

BIODIVERSITY RESEARCH BASED ON LOCAL FLORA APPROACH IN RUSSIAN ARCTIC

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“Concrete flora” (A.I.Tolmatchev 1931) = a minimal floristic unit really existing in nature which is natural and comparable. “Concrete or elementary flora (CF) is homogenous enough, differentiated only ecologically flora of a limited part of the Earth surface”.

Criteria of homogeneity = constancy of species composition in similar habitats throughout the area of the CF.

Criteria of elementarity = absence of any floristic boundaries within the area under investigation.

Species richness of CF depends on the characteristic for the area set of habitats and historical factors.

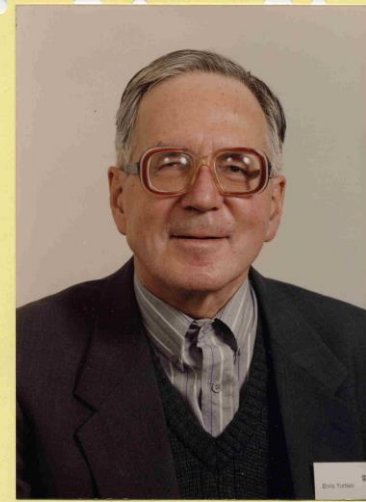
The size of the area should be big enough to reveal all possible habitat types and can vary in different geographic zones (Tolmatchev,1974; Schmidt, 1972; Yurtsev, 1975).

For the Arctic it is equal ca 100 km² (Tolmatchev, 1970; Yurtsev, 1975) in lowland parts and ca. 300 km² – in mountainous parts, in taiga it is an area of ca 600 km².

LOCAL FLORA (LF) VS CONCRETE FLORA (CF)

Tolmachev distinguished between concrete (or elementary) flora and the area selected for the revealing of it: area-minimum of CF.

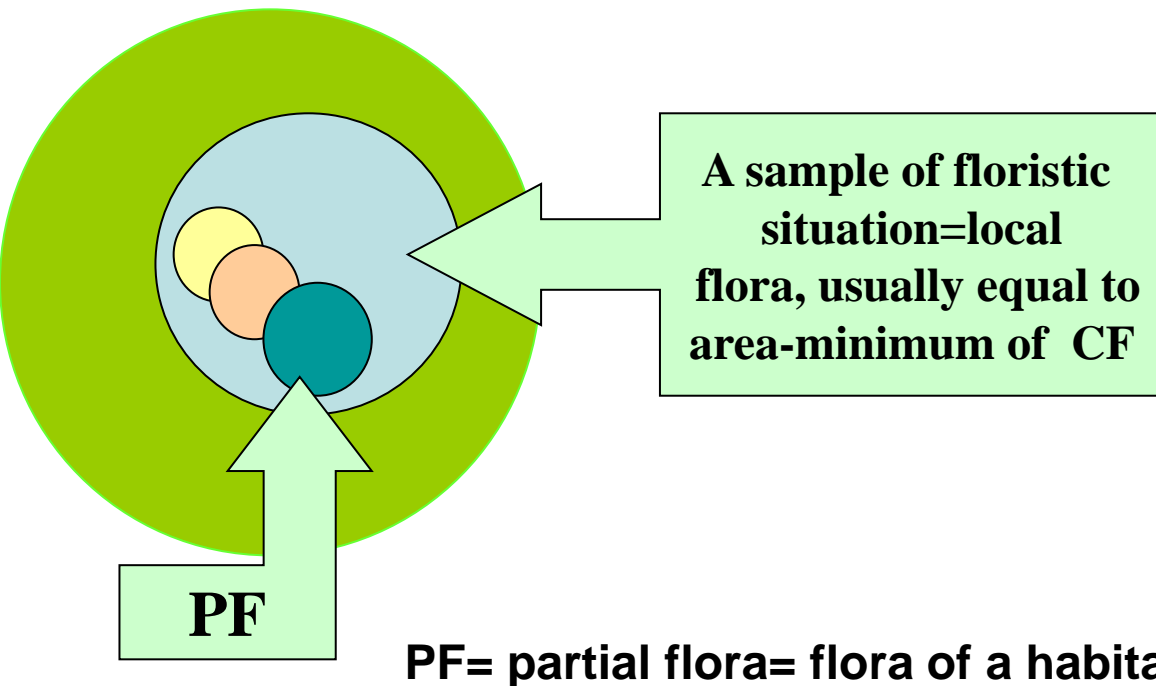
Yurtsev: in the field we perform a selective floristic sampling of some locality = “sample of floristic situation in a geographic point” = “flora of vicinity of a geographic point” = “local flora” (LF).



In practice, to study of CF/LF = to examine the area around base camp by radial routes about 6-7 km long during 2-3 weeks.

We compile species lists for all habitats existing in the area.

Information of species

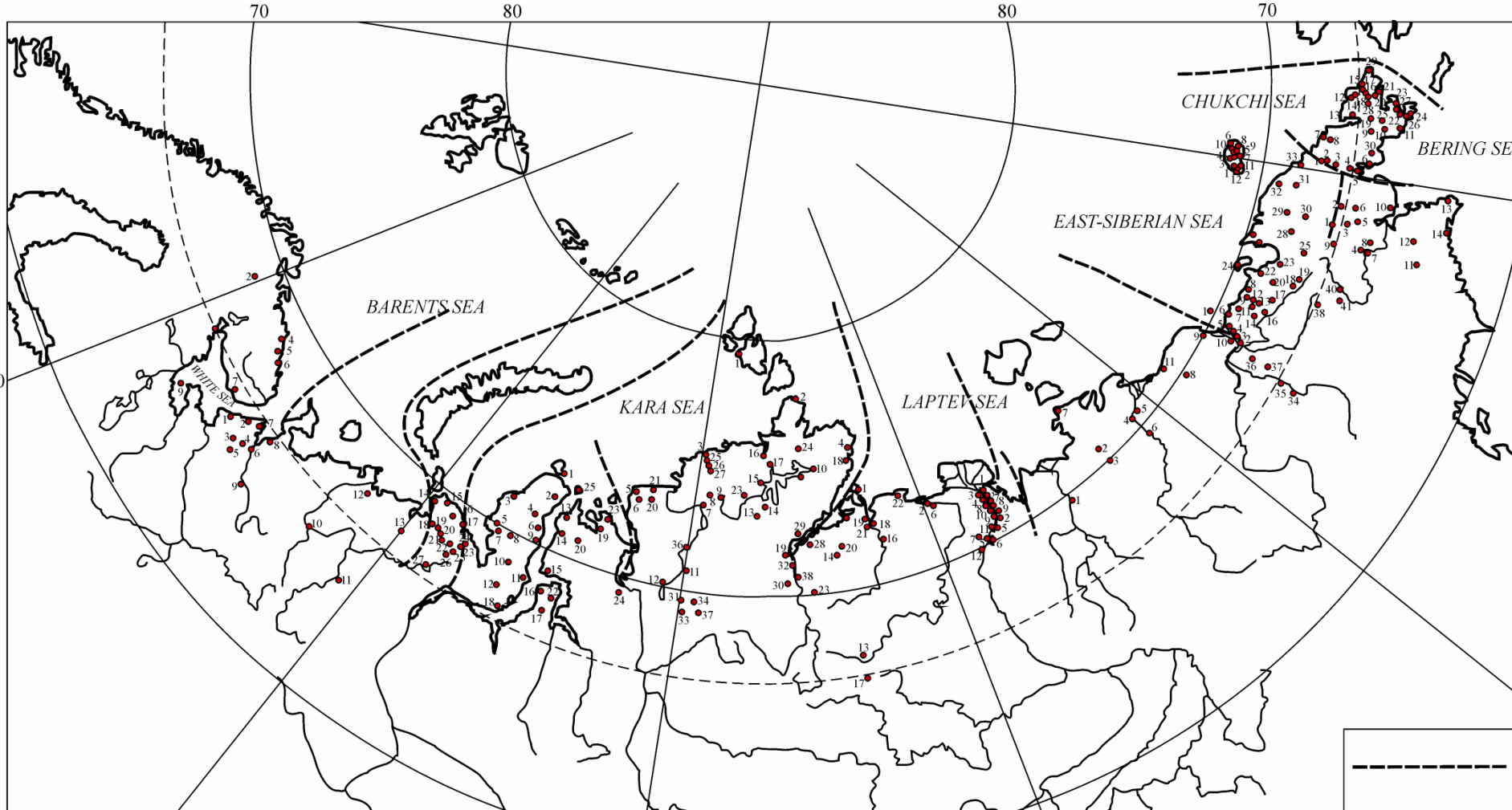


Landscape activeness (Yurtsev 1968, 1987, 1989, etc.) is estimated on the base of 3 characters: 1) species ecological amplitude; 2) abundance; 3) constancy in its habitats; 4) how common are the habitats where species exist in the area.

	Ecological amplitude									
Abundance	Euritopic		Hemi-euritopic		Hemi-stenotopic		Stenotopic			
							Common habitats		Rare habitats	
	Always	Sporadic	Always	Sporadic	Always	Sporadic	Constant	Non-constant	Constant	Non-constant
Copiosus	V	V	IV	IV	III	II	III	II	II	I
Sparsus	IV	IV	III	III	III	II	III	I	I	I
Solitarius	III	II	II	II	II	I	II	I	I	I

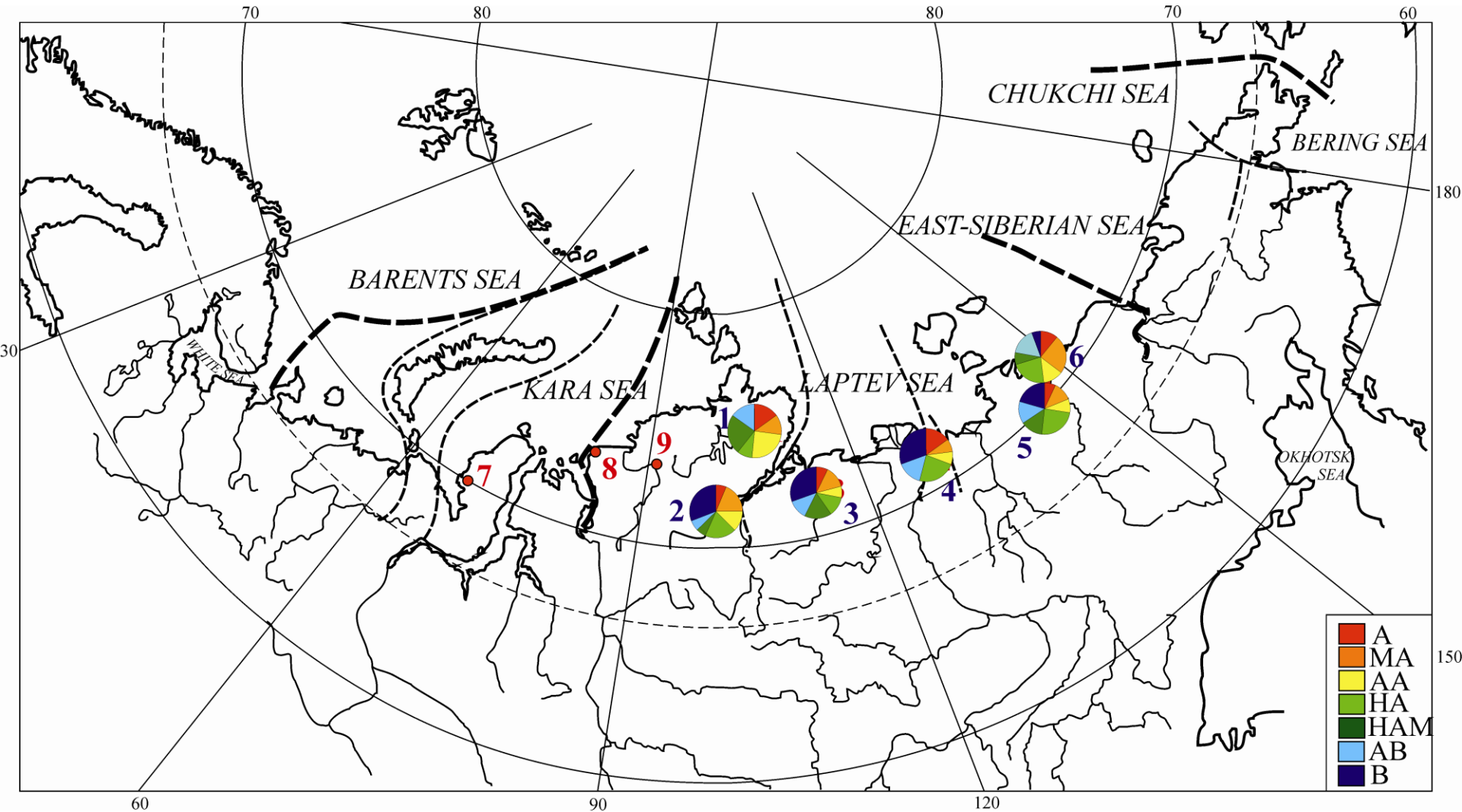
I– non active, II– low active, III- medium active, IV- high active, V–superactive

The distribution of local floras included into the network of biodiversity monitoring sites in Russian Arctic,



Representative for the sector (subprovince, subzone) ; Specific, unique features of this particular landscape, presence of rare species, endemics; Situated at boundaries of subzones, phytochoria (ecotone position); flora should be revealed completely enough; information about distribution of each species, its activeness

Only few local floras were re-inventoried by now, results of re-inventory are not uniform. For several sites – no changes, for several – increase in boreal and hypoarctic species was noted



Study of local floras allow to get new information about distribution of species and to reconstruct the history of migrations. Species which were formerly considered as narrow endemics were found in local floras remote from known previously sites.

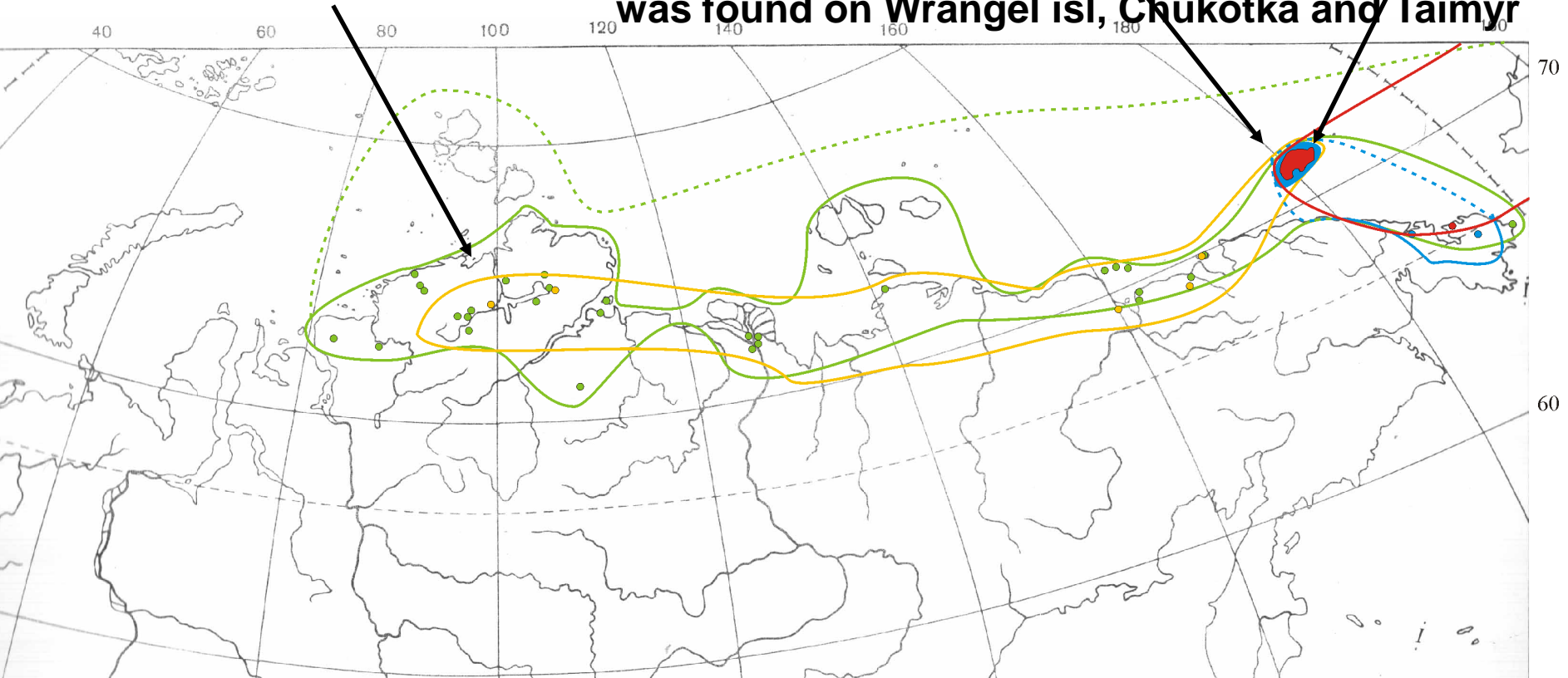
Draba oblongata
(*D. groenlandica*)

Was considered endemic of Greenland and Canadian Arctic archipelago

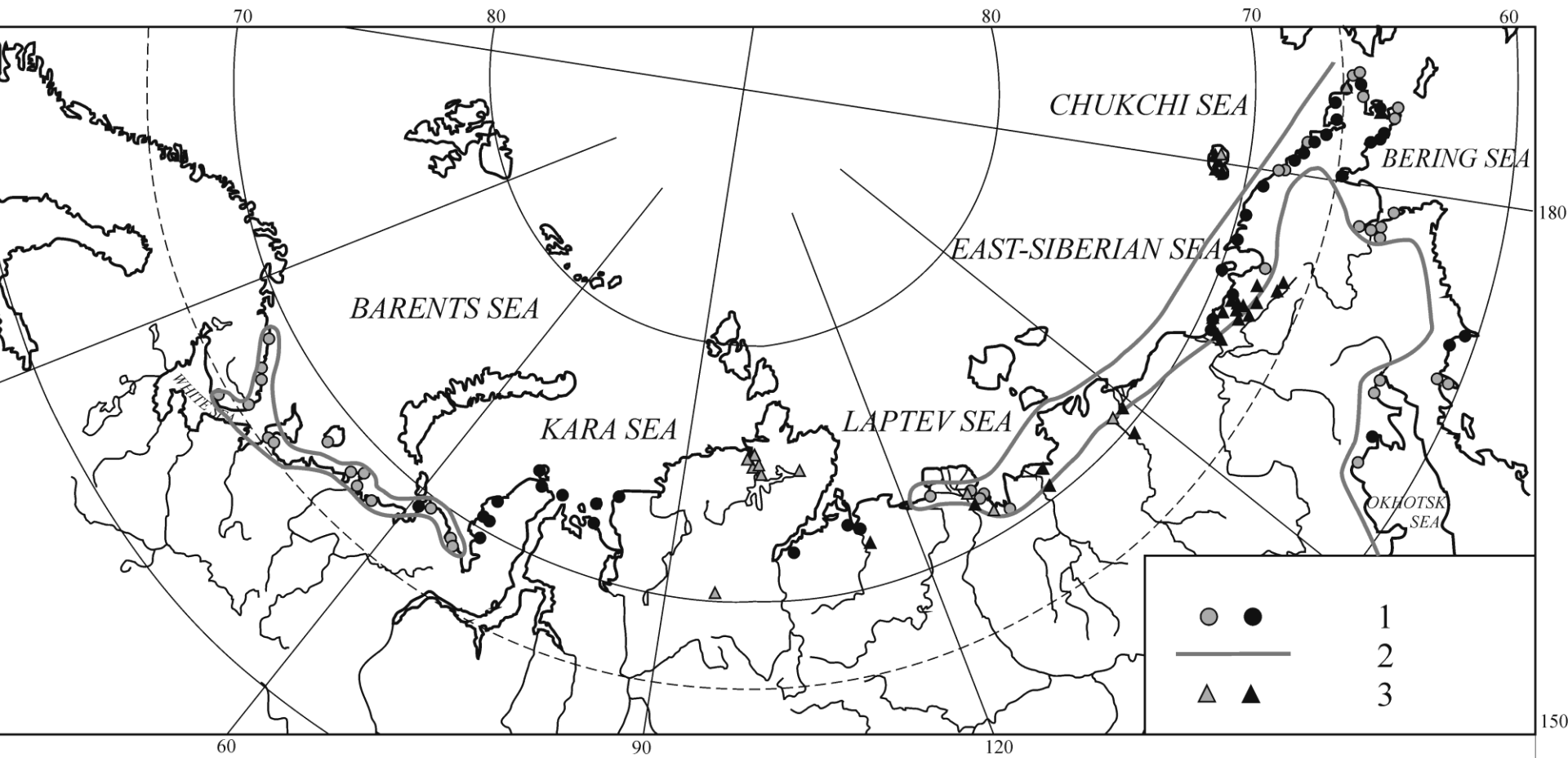
Oxytropis wrangelii и *Puccinellia colpodioides*
Was considered as endemic of Wrangel Island

Gastrolychnis ostenfeldii

Was considered as endemic of NW Canada, but was found on Wrangel Isl, Chukotka and Taimyr



***Calamagrostis deschampsioides* (1) was mainly found along the coast of the European part of Arctic and along Chukotka coast, now it is not yet found only in Taimyr. *Roegneria villosa* (3) was considered as rare species with isolated populations in East Siberian Arctic, now we can confirm that its range is from Taimyr to Beringian coast**



Grey icons – locations shown in the 'Arctic Flora of USSR', black – later findings in local fl

Scheme of floristic regionalization of the Arctic (Yurtsev et al.1978, shorten English version Yurtsev 1994), since that - many new findings, revision of herbarium from studied earlier local floras.

Species	Former status	Present status
Castilleja arctica	Yamal-Gydan subprovince, rare endemic, differential	Common in YA-G, found in Taimyr and Anabar
Lychnis sibirica	Yamal-Gydan eastern co-differential	Found in Kanin-Pechora
Draba pohlei	Endemic of ast Siberian province	Found in Ural-Nov. Zemlya subpr., co-dif
Carex trautvetteriana, C.williamsii	Differential for Kharaulakh	Found in Taimyr and Anabar-Olenek



Taraxacum semitubulosum, differential for Kharaulah, endem, now found in Anabar-Olenek.

Papaver gorodkovii, was differential for Chukchi province, found in Taimyr



Гербарий Государственного биосферного заповедника "Таймырский"
 96-12 Центральный Таймыр, передовой хребет гор Бырранга, бассейн оз. Левинсон-Лессинга, 74 30' с.ш., 98 30' в.д.
Oxytropis putoranica M. Ivanova
 Место сбора: Известняковое плато слабоздернованное
 Дата: 23.07.96 Точка сбора: (decimal degrees Pulkovo+2) 74.5379 с.ш., 98.6749 в.д.
 Col.: Е.Б. Поспелова Det.: Е.Б. Поспелова



Artemisia lagopus ssp. abbreviata
 Co-dif Kharaulakh and Anabar-Olenek

Oxytropis putoranica – endemic of Taimyr

East Siberian Province

Taimyr subprovince

Puccinellia byrrangensis,
Puccinellia gorodkovii,
Puccinellia jennissejensis,
Roegneria lenensis,
Cerastium regelii subsp.
caespitosum,
Draba taymyrensis
Oxytropis putoranica
Cortusa matthioli subsp. *altaica*
Dracocephalum nutans
Castilleja tenella
Claytonia joanneana
Ptarmica impatiens
Taraxacum platylepium

Anabaro-Olenek subprovince

Arctopoa trautvetteri
Helictotrichon schellianum
Taraxacum semitubulosum
Potentilla lenensis
Artemisia lagopus subsp.
triniana
Artemisia lagopus ssp. *abbreviata*
Caragana jubata

Kharaulakh subprovince

Saxifraga lactea
Spirea dahurica
Oxytropis sordida subsp.
arctolenensis
Taraxacum semitubulosum
Potentilla lenensis
Artemisia lagopus ssp. *abbreviata*
Caragana jubata

Both Taimyr and Anabaro-Olenek

Deschampsia vodopjanoviae, *Festuca jacutica*, *Trisetokoeleria taimyrica*
Juncus longirostis, *Oxytropis czekanowskii*, *Oxytropis tichomirovii*
Taraxacum byrrangica, *Taraxacum taimyrense*

Yana-Kolyma subprovince

Arctopoa petrovskyi
Elytrigia villosa
Gorodkovia jacutica
Astragalus penduliflorus
Oxytropis middendorffii
subsp. jarovoi
Papaver stubendorffii
Androsace gorodkovii
Artemisia gmelinii
subsp. scheludjakoviae (-)
Artemisia lagopus
subsp. jarovoi
Taraxacum jacuticum (-)
Artemisia jacutica (-)

Continental Chukotka

Roegneria nepliana
Suaeda arctica
Carex sordida = *C. hirta*
Hedinia czukotica
Chrysosplenium alternifolium
subsp. arctomontanum
Potentilla anjuica
Oxytropis middendorffii
subsp. coerulescens
Oxytropis schmorgunovii
Oxytropis sverdrupii
Plantago canescens
subsp. jurtzevii
Artemisia flava
Taraxacum anadyricum
Taraxacum chaunense
Taraxacum leucocarpum

Both in Yana-Kolyma and Continental Chukotka

Festuca kolymensis, *Oxytropis ochotensis*, *Oxytropis vasskovskyi*,
Veronica incana

Beringian Chukotka

Botrychium pinnatum

Puccinellia beringensis

Puccinellia czukczorum

Rumex beringensis

Rumex krausei

Claytonia sarmentosa

Aconitum delphinifolium

subsp paradoxum

Anemone parviflora (-)

Papaver walpolei (-)

Aphragmus escholtzianus (-)

Arabidopsis tschuktschorum

Potentilla beringensis

Potentilla czegetunica

Oxytropis berengensis

Dodecatheon frigidum

Artemisia senjavinensis



Dodecatheon frigidum

Variables studied with Russian Arctic local floras database

- **number of: species(=sp. richness), genera, families in local and regional floras;**
- **mean± SE, min, max number of sp., gen., fam. for local floras of the region**
- **percent portion of species richness of a certain local flora to species richness of respective regional flora**
- **mean; min; max number of species in: family,genus; number of genera in family**
- **number and portion of single species genera and families**
- **number and portion of differential species and genera**
- **number of species in 5 and 10 richest families and their portion in the flora**
- **ratio *Asteraceae/Poaceae*; *Cyperaceae/Poaceae***
- **composition of the richest and poorest families**
- **ratio of different divisions of vascular plants**
- **presence, number and portion of rare species (occur in 1-2 local floras)**
- **number and portion of species with 100% occurrence in local floras of a subprovince**
- **similarity of local floras by species composition (Sørensen similarity index)**
- **index of complexity of the taxonomic structure (Shmidt,1984)**
- **index of autonomy (autochtonity-allochtonity) (Malyshev, 1976)**
- **portion of woody plants species**
- **presence and composition of trees**
- **number and ratio of longitudinal and latitudinal groups and fractions**
- **similarity of local floras by geographical structure**



Typical landscape in Yamal-Gydan sector

Mean species richness of local floras in Chukotka subprovinces varies between 273 to 346. In Yamal it is 164, in Taymyr – 172.

The relatively high species richness of East-Asian floras is caused by the relief diversity, the floras history and close proximity of the region to the ancient speciation centers – Angarida and Beringia

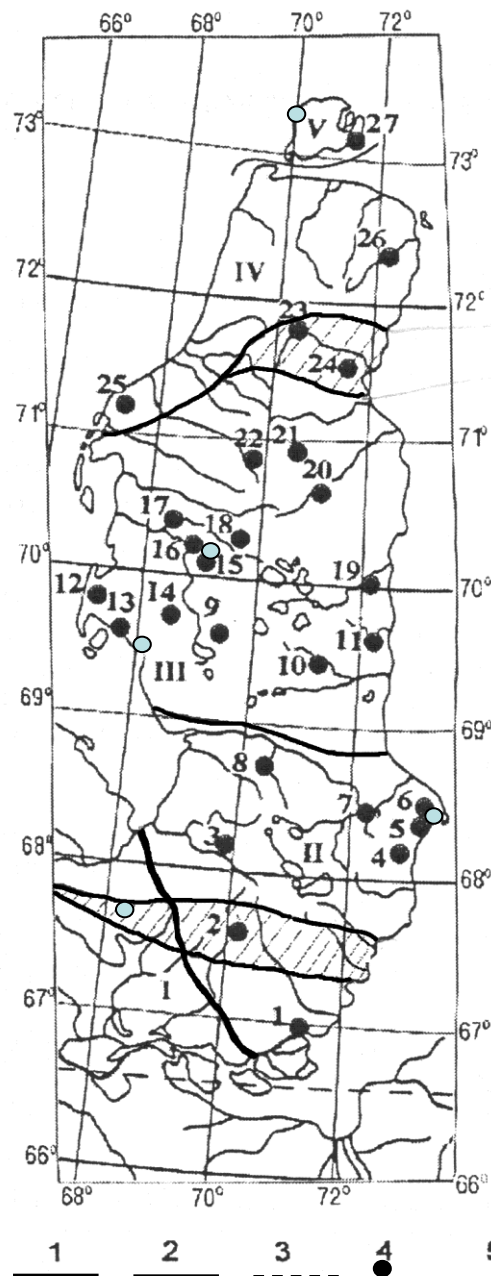


Typical landscape in Chukotka sector

YAT study sites

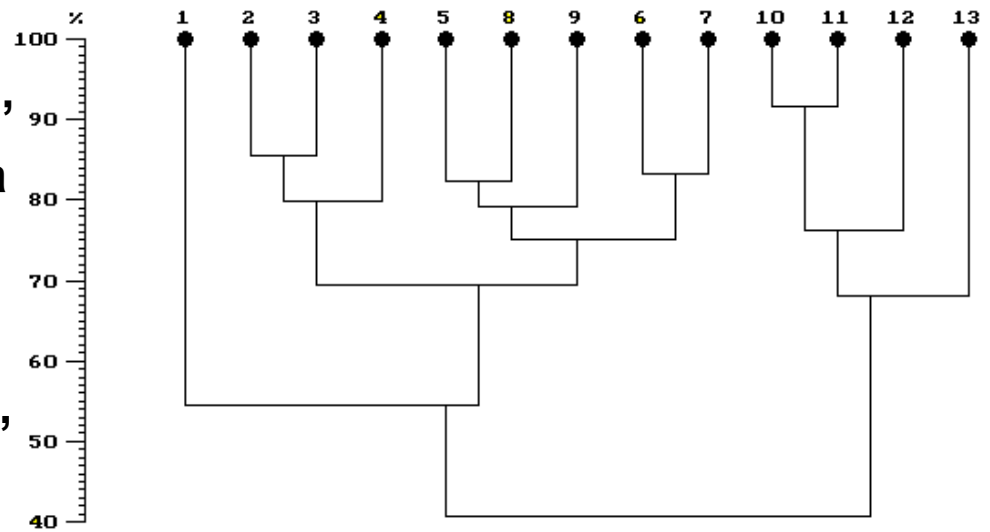


Local flora study sites (1970-2012)

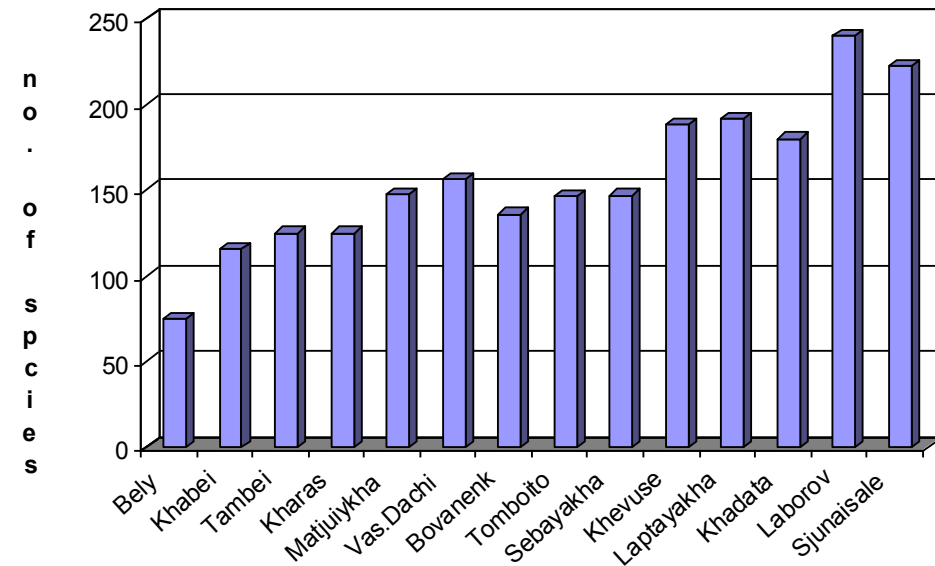


1—southern boundary of Yamal peninsula полуострова; 2—northern boundaries of geobotanical subzones (I – forest-tundra; II – southern hypoarctic tundra; III – northern hypoarctic tundra; IV – arctic tundra); 3 – Polar circle; 4 – local flora study sites studied by **Olga Rebristaya** alone or together with **Olga Khitun**: 1- Сюнайсале (Сю), 2 – Хадыта (Хд), 3 – Харангынето (Хр), 4 – Еръяха (Ер), 5 – Лаптаяха (Ла), 6 – Хевесе (Хе), 7 – Юрибей (Юр), 8 – Хутыяха (Ху), 9 – Себаяха (Се), 10 – Ляккатосе (Ля), 11 – Юрибейтояха (Ют), 12 – Марресале (Мр), 13 – Хаяхаяха (Хх), 14 – Салетаяха (Са), 15 – Неромаяха (Не), 16 – Нгранато (Нг), 17 – Бованенково (Бо), 18 – Томбойтояха (Тм), 19 – Мантыто (Мн), 20 – Вэнуейуо (Вэ), 21 – Матюйяха (Ма), 22 – Тиутей (Ти), 23 – Верхний Тамбей (ВТ), 24 – Тирваяха (Тр), 25 – Харасавэй (Хс), 26 – Хабейяха (Хб), 27 – Белый (Б). Without number sites studied by Olga Khitun only (blue circles): 144 km, Mus Kamennui, Yara-yakha, Bovanenkovo, Bely-west

Clear dependence between zonal position and floristic diversity is exhibited in the region as well. Floras' diversity decreases gradually from ca 240 species at "Laborovaya" (E), 156 – at "Vaskiny Dachi" (D), 125 – at "Kharasavei" (C) and 65-75 at "Bely" (B). Variation in species richness and, partly, in composition and coverage depends also on local relief, soil and drainage conditions.

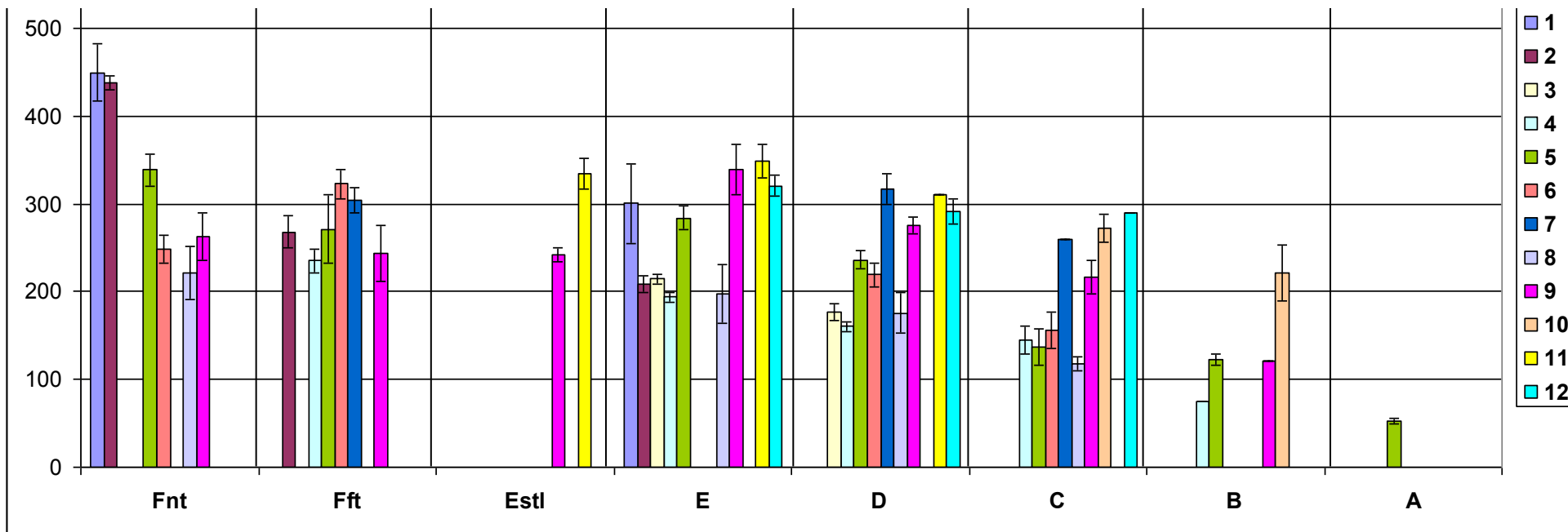


Species richness of Yamal local floras



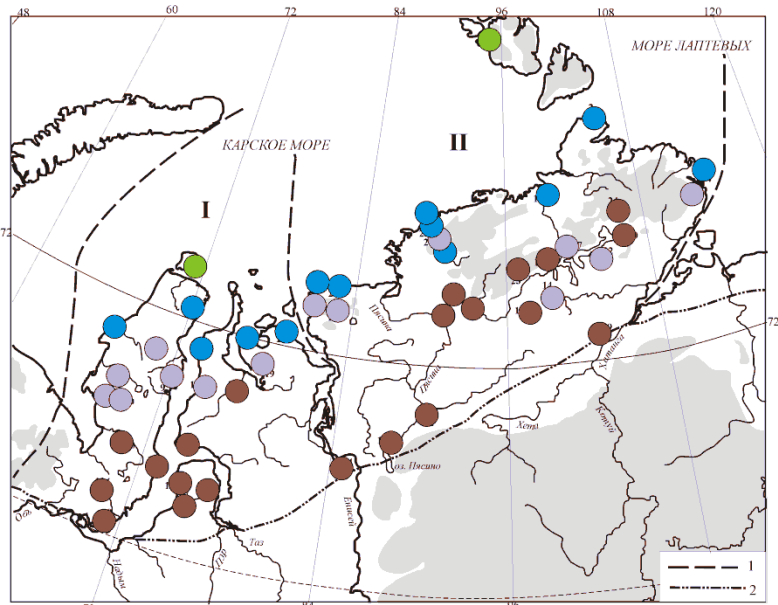
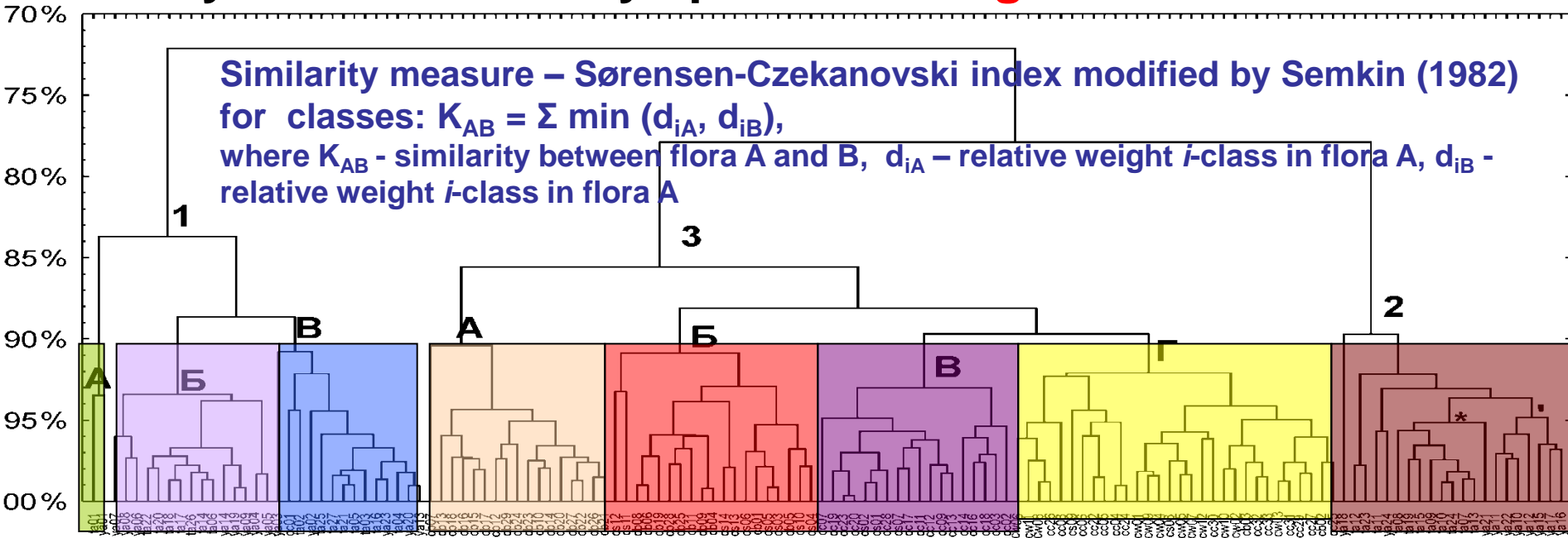
Local floras from different subzones group in clusters according to their zonal position. 1 - LF "Ostrov Bely", northern variant of arctic tundra; 2 and 3 – LF "Khabeiyakha" and "Tambei", 4 – LF "Kharasavei" – southern variant of arctic tundra. (Low level of connection of "O. Bely" explains by big difference in species richness with other floras). 5– 9 LF from northern hypoarctic tundra subzone: "Matuiyakha", "Vaskiny Dachi", "Bovanenkovo", "Tomboito", "Sebasyakha", 10-12 – LF from southern hypoarctic tundra: "Khevese" Laptayakha, Khadyta; 13- LF "Sjunaisale" from northern forest-tundra

Average number of species (+/- SE) in local floras in different subprovinces and in different subzones



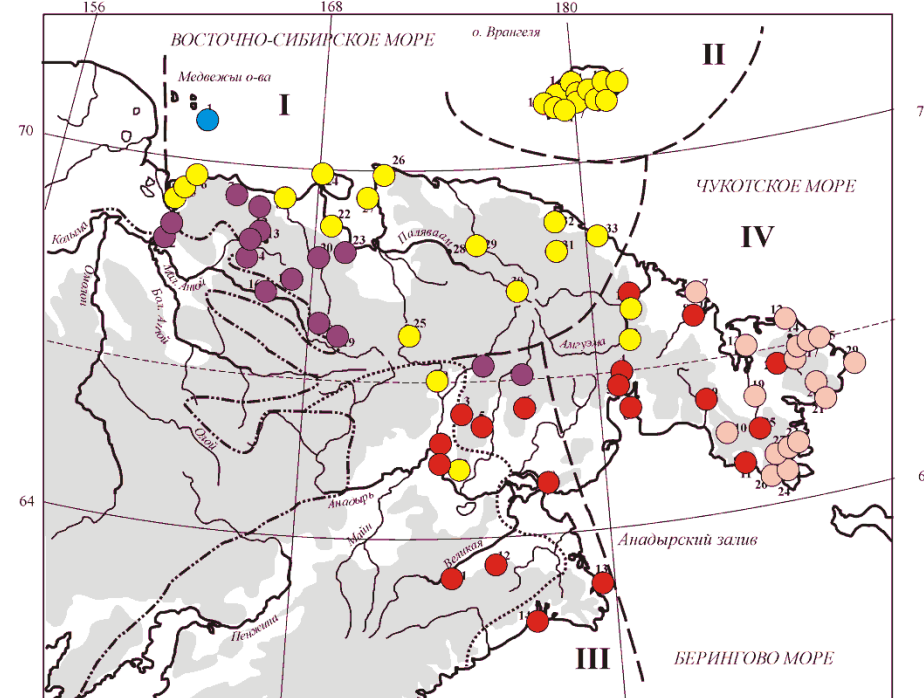
1= Kola-Karelia (KK); 2= Kanin-Pechora (KP); 3= Ural-Novaya Zemlya (UN);
 4= Yamal-Gydan (YG); 5= Taimyr (T); 6= Anabar-Olenek (AO); 7=
 Kharaulakh (K); 8=Yana-Kolyma (YK); 9 = Continental Chukotka (CC); 10=
 Chukotka, Wrangel Island (CW); 11= Southern Chukotka (CS); 12=
 Beringian Chukotka (CB)

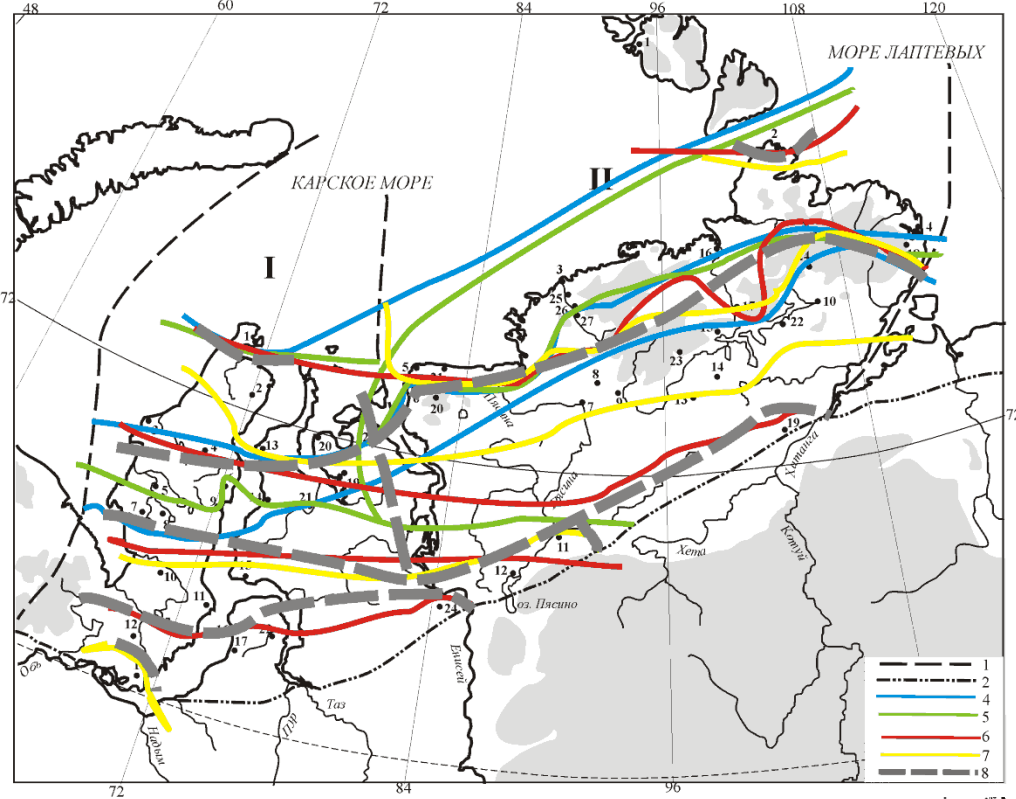
Similarity of local floras by spectra of longitudinal fractions



Clusters:

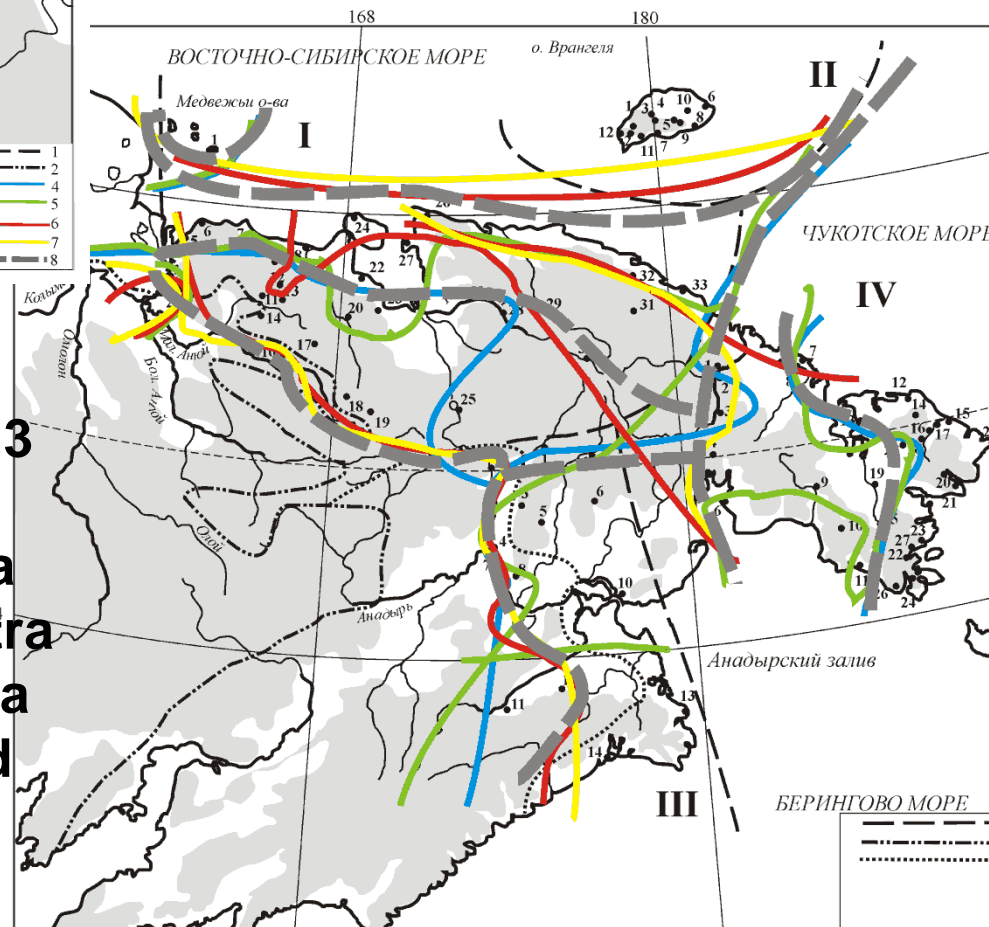
- 1A
- 1Б
- 1B
- 2
- 3A
- 3Б
- 3В
- 3Г



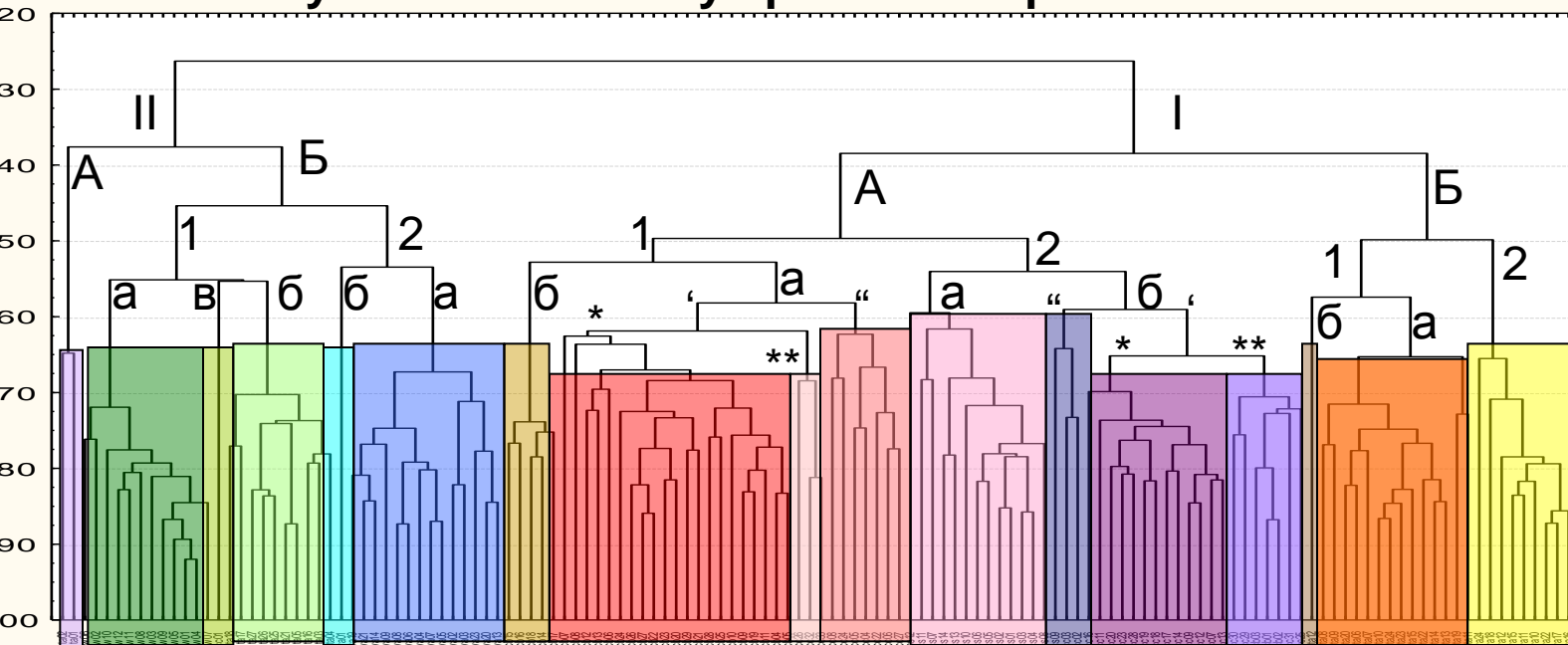


All boundaries by similarity of geographic structure spectra and areas of density of ranges of geographic groups and fractions in different sectors of the Arctic

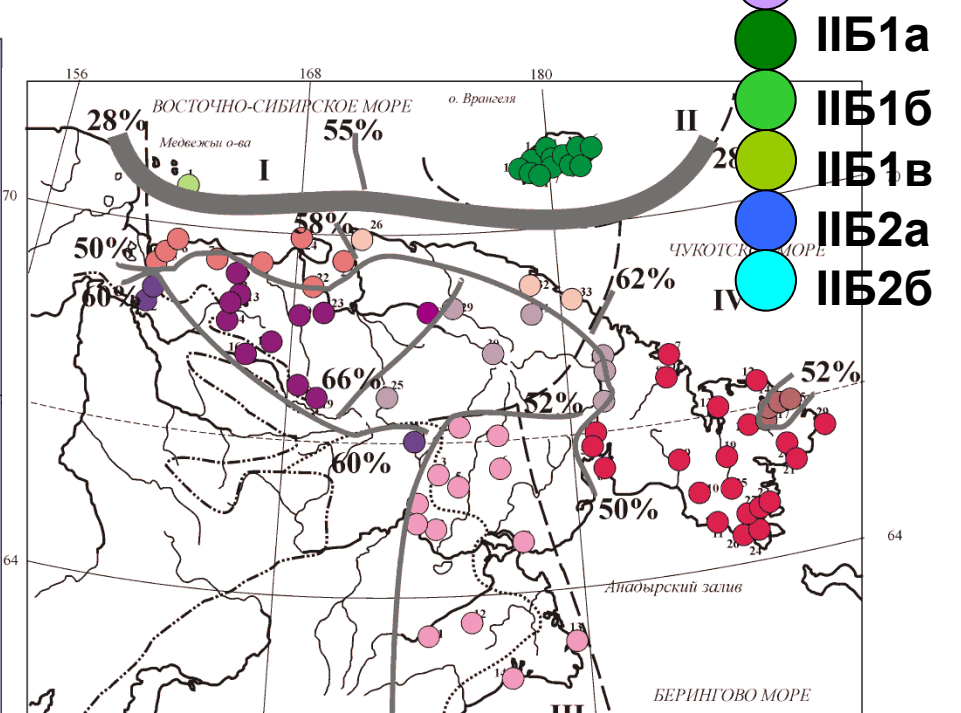
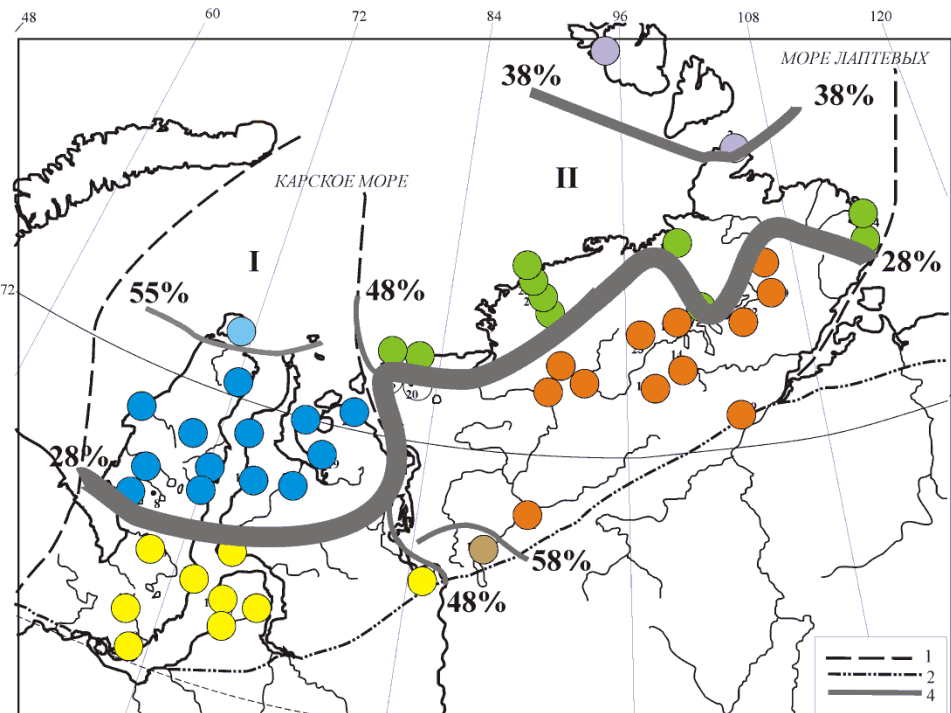
Boundaries : 1- floristic subprovinces, 2 – open woodlands, 3 – stlanic subzone, 4 – by spectra of longitudinal fractions, 5 – by spectra of longitudinal groups, 6 – by spectra of latitudinal fractions, 7 – by spectra of latitudinal groups, 8 – generalized by density of all boundaries in distribution of groups and fractions

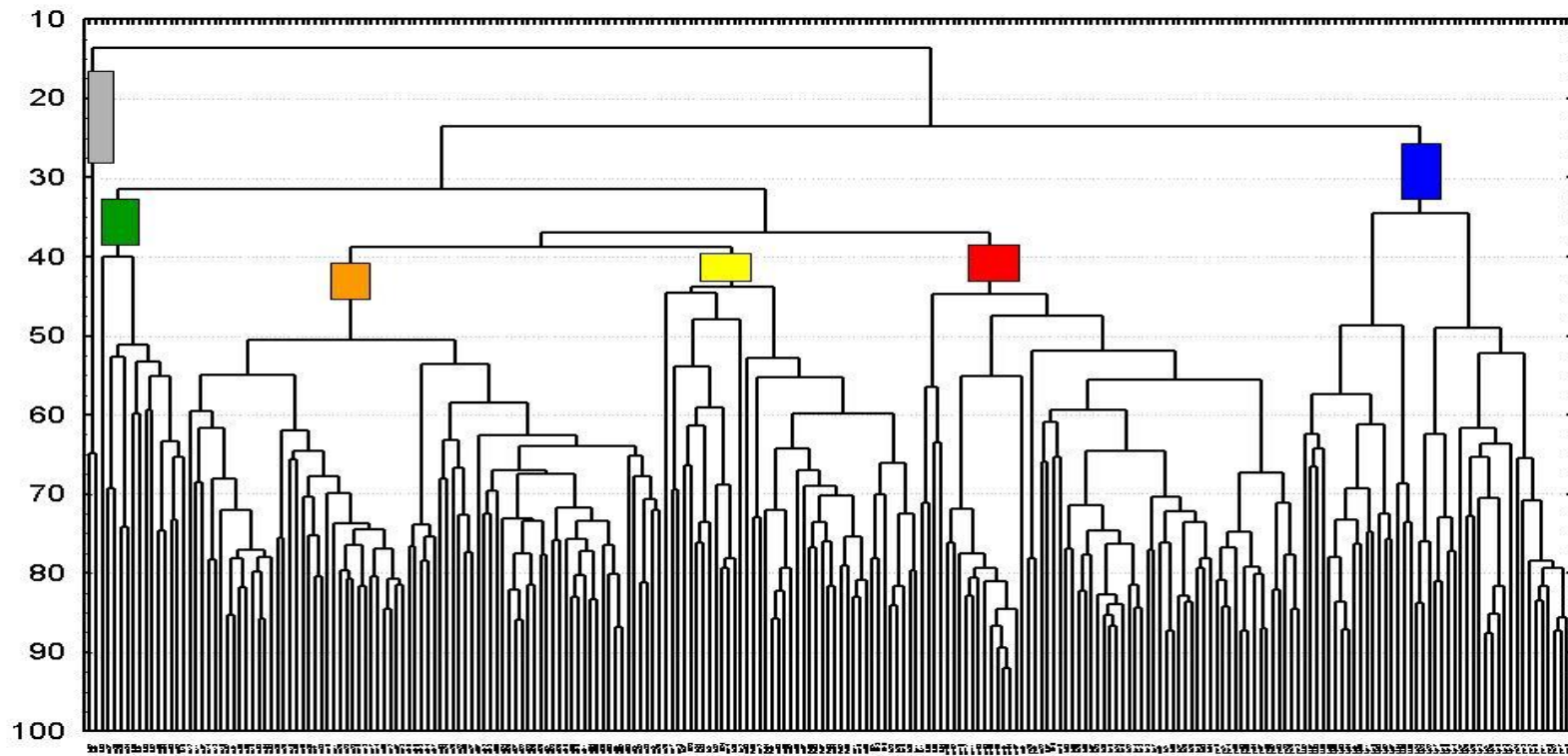
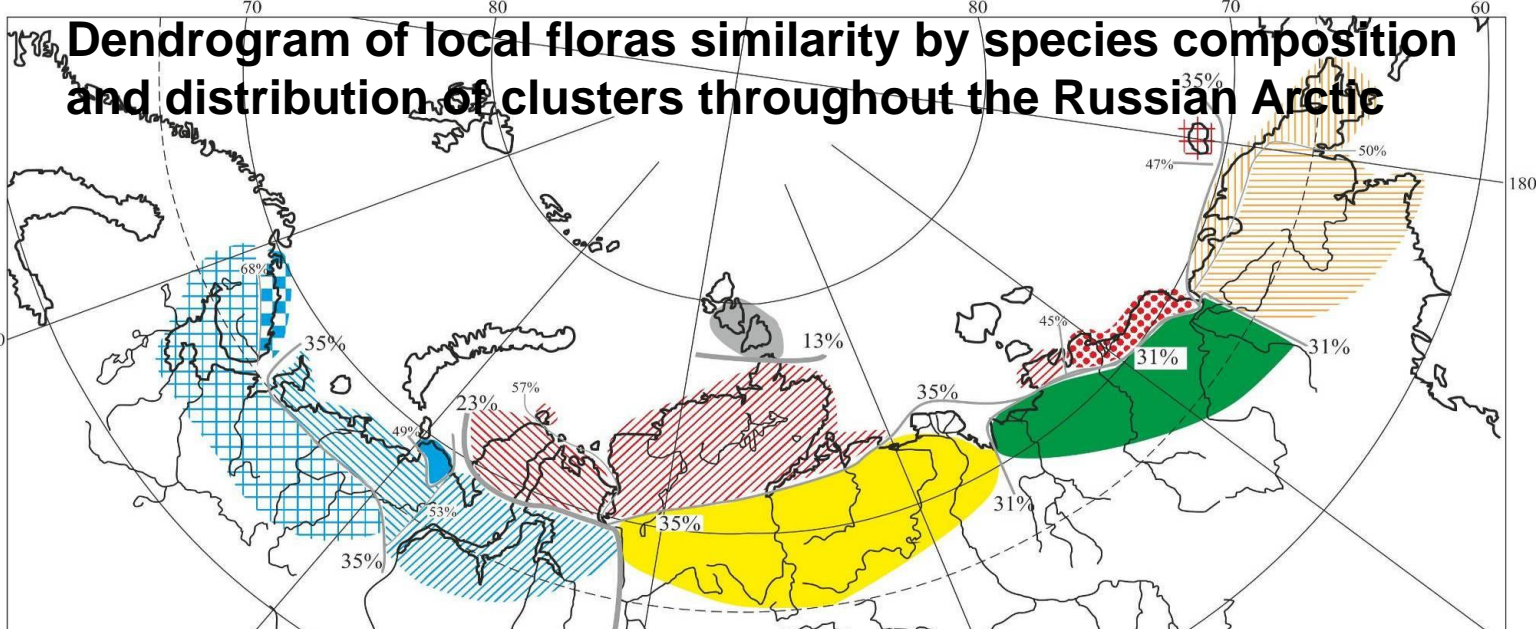


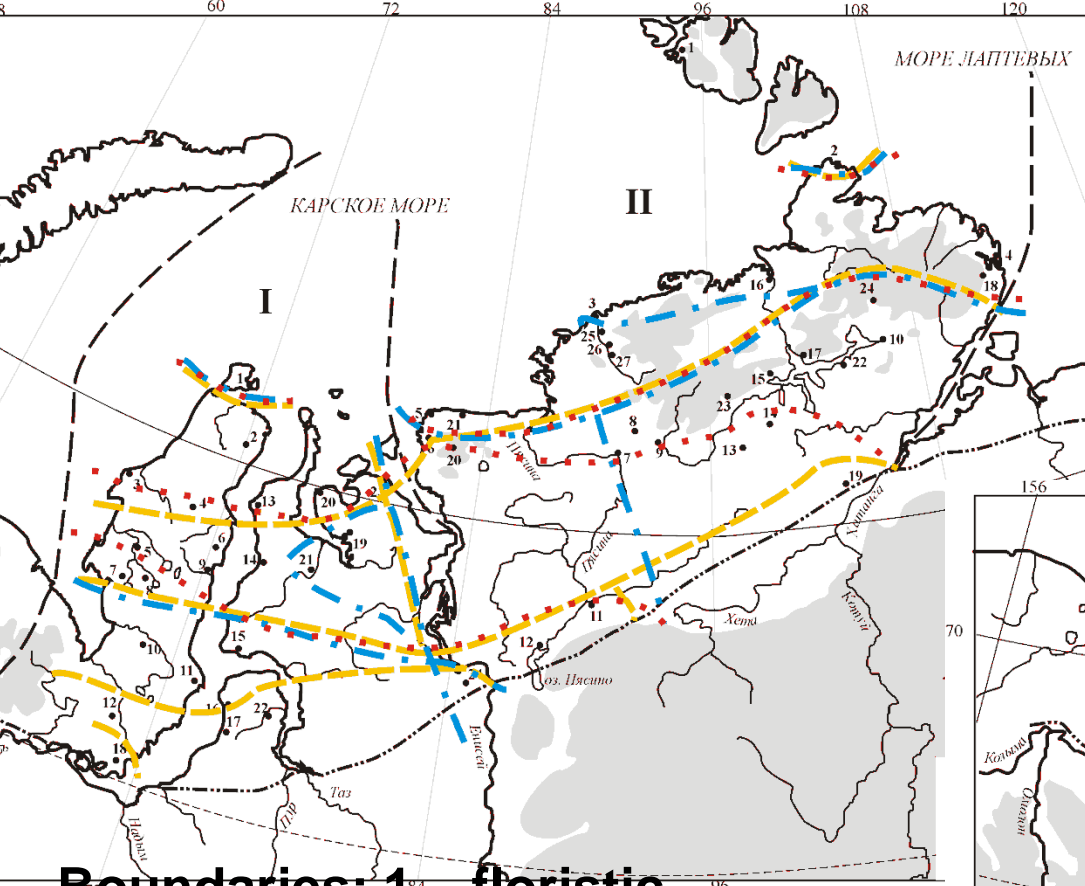
Similarity of local floras by species composition



- IA1a^{***}
- IA1a^{***}
- IA1a^{***}
- IA16
- IA2a
- IA26'
- *IA26^{***}
- IA26^{***}
- IB1a
- IB16
- IB2
- IIA
- IIБ1a
- IIБ16
- IIБ1В
- IIБ2a
- IIБ26

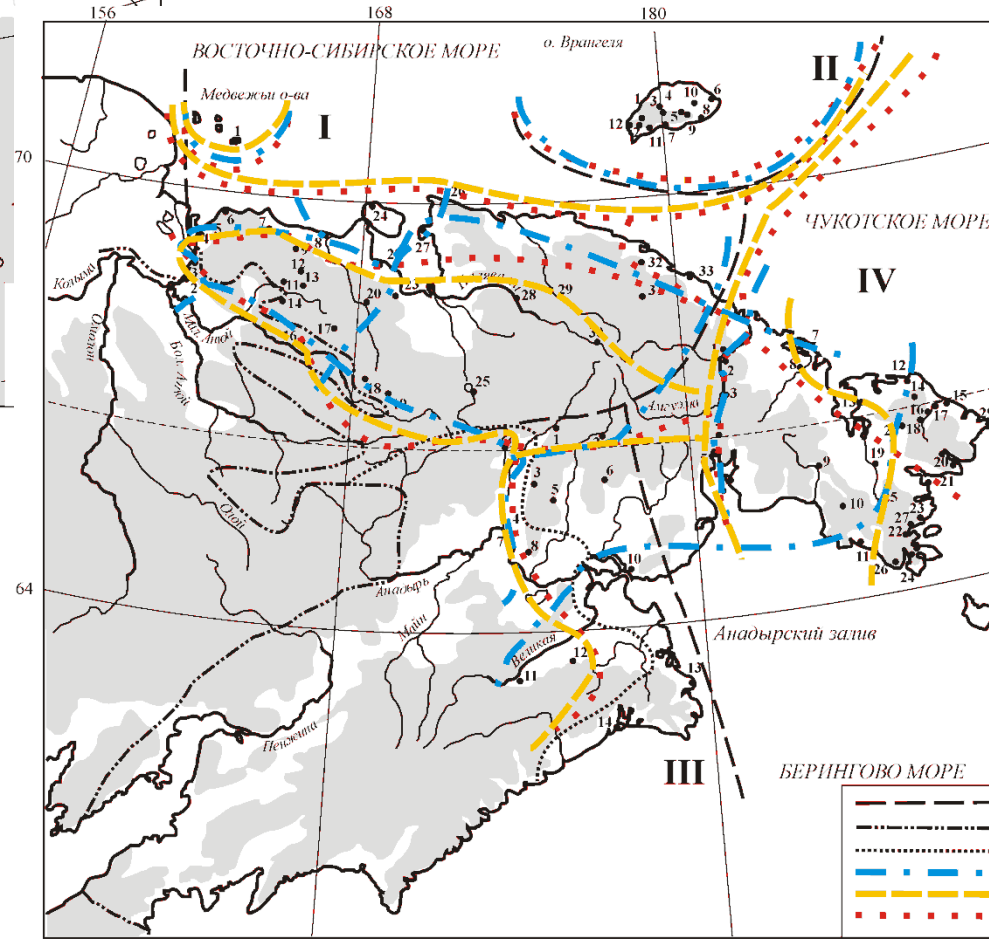






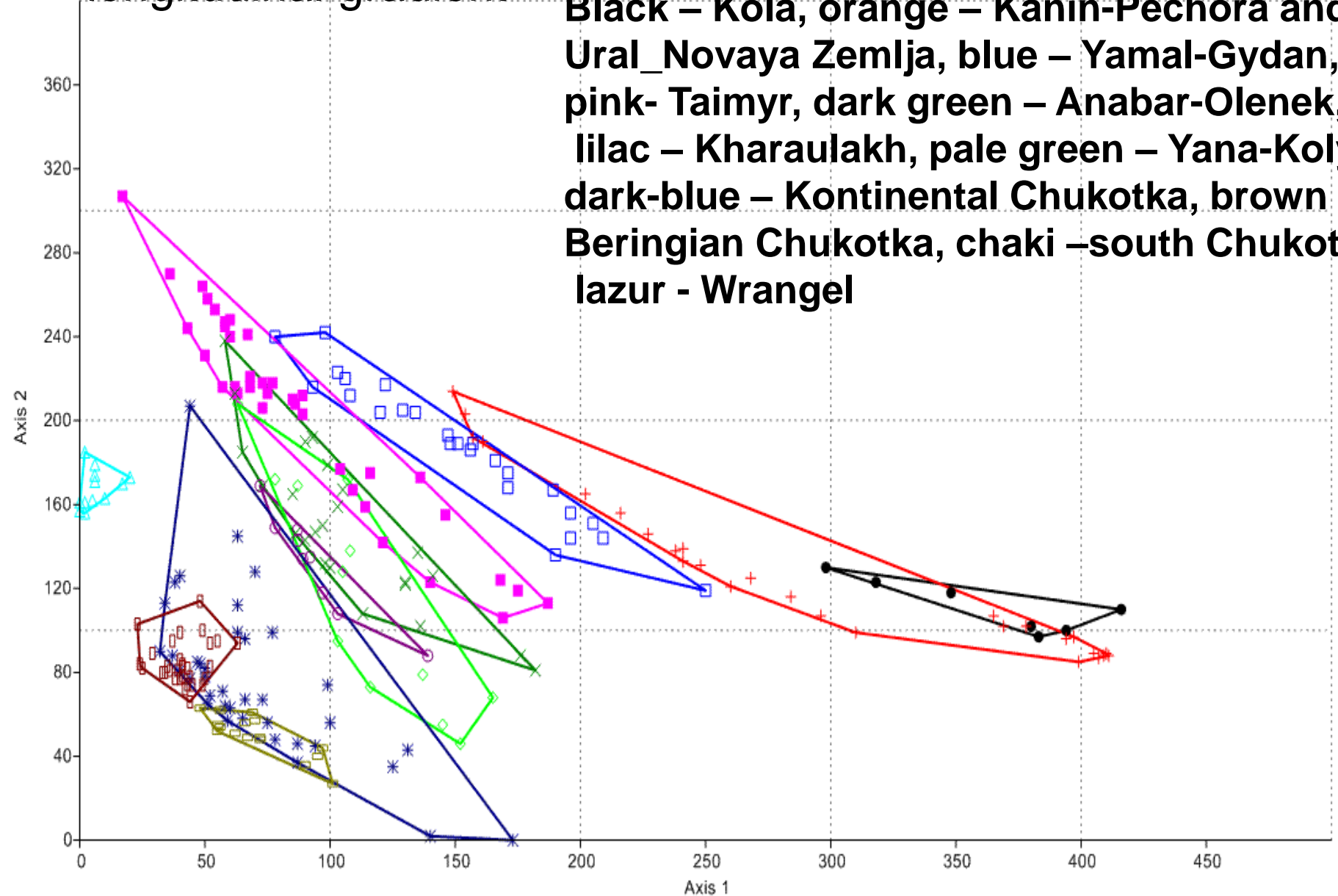
Combination of all boundaries by 10 parameters of geographical and taxonomical structure of local floras

Boundaries: 1 – floristic subprovinces, 2 – open woodlands, 3 – subzone of stlanik, 4 – by condensation of ranges of distribution of longitudinal groups and fractions, 5 – by similarity of spectra of geographic structure 6 – by similarity of spectra of taxonomic structure

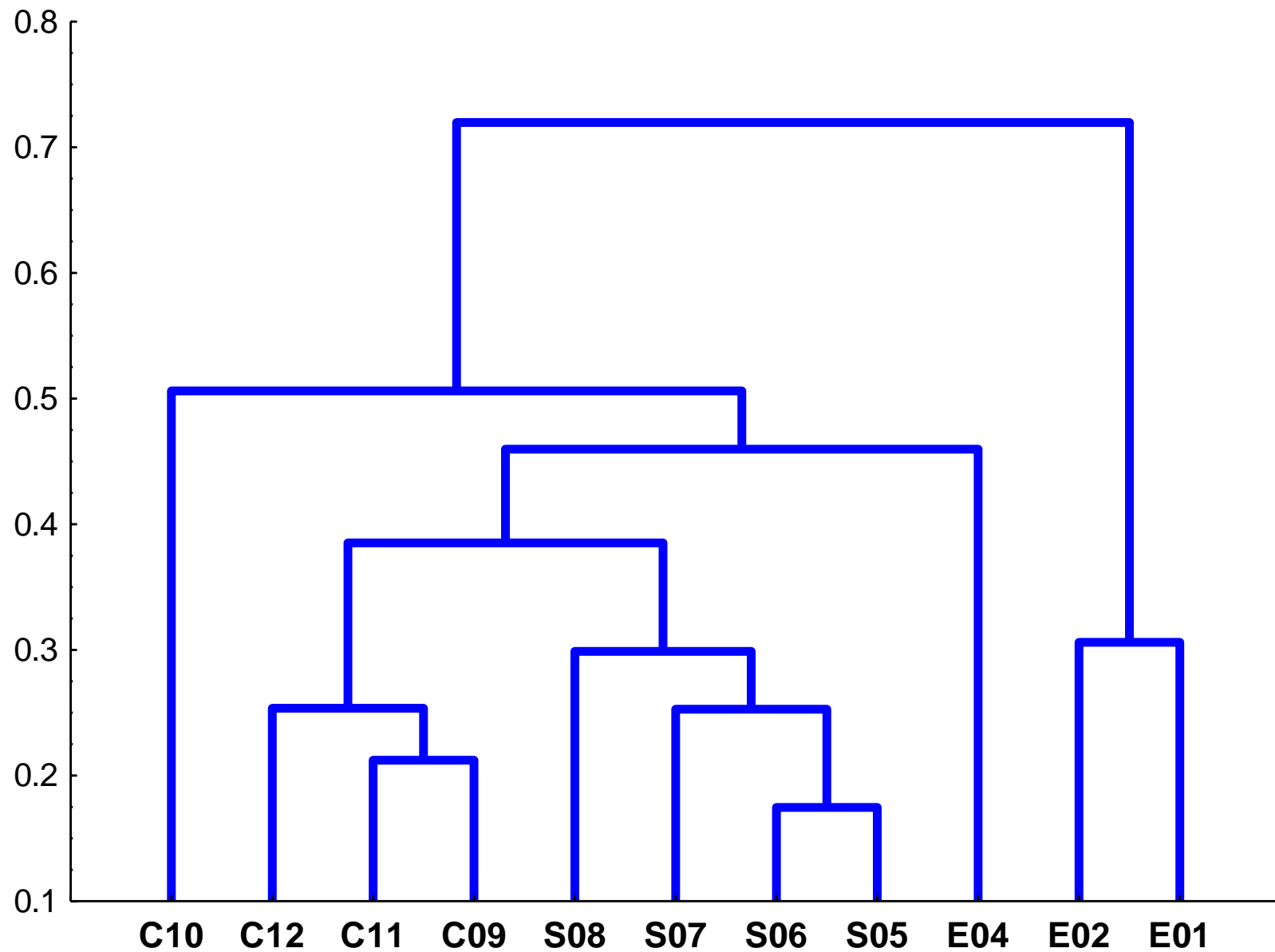


DCA ordination of 238 lists of species (LF), axis 1 reflects longitudinal gradient

Black – Kola, orange – Kanin-Pechora and Ural_Novaya Zemlja, blue – Yamal-Gydan, pink- Taimyr, dark green – Anabar-Olenek, lilac – Kharaulakh, pale green – Yana-Kolyma, dark-blue – Kontinental Chukotka, brown – Beringian Chukotka, chaki –south Chukotka, lazur - Wrangel



Similarity of floras of 11 subprovinces by species composition



Use of our data for nature conservation :

- Revealing of rare and endemic species
- Revealing of the territories with abundance of rare species
- Suggestion of objects for the Red and Green Data Books;
- Writing the essays for the Red and Green Data Books

Salix berberifolia ssp. *fimbriata*

THANK YOU!!!

