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CLASSIFICATION OF NORTHERN BOREAL DARK CONIFEROUS FORESTS OF THE WEST SIBERIAN PLAIN

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ABSTRACT - Classification of northern boreal dark coniferous forests in the West Siberian plain was developed using the Braun-Blanquet approach. In the northern part of the West-Siberian plain, boreal coniferous forests occur at the northern limit of their range characterized by cold continental climate and prevalence of long-frozen, poorly drained soils in watersheds. All syntaxa were assigned to the class *Vaccinio-Piceetea* Br.-Bl. *in* Br-Bl., Siss. & Vlieger 1939, order *Piceetalia excelsae* Pawł. in Pawł., Sokołowski & Wallisch 1928. Association *Rubo arctici-Abietetum sibiricae* ass. nova hoc loco was included in the alliance *Aconito rubicundi-Abietion sibiricae* Anenkhonov et Chytry 1998. Association *Pino sibiricae-Abietetum sibiricae* ass. nova hoc loco was included in the provisional alliance *Pino sibiricae-Abietion sibiricae*. Some problems of the syntaxonomic status of north-boreal dark-coniferous forests are disscused.

KEY WORDS: BOREAL FORESTS, SYNTAXONOMY, VACCINIO-PICEETEA, WEST SIBERIA

INTRODUCTION

Despite the fact that boreal dark coniferous forests predominate over vast areas in Northern Asia they represent one of the most poorly studied vegetation types. There are only a few publications containing regional syntaxonomic systems that are developed for Eastern Siberia, Baikal region, the Sayan Mountains and Russian Far East. (Anenkhonov & Chytry, 1998; Ermakov et al., 2002; Krestov & Nakamura, 2002; Neshatayev et al., 2002). The majority of studies carried out using the Braun-Blanquet approach were aimed at Central, Northern, and Eastern Europe (Pawłowski et al., 1928; Braun-Blanquet et al., 1939; Oberdorfer, 1957; Kielland-Lund, 1981; 1994; Ellenberg, 1986; Mucina et al., 1993; Dierssen, 1996).

North boreal forests with predominance of *Picea obovata*, *Pinus sibirica* and *Abies sibirica* alternating with *Betula pubescens* are widespread on watersheds in middle and south boreal subzones of the West Siberian Plain. However they never occur in zonal sites of the north boreal subzone because of unfavourible cold climate, seasonal frozen soils, and waterlogged areas. They are concentraited in the river valleys characterized by a warmer microclimate and better soil drainage.

The aim of this study was to elaborate classification system of north boreal dark-coniferous forests of West Siberian plain and analyse the diagnostic features of associations and higher units.

STUDY AREA

The area studied covers the northern part of the West Siberian plain (Fig.1) with variations of altitudes between 80 and 130 m. The central part (Siberian Uvals) represents an undulating plain prone to weak erosive processes. The height of hills reaches only 5-10 m but their extent varies between 200 m and 5-10 km. Glacial and fluvial-glacial deposits

predominate in the landscapes (Zemtsov, 2000). The Surgutskoye Polesye and Pur-Nadym accumulative plains are marshlands with numerous lakes. Forests occur only in well-drained sites - in river valleys and sandy deposits of watersheds.

The climate is cold, humid and continental. The mean annual temperature is - 4 ºC, minimum temperatures in January reach - 50.8 ºC. Negative air temperatures are observed from September to June. This promotes prolongation of snow cover over a long period. The annual precipitation is 584 mm, the relative air humidity varies between 68 and 88% during year (Anonymous, 1966-1970). Soil cover is formed by combination of podzolic, gydromorphic, peat-podzolic, peat and alluvial soils.

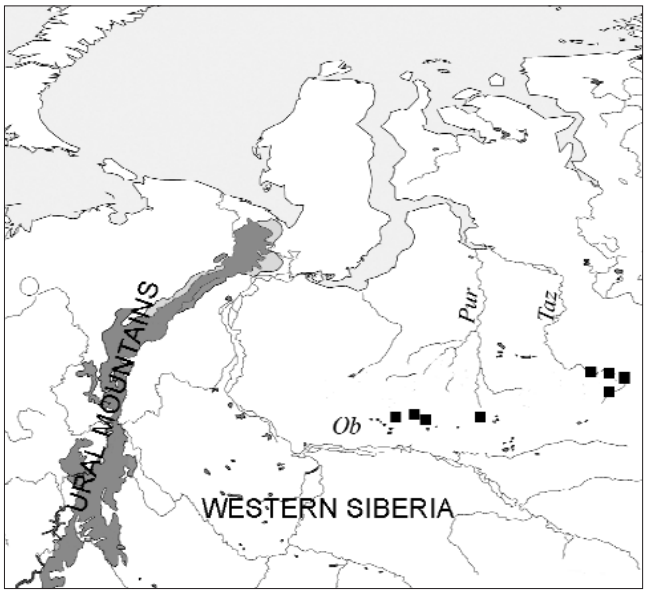

Fig. 1. Localities of relevés of dark-coniferous boreal forests in Western Siberia.

DATA AND METHODS

The basis for the classificatin was 29 relevés of dark coniferous forests collected from the central part of the north boreal subzone of the West Siberian Plain. Additionally 44 relevés from north-eastern part of the West Siberian Plain were taken from the monograph by Neshatayev et al., (2002), with an aim to cover a broad range of different habitats from various parts of the study area. Selected sites were sampled in plots (relevés) of the size of 200-400 m^2, where all vascular plants, bryophytes and macrolichens were recorded and assigned to a cover-abundance value on the Braun-Blanquet scale. A total of 73 plots were used in the study.

The classification of plant communities was carried out using the Braun-Blanquet approach (Westhoff & van der Maarel, 1973). The plot records were stored in the TURBOVEG database (Hennekens, 1996) and classified by TWINSPAN (Hill, 1979). For every degree of the Braun-Blanquet scale, a new pseudospecies level was introduced in TWINSPAN, i.e. classification used cover-abundance information. To arrive at floristically and ecologically uniform units, TWINSPAN results were manually modified by merging some groups and shifting a few plots from one cluster to another.

The vegetation units were named in accordance with phytosociological nomenclature (Weber et al., 2000). For characterization of the syntaxa in the synoptic tables, the Braun-Blanquet scale (r, +, 1, 2, 3, 4, 5) and constancy scale: I (1-20%), II (21-40%), III (41-60%), IV (61-80%), V (81-100%) were used. Species names follow the list of vascular plants of the former USSR (Cherepanov, 1995) and the check-list of mosses of the former USSR (Ignatov & Afonina, 1992).

RESULTS

Classification

According to the Twinspan results four groups of vegetation plots were distinguished, each one with a distinctive floristic composition and clear ecological interpretation. After comparison of these groups with the phytosociological literature (Pawlowski et al., 1928; Braun-Blanquet et al., 1939, Oberdorfer, 1957; Kielland-Lund, 1981; 1994; Ellenberg, 1986; Mucina et al., 1993; Dierssen, 1996), we suggest their syntaxonomic interpretation within one classe, one order, two alliances, two associations and three subassociations.

A whole set of releves was attributed to the class *Vaccinio-Piceetea* Br.-Bl. *in* Br-Bl., G.Siss. et Vlieger 1939 comprising boreal coniferous forests of Eurasia. In the northern part of the West-Siberian plain, the *Vaccinio-Piceetea* forests occur at the northern the range limit where their sites are characterized by cold continental climate and long-frozen poorly drained soils. As a result, they demonstrate low values of canopy density, simple phytocoenotic structure and form distinct transitional ecological series into bogs of the class *Oxycocco-Shagnetea* Br.-Bl. et Tx. ex Westhoff et al., 1946. All north boreal communities of the *Vaccinio-Piceetea* are characterised by poor floristic compositions as compared to more southern types due to the decrease of the moderately thermophilous plants number. Despite general floristic poorness they contain a distinctive group of characteristic and differential species of the class (*Lonicera caerulea, Vaccinium vitis-idaea, V. myrtillus, Linnaea borealis, Goodyera repens, Trientalis europaea, Orthilia secunda, Pyrola rotundifolia, Moneses uniflora, Listera cordata, Hylocomium splendens, Pleurozium schreberi, Dicranum polysetum, Ptilium crista-castrensis, Peltigera aphthosa, P. canina*).

All dark coniferous north boreal forests from the studied area were included in the European-Siberian order *Piceetalia excelsae* Pawł. in Pawł., Sokołowski & Wallisch (1928). The Siberian part of the order range is predominantly concentrated in middle boreal and south boreal subzones. However, in the north boreal subzone, there are only separate "islands" of these forests occurring in extra-zonal habitats located in the well-drained, moderately warm slopes, and terraces of river valleys. These sites are characterized by the most favorable thermal soil regime and good drainage. Due to these local environments, thermophilous south-boreal plants, which avoid long-frozen soils and permafrost, penetrate together with dark coniferous forests into the north boreal subzone. Most of them are diagnostic species for the *Piceetalia excelsae*: *Abies sibirica, Sorbus sibirica, Padus avium, Maianthemum bifolium, Rhytidiadelphus triquetrus, Gymnocarpium dryopteris, G. jessoense, Diplazium sibiricum, Athyrium filix-femina, Oxalis acetosella, Lycopodium annotinum, Phegopteris connectilis, Dryopteris carthusiana, D. expansa*. The order includes two alliances that difer in character of habitat thermal regimes.

The Alliance *Aconito rubicundi-Abietion sibiricae* Anenkhonov et Chytry 1998 (Table 1: 1-3) described in Baikal region extends through southern Siberia to the Urals. The characteristic feature of the alliance is an essential role of gygro-mesophytic tall-forb plants (*Aconitum septentrionalis, A. volubile, Cacalia hastate, Delphinium elatum, Senecio nemorensis, Thalictrum flavum, Heracleum dissectum, Cirsium heterophyllum, Crepis sibirica, Lilium pilosiusculum, Geranium albiflorum*) indicating moderately cold humid climate (with large precipitation and a well-developed snow layer in winter season) determined by permanent influence of the Atlantic himid air masses.

Table 1. Synoptic table of north boreal dark coniferous forests syntaxa of the West-Siberian Plain
(abbreviations: all. *P.s.-A.s.* - alliance *Pino sibiricae-Abietion sibiricae*; ass. *P.s.-A.s.* - association *Pino sibiricae-Abietetum sibiricae*)

Syntaxon Nr.		**1**	**2**	**3**	**4**
Nunber of releves		**31**	**14**	**6**	**22**
Species of tree layer					
Pinus sibirica	all. *P.s.-A.s.*	V +-4	I	IV +-2	V +-3
Picea obovata	all. *P.s.-A.s.*	V 1-3	II 1-2	V +-5	V +-3
Larix sibirica	all. *P.s.-A.s.*	IV +-4	.	II +	III 1-3
Abies sibirica	all. *P.s.-A.s.*	IV +-3	I 2-3	II 5-5	III +-3
Betula pubescens		V +-4	V 1-5	V +-3	V +-5
Pinus sylvestris		.	.	II +-2	I 1-2
Populus tremula		I	I	.	I +
Diagnostic species (DS) of the Ass. ***Rubo arctici-Abietetum sibiricae***					
Calamagrostis langsdorffii	ass. *P.s.-A.s.*	IV +-3	V 1-3	V 2-3	IV +-2
Rosa acicularis	ass. *P.s.-A.s.*	V +-4	IV +-2	IV +-2	IV +-2
Rubus arcticus	ass. *P.s.-A.s.*	V +-2	V +-2	III +-2	IV +-2
Equisetum arvense		V +-3	V +-3	I +	II +-2
Ribes hispidulum		V +-2	I +	III +	I +
Veronica longifolia		I	III +-2	V +-2	I +
Variant *Betula pubescens*					
Ribes nigrum		II +-2	IV 1-2	.	I +
Ranunculus repens		I	III +-2	I 2	I +
Vicia cracca		I	II +-1	.	.
Variant *Viola palustris*					
Viola palustris		.	.	V +-2	.
Solidago virgaurea		II	I 2	V +-2	II
Comarum palustre		I	II +-2	IV +-2	.
Thyselium palustre		.	.	III +-2	.
DS Ass. ***Pino sibiricae-Abietetum sibiricae***					
Polytrichum commune		I +-1	I +	III +-2	IV 1-4
DS All. ***Aconito rubicundi-Abietion sibiricae***					
Veratrum lobelianum		V +-2	IV +-2	V +-2	III +-1
Aconitum septentrionalis		V +-3	III 2-2	I +	.
Cacalia hastata		V +-2	III +-2	V +-2	I +

Syntaxon Nr.	**1**	**2**	**3**	**4**
Nunber of releves	**31**	**14**	**6**	**22**
Delphinium elatum	III +-1	II +	I +	.
Senecio nemorensis	III +-2	III +-1	V +-2	.
Galium boreale	IV +-2	III +-2	III +-2	I +
Thalictrum minus	.	I +	IV +-2	I +
Thalictrum flavum	IV +-2	IV +-2	.	.
Aconitum volubile	II +-2	II +-1	.	.
Heracleum dissectum	II +-2	III +-3	.	.
Cirsium heterophyllum	I	I 2-2	.	.
Crepis sibirica	I	II +	.	.
Lilium pilosiusculum	I	.	.	.
Geranium albiflorum	.	.	II 2	.
Adoxa moschatellina	I	.	.	.
DS Ord. ***Piceetalia excelsae***				
Sorbus sibirica	V +-2	IV +-2	V +-3	V +-5
Padus avium	IV +-2	IV +-3	II +-2	I +-2
Maianthemum bifolium	V +-2	III +-1	IV +-2	IV +-2
Rhytidiadelphus triquetrus	IV 2-2	I +-1	.	I +
Lycopodium annotinum	I +-2	.	.	I 1-2
Gymnocarpium dryopteris	I	.	II +-2	I +-2
Gymnocarpium jessoense	I	I +	.	I +
Diplazium sibiricum	I	.	.	I 1
Phegopteris connectilis	I	.	.	.
Dryopteris carthusiana	I	.	.	.
Dryopteris expansa	I	.	.	.
Athyrium filix-femina	I	I +-1	.	.
Oxalis acetosella	I +-1	I 1	.	.
DS Cl. ***Vaccinio-Piceetea***				
Lonicera caerulea	V +-2	V +-2	III +-2	III +-2
Vaccinium vitis-idaea	III +-3	I +	III +	V 1-3
Linnaea borealis	V +-4	I +-1	III 2	V +-3
Trientalis europaea	V +-2	IV +-2	V +-2	V +-2
Pyrola rotundifolia	V +-2	II +-1	.	III +-2
Orthilia secunda	III +-1	I +	IV +-2	IV +-2
Vaccinium myrtillus	.	.	I +	III +-3
Goodyera repens	II	.	.	I +
Moneses uniflora	.	.	II +	.
Listera cordata	.	.	I +	.
Hylocomium splendens	V +-4	II +-2	I 2	IV 1-5
Ptilium crista-castrensis	III +-3	.	I +	III +-3
Pleurozium schreberi	IV +-4	II +-1	III +-3	IV 2-4
Dicranum polysetum	II +-2	I +-2	.	I +-2
Peltigera aphthosa	I	I 1	.	II +-1
Peltigera canina	.	.	.	I +
Other species				
Duschekia fruticosa	II +-2	III +-2	IV 2-3	III +-3
Atragene sibirica	V +-2	II +-2	III +-2	II +-2
Stellaria bungeana	IV +-2	III +-2	.	.
Rubus saxatilis	I +-2	I +-2	III 2-2	II +-2
Mnium species	.	.	IV	.
Festuca ovina	II +-2	I +	.	II +-2
Chamaenerion angustifolium	I	II +	II +	II
Filipendula ulmaria	I	II +-4	II 2	.
Tanacetum vulgare	II	I +-1	.	I
Glyceria lithuanica	II	II +-1	.	I
Calliergon cordifolium	.	II +-2	.	.
Urtica sondenii	I	II +-1	.	.
Swida alba	I	II +-2	.	.
Viola epipsiloides	I	II +-1	.	.
Sanionia uncinata	I	II +-1	.	.
Ribes nigrum	.	II 2	.	.
Poa pratensis	I	II +	.	I
Pseudobryum cinclidioides	I	II +-2	.	.

Syntaxon Nr.	**1**	**2**	**3**	**4**
Nunber of releves	**31**	**14**	**6**	**22**
Drepanocladus species	.	.	II ^{2}	.
Rubus idaeus	.	.	II	.
Parnassia palustris	.	.	II	I
Trollius asiaticus	I	.	II	.
Equisetum sylvaticum	.	I $^{+}$	II $^{+}$	I
Juniperus communis	.	.	II $^{+2}$	II $^{+2}$
Festuca rubra	I	.	.	II

Species with occurence I: *Aconitum baicalense* - 1, 2, 4, *Actaea erythrocarpa* - 1, 4, *Alopecurus pratensis* - 1, 2, *Angelica archangelica* - 3, 4, *A. sylvestris* - 1, 2, *Aulacomnium palustre* - 4, *Bromopsis species* - 4, *Bryum species* - 1, *Calamagrostis epigeios* - 1, 2, *C. lapponica* - 4, *C. obtusata* - 1, 4, *Calla palustris* - 3, *Calliergon cordifolium* - 1, 2, *Caltha palustris* - 2, 3, *Cardamine macrophylla* - 1, 2, *C. pratensis* - 1, *Carex acuta* - 4, *C. aquatilis* - 1, *C. brunnescens* - 3, 4, *C. cespitosa* - 1, 2, 3, *C. cinerea* - 1, 4, *C. globularis* - 1, 4, *C. juncella* - 1, *C. lapponica* - 1, 4, *Carex species* - 3, 4, *C. vaginata* - 4, *C. vesicaria* - 2, 3, *Chamaedaphne calyculata* - 4, *Cladonia arbuscula s. mitis* - 1, *C. cenotea* - 1, *C. crispata* - 1, *C. gracilis* - 1, *C. rangiferina* - 1, *C. subfurcata* - 4, *Climacium dendroides* - 1, 2, 3, 4, *Corallorrhiza trifida* - 1, *Crepis paludosa* - 3, *Dicranum fragilifolium* - 4, *D. fuscescens* - 1, 4, *D. species* - 3, 4, *Diphasiastrum complanatum* - 1, 4, *Empetrum hermaphroditum* - 4, *Equisetum pratense* - 1, 4, *Galium palustre* - 2, *Hieracium umbellatum* - 2, 4, *Hypericum linarioides* - 2, *Icmadophila ericetorum* - 4, *Juniperus sibirica* - 1, *Lathyrus palustris* - 2, *Ledum palustre* - 4, *Lophozia ventricosa* - 4, *Luzula pilosa* - 4, *Melampyrum pratense* - 4, *Moehringia lateriflora* - 1, *Myosotis palustris* - 1, - 3, *Orthodicranum flagellare* - 1, *Paris quadrifolia* - 1, *Pedicularis labradorica* - 4, *Petasites frigidus* - 1, *Peucedanum species* - 4, *Phalaroides arundinacea* - 2, *Plagiomnium confertidens* - 1, 2, *P. ellipticum* - 1, *Pleurospermum uralense* - 1, 2, 3, *Poa angustifolia* - 2, *P. palustris* - 1, 2, 4, *P. sibirica* - 2, *Pohlia nutans* - 1, 4, *Polytrichum juniperinum* - 1, 4, *P. strictum* - 1, 3, *Potentilla norvegica* - 1, *Pylaisiella polyantha* - 4, *Ranunculus lapponicus* - 1, 2, 4, *R. species* - 3, *Rubus chamaemorus* - 3, 4, *R. matsumuranus* - 1, 2, 4, *Rumex acetosa* - 2, *R. thyrsiflorus* - 1, *Salix bebbiana* - 1, 2, 4, *S. dasyclados* - 4, *S. hastata* - 1, *S. jenisseensis* - 1, *S. phylicifolia* - 3, *S. phylicifolia* - 2, *S. phylicifolia* - 1, *S. pycnostachya* - 1, *S. species* - 3, 4, *Salix viminalis* - 1, 2, *Sambucus sibirica* - 4, *Sanguisorba officinalis* - 1, 4, *Saussurea alpina* - 1, *Sphagnum angustifolium* - 1, 4, *S. girgensohnii* - 1, 3, 4, *S. species* - 3, *S. squarrosum* - 2, *Spiraea media* - 1, *Stellaria longifolia* - 1, *Stellaria palustris* - 1, *Tanacetum bipinnatum* - 4, *Trisetum sibiricum* - 1, *Urtica dioica* - 3, *Vaccinium uliginosum* - 1, 4, *Viola selkirkii* - 4, *V. uniflora* - 3.

Association *Rubo arctici-Abietetum sibiricae* ass. nova hoc loco (Tabl 1, col. 1-3).

Diagnostic species: *Calamagrostis langsdorffii, Rosa acicularis, Rubus arcticus, Equisetum arvense, Ribes hispidulum, Veronica longifolia*

Nomenclature type (holotypus) of the association is relevé nr. 800 (Neshatayev et al., 2002, table 7.5, col. 13): West Siberia, the Taz river basin, Verhne-Tazovskii State Reserve, river valley, area 400 m^2 , cover tree layer = 55%, shrub layer = 30%, herb layer = 30%, moss layer = 30%. *Pinus sibirica* - 2, *Picea obovata* - 2, *Larix sibirica* - +, *Abies sibirica* - 3, *Betula pendula* - 2, *Sorbus sibirica* - 2, *Padus avium* - 2, *Duschekia fruticosa* - 2, *Ribes hispidulum* - 1, *R. nigrum* - 2, *Lonicera coerulea* - 1, *Rosa acicularis* - 2, *Swida alba* - +, *Calamagrostis langsdorffii* - 2, *Rubus arcticus* - 1, *Equisetum arvense* - 2, *Ranunculus repens* - +, *Veratrum lobelianum* - 2, *Aconitum septentrionalis* - 2, *Thalictrum flavum* - 2, *Pyrola rotundifolia* - 2, *Cacalia hastata* - 1, *Delphinium elatum* - +, *Senecio nemorensis* - 1, *Galium boreale* - 1, *Aconitum volubile* - 1, *Heracleum dissectum* - 1, *Linnaea borealis* - 1, *Trientalis europaea* - 1, *Orthilia secunda* - 1, *Maianthemum bifolium* - 1, *Gymnocarpium jessoense* - +, *Oxalis acetosella* - +, *Stellaria bungeana* - +, *Atragene sibirica* - 2, *Solidago virgaurea* - +, *Glyceria lithuanica* - +, *Viola epipsiloides* - +, *Hylocomium splendens* - 2, *Ptilium crista-castrensis* - 1, *Pleurozium schreberi* - 2, *Rhytidiadelphus triquetrus* - 2, *Plagiomnium ellipticum* - 1.

Communities of this association are spread all over the north boreal subzone of West Siberia. They are encountered on higher terraces of large river valleys where seasonal flooding continues for a very short period or is absent.

The tree layer cover varies from 40 to 70%, height is of 18-20 m. The shrub layer is poorly developed. The herb layer (cover 40-80%) is subdivided into two sub-layers. Tall-forbs (*Aconitum septentrionalis, Cacalia hastata, Calamagrostis langsdorffii, Delphinium elatum, Senecio nemorensis, Thalictrum minus, Thalictrum flavum, Heracleum dissectum, Veratrum lobelianum*) dominate in the higher sub-layer with low herbs and dwarf-shrubs (*Rubus arcticus, Equisetum arvense, Maianthemum bifolium, Vaccinium vitis-idaea, Linnaea borealis, Orthilia secunda*) dwarf-shrubs forming the lower one. Moss layer varies in cover from 15 to 90% and is dominated by *Pleurozium schreberi, Hylocomium splendens, Rhytidiadelphus triquetrus, Ptilium crista-castrensis*.

Variant *typicum* (Table 1, col. 1) occurs in well-drained river valleys of more elevated north-eastern part of the West Siberian Plain.

Variant *Betula pubescens* (Table 1, col. 2) includes dark-coniferous-birch mixed and birch (with participation of conifers) forests occupying the ecologically transitional sites between flood-plains dominated by willow communities and higher terraces with forests of the previous variant.

Variant *Viola palustris* (Table 1, col. 3) represents a

geographical type of forests occurring on the higher slopes of small river valleys in the central (the lowest) part of the West Siberian Plain. Grass layer is characterized by essential reduction of tall-forb species and increasing roles of some hygrophilous plants (*Viola palustris, Comarum palustre, Polytrichum commune*) indicating approximation of subsoil waters.

The alliance *Pino sibiricae-Abietion sibiricae* all. prov. (Table 1, col. 4) represents the most cold-resistant ecological type of north boreal dark-coniferous (with participation of larch) forests in Siberia. They differ from other middle- and south boreal communities of the *Piceetalia excelsae* by the poorest species compositions, absolute predominance of a few widespread boreal dwarf-shrubs, herbs, bryophytes, and by the absence of any own characteristic taxa.

Association *Pino sibiricae-Abietetum sibiricae* ass. nova hoc loco (Table 1, col. 4).
Diagnostic species: *Rosa acicularis, Calamagrostis langsdorffii, Rubus arcticus, Polytrichum commune*.
Nomenclature type of the association (holotypus) is relevé nr. 848 (Neshatayev et al., 2002, table 7.7, col. 18): West Siberia, the Taz river basin, Verhne-Tazovskii State Reserve, river valley, area 400 m^2 , cover tree layer = 75%, shrub layer = 3%, herb layer = 30%, moss layer = 75%. *Pinus sibirica* - 2, *Picea obovata* - 2, *Larix sibirica* - 2, *Abies sibirica* - 1, *Betula pendula* - 3, *Salix bebbiana* - 1, *Rosa acicularis* - 1, *Sorbus sibirica* - +, *Lycopodium annotinum* - 2, *Vaccinium vitis-idaea* - 2, *Linnaea borealis* - 2, *Pyrola rotundifolia* - 1, *Orthilia secunda* - 1, *Vaccinium uliginosum* - 1, *Trientalis europaea* - +, *Maianthemum bifolium* - 1, *Calamagrostis obtusata* - 1, *Chamaenerion angustifolium* - r, *Equisetum pratense* - +, *Aconitum baicalense* - 2, *Rubus arcticus* - +, *Equisetum arvense* - +, *Pedicularis labradorica* - +, *Hylocomium splendens* - 3, *Ptilium crista-castrensis* - 1, *Pleurozium schreberi* - 3, *Dicranum polysetum* - +, *D. fuscescens* - +, *D. fragilifolium* - +, *Peltigera aphthosa* - +, *Polytrichum commune* - 2, *P. juniperinum* - +, *Pohlia nutans* - +, *Lophozia ventricosa* - +, *Cladonia subfurcata* - +.
Forests of this association occur all over the north boreal subzone of West Siberia. They occupy margins of the highest terraces adjacent to watersheds. These habitats are under a weak influenced of warmer river valleys micro-climate, and they are also characterized by poorly drained soils.
Mixed tree layer (*Picea obovata, Pinus sibirica, Abies sibirica, Larix sibirica* and *Betula pendula*) has lower values of cover (30-50%) and height (17-19 m). The shrub layer is poorly-developed with a cover of 1-5%. Dwarf-shrub-herb layer shows cover values of 10-30%. It is dominated by *Vaccinium vitis-idaea, Linnaea borealis* and sometimes *Vaccinium myrtillus*. A few moderately thermophilous herb species (*Maianthemum bifolium, Lycopodium annotinum, Gymnocarpium dryopteris*) indicate relation of this association to the order *Piceetalia excelsae*. The moss layer is dominated by typical boreal mosses (*Pleurozium schreberi*, *Hylocomium splendens*, *Ptilium crista-castrensis,* and *Polytrichum commune*).

DISCUSSION

Extrazonal north boreal dark-coniferous forests occurring near sub-Arctic zone of Northern Asia represent a unique ecological and phytosociological vegetation type. Cold and continental climate results in poor floristic compositions of the communities and in poorness of diagnostic species groups of the higher units. That is why the placement of these forests within the *Vaccinio-Piceetea* class systems is still debated. Analogous north boreal dark-coniferous forests of Northern Europe (associations *Chamaemoro-Piceetum abietis* K-Lund 1962 and *Eu-Piceetum abietis* (Cajander, 1921) K-Lund 1962) were included into the order *Piceetalia excelsae* and alliance *Piceion excelsae* Pawłowski et al., 1928 (Kielland-Lund, 1981; 1994; Dierssen, 1996). However the north boreal European forests contain more thermophilous boreal species widespread both in Scandinavia and Central Europe (such as *Picea abies, Dryopteris assimilis, Anemone nemorosa, Deschampsia flexuosa, Dactylorhiza maculata, Agrostis tenuis, Veronica officinalis, Fragaria vesca*) due to oceanic climate influence. West Siberian communities occurring in regions with cold continental climate and long frozen soils are characterized by the lowest values of constancy or absence of such moderately thermophilous *Piceetalia excelsae* species as *Diplazium sibiricum*, *Phegopteris connectilis, Dryopteris carthusiana, Dryopteris expansa, Athyrium filix-femina, Cinna latifolia, Circaea alpina, Oxalis acetosella.* Nevertheless, their affiliation with the *Piceetalia excelsae* is beyond doubt due to the presence of several more cold-tolerant diagnostic species of this order (*Sorbus sibirica, Padus avium, Maianthemum bifolium, Rhytidiadelphus triquetrus*). These species accompany only dark-coniferous forests in the exrtazonal sites of the north boreal sub-zone. They make it possible to distinguish between the *Piceetalia excelsae* dark-coniferous communities and West Siberian zonal light coniferous (*Larix sibirica*) north boreal forests of the order *Ledo-Laricetalia cajanderi* originally described for Eastern Siberia (Ermakov et al., 2002; Krestov et al., 2009).
The syntaxonomic positions of two described associations in the alliances are different. However, it is clear that none of these associations could be included into the European alliance *Piceion excelsae* due to the absence of diagnostic species in this alliance and the presence of other essential distinctions in floristic compositions (first of all it concerns the tree layer dominants). Moderately thermophilous

association *Rubo arctici-Abietetum sibiricae* was included in the alliance *Aconito rubicundi-Abietion sibiricae* (described by Anenkhonov and Chytry (1998) from South-Eastern Siberia because of participation of tall-borb species, such as *Aconitum septentrionalis, Cacalia hastata, Delphinium elatum, Veratrum lobelianum, Senecio nemorensis, Thalictrum flavum, Aconitum volubile, Heracleum dissectum, Cirsium heterophyllum, Crepis sibirica* forming the diagnostic species core of this alliance. This diagnostic species group is of great importance when indicating peculiarities in the special ecological type of Siberian boreal forests occurring in regions with the humid moderat continental climate.

The most cryophytic association *Pino sibiricae-Abietetum sibiricae* does not contain diagnostic species of any existing alliances. In fact, this scarse in species composition community is the "ecological and geographical periphery" of dark-coniferous forests occurring near the sub-Arctic zone of Northern Asia. In the current paper, it is preliminarily placed into the provisional alliance *Pino sibiricae-Abietion sibiricae* all. nova prov. Similar poor in species communities are widespread in the Southern Siberian mountains where they occur at the upper boundary of the forest belt. The main peculiarity of this alliance is the absence of any characteristic species. All plant species are characterized by wide geographical ranges and broad ecological amplitudes. That is why the diagnostic species of the *Pino sibiricae-Abietion sibiricae* are the same with those of the order *Piceetalia excelsae*. Moreover the combination of North Asian tree species *Picea obovata, Pinus sibirica, Abies sibirica, Larix sibirica* can be used as a special diagnostic feature indicating geographical (Siberian) distribution of the alliance. Additional introduction of geographically wider data set should be done to develop this alliance concept.

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