we considered it as a zonal community (Telyatnikov et al., in press). This idea goes back to Gorodkov (1935). Matveyeva & Zanokha (1986) in their surveys of vegetation in the southern tundra of the Taimyr Peninsula also referred communities with abundant *Eriophorum vaginatum* to the zonal type.

Though tussock tundra is physiognomically very similar and have similar species composition in various regions, some regional or local variation is present (Walker et al. 1994). For example, *Cassiope tetragona*, common in this type of tundra in Taimyr, was not found in similar habitats in the West Siberian Arctic. We found some difference in dominant species of *Sphagnum* mosses. In the central part of the Gydansky Peninsula, *Sphagnum balticum* and *S. aongstroemii* were dominant in tussock tundra, the latter is also the main dominant in tussock tundra in the STS of Taimyr (Matveeva & Zanokha 1986). On the Tazovsky Peninsula, *Sphagnum balticum* and *S. lenense* dominate in the tussock tundra. In the study area we found *Sphagnum aongstroemii* only on the former lakebeds of drained lakes in the wet sedge-moss mires.

Tussock tundra usually develops on loam and clay grounds and is characterized by a poorer drainage. However, in the studied localities sand deposits were widespread, so sandy loams and sands were underlaying relatively thick organic peaty horizons. It is likely that these peat horizons provide the conditions suitable for such communities. The presence of thick peaty horizons is very characteristic of subarctic tundra in the West Siberian Arctic (Rebristaya 2013, Khitun 2005). Peaty acidic soils are favourable for many oligotrophic hypoarctic species, but are an obstacle to the spread of arctic species southwards (in contrast to Taimyr, where arctic species are present even in the southern tundra). The absence of arctic species is the main reason that the species richness of zonal communities in the West Siberian Arctic is lower, when compared to Taimyr; and the tussock tundras are the poorest of the zonal communities in the region (by species composition). Only in the subzone of the arctic tundra, where organic horizons are minimal and mineral horizons are close to the surface, we recorded the increase of forb species and zonal communities become one of the richest by number of species (Khitun 1998, 2005).

In the studied locality, as well as in the localities in the southern part of the TTS on the Gydansky Peninsula, we did not find *Dryas*-dominated communities *Dryado octopetalae–Hylocomietum alaskani* (Andreev 1932) Lavrinenko et Lavrinenko 2018, which was unexpected, taking into account the widespread sandy grounds. It is probable that the thick peat horizons and poor drainage, overall, was the reason for their absence. In previously studied sites on the Tazovsky Peninsula *Dryas*-dominated stands were also rare (Khitun 1989).

Vegetation in the southern part of the TTS on the Gydansky and in the STS on the Tazovsky Peninsulas is phytocoenologically linked with the territories located westwards. Association *Carici stantis–Warnstorfietum exannulatae* is common with the East-European Arctic but there are no common associations with regions located to the east. In the northern part of the TTS on the Gydansky Peninsula, we discovered the opposite trend, finding connections only with regions located eastward, i.e. Taimyr, East Siberia (Telyatnikov et al. 2019).

We found a high degree of similarity between vegetation of Tazovsky and southern part of the TTS of the Gydansky Peninsula. Four of six associations which we described are common for these territories (*Hierochloo alpinae–Hylocomietum splendentis*, *Dicrano maji–Salicetum lanatae*, *Eriophoro leiocarpi–Caricetum rotundatae*, *Carici stantis–Warnstorfietum exannulatae*) and only two (*Sphagno girgensohnii–Betuletum nanae* and *Empetro subholarctici-Eriophoretum vaginati*) are specific for the STS on the Tazovsky Peninsula. At the same time, comparison of the northern part of the TTS and STS, revealed low similarity with only one association in common (*Hierochloo alpinae–Hylocomietum splendentis*).

CONCLUSION

Summarizing the results of our phytosociological research in the Gydansky and Tazovsky Peninsulas, we conclude that the results correspond with the statements of Alexandrova (1980), who wrote that the vegetation of the northern part of the TTS differed notably from the vegetation of the southern parts of the TTS and of STS. The two latter are rather similar by species composition and structure. According to Alexandrova (1980), zonal communities in the northern belt of the subarctic tundra (coinciding with northern part of TTS) have the features transitional to the arctic tundra subzone, but the presence of low shrubs (dwarf birch and willows) is characteristic for subarctic tundra. Our data confirm this conclusion.

ACKNOWLEDGEMENTS

The authors are grateful to Transregional Expeditional Center "Arctica", Scientific Center of Arctic Studies and Department of Science and Innovations of the Yamal-Nenets Autonomous Area for the field work logistics. We are very thankful to Dr. Il'ya Zhdanov for identification of lichens in the field, to our cartographer Yakov Gunin for various help during the field work and to Bernard Steward for improving the English language text. The work was carried out with funding of the State Task of the Central Siberian Botanical Garden Siberian Branch RAS (№ AAAA-A21-121011100007-6), and with the support of the RFBR (project no 18-04- 01010 A). Work of the reseachers of the Komarov Botanical Institute RAS was carried out within the framework of the institute topics № AAAA-A19-119030690002-5 and № 121021600184-6, and support of RFBR project no 18-05-60093.

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