Study of Plant Species Diversity in the West Siberian Arctic

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Abstract—The West Siberian Arctic, due to its history and physiography, is characterized by a simple biotope (habitat) structure and low species richness. By analyzing full vegetative species inventories in specific localities, comparisons of floras of different biotopes (such as partial floras), and identification of the roles of individual species across the landscape, our research revealed subzonal changes in the structure of plant species diversity. Though general taxonomic diversity decreases from the southern hypoarctic tundra to the arctic tundra subzone, the number of species in partial floras does not decrease significantly. There was an increase in ecological amplitudes (mainly of arctic and arctic/alpine species) in the majority of habitats. The ratio of geographical groups differs greatly between subzones: hypoarctic and boreal species prevail in the southern subzone; arctic and arctic/alpine species replace them in arctic tundra.

The West Siberian Arctic (Yamal, Tazovsky, Gydansky Peninsulas) is an inaccessible and sparcely populated (5 people per 100 km^2) area of 235,000 km^2. It has attracted attention as an area of conflict between fragile arctic ecosystems, traditional land use by indigenous nenetz people (overgrazing of lichen pastures, exhaustion of hunting resources), and oil and gas extraction activities. According to reports by Vilchek and Bykova (1992), approximately 0.1 percent of land in Yamal is severely disturbed. Due to its history and physiography, the region is characterized by a simple biotope structure and low species richness (about 400 vascular plant species) and can be a good model for the study of zonal trends in biodiversity. This research was based on full species inventories, comparisons of floras of different biotopes, and identification of the role of each species in the landscape (species activity) to allow an understanding of zonal changes in biodiversity.

Study Area

The West Siberian Arctic is a part of the West Siberian plain with average elevations of 30 to 40 meters a.s.l., numerous creek and river valleys and ravines, widespread mires, and a great number of lakes. Bedrock is not exposed anywhere; the territory is covered by a thick (up to 300 meters) layer of Quaternary deposits, formed by alternating clay, clayey, and sandy layers (Sisko 1977). The study area lies within the zone of continuous permafrost, where seasonal freeze-thaw processes and cryogenic natural disturbances (thermokarst, solifluction, streambank erosion, landslides) occur.

The climate is continental and rather severe. The absence of weather stations in the study area forced us to use the nearest data to characterize climatic conditions (table 1). Average July temperatures range from 11 degrees centigrade in the south to 4 degrees centigrade in the north. Average January temperatures range from minus 25 degrees centigrade in the south to minus 27 degrees centigrade in the north; the average low temperature is minus 29 to 30 degrees centigrade, while the absolute low is about minus 50 degrees centigrade. Strong winds are common. Precipitation decreases from south to north. The flatness of the terrain and great latitudinal range (from the Arctic Circle to about 74° N) lead to clear subzonal differences attributable to the reaction of the flora to summer warmth. Positive temperatures occur from June to September. Phenological autumn comes during the second half of August with a sharp decrease in day length and the first frosts. Though positive temperatures occur in September, the growing season is over by then. The length of the growing season is constant at approximately 3.5 months across the study area, whereas the cumulative degree days above zero and above 5 degrees centigrade almost double from north to south. Each subzone is characterized by the sum of daily mean temperatures above 5 degrees centigrade that exerts strong influences on flora and vegetation. The boundaries of botanical-geographic subzones in the region correlate with summer month isotherms. Thus, the southern boundary of the arctic tundra subzone in the West Siberian Arctic roughly coincides with the 5 degree centigrade isotherm of July (roughly 71° N), whereas, in Taimyr it lies farther north (roughly 73° N), but also correlates with a 5 degree centigrade isotherm.

Methods

Floras of eight geographical localities, or "local floras" (Yurtsev 1987), were studied in the north of West Siberia during the field seasons of 1983 through 1991: four of them were situated in the southern hypoarctic tundra, and four in the arctic tundra (table 2; fig. 1). In this paper, we use the floristic subdivision of the tundra zone suggested by Yurtsev (1994). In the West Siberian Arctic, these boundaries coincide with the limits of botanical-geographic subzones of southern or shrub tundra and arctic tundra proposed by Gorodkov (1935).

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Table 1—Temperature and precipitation measures in different subzones of the West Siberian Arctic and adjacent regions (compiled from: Petrov 1973).

Subzone	Meteorological station	Mean summer months temperature °C				Mean annual t °C	Summs of daily mean temperatures		Precipitation (mm)
		VI	*VII*	*VIII*	*IX*		*>0*	*>5*	*annual*
Southern hypoarctic tundra	Korotaikha (Bolshezemelskaya Tundra)	+4.3	+10.2	+8.7	4.3	–6.6	624	499	350
Southern hypoarctic tundra	Mys Kamenny (Yamal)	+0.7	+8.1	+10.1	+5.0	–9.4	758	668	353
Southern hypoarctic tundra	Kresty (Taimyr)	+3.4	+11.4	+8.6	+1.5	–12.3	730	432	344
Arctic tundra	Kharasavei (Yamal)	+0.7	+5.5	+5.7	+2.3	–9.6	460	289	296
Arctic tundra	Tambei (Yamal)	+1.0	+5.5	+6.4	+2.3	–10.6	493	344	301
Arctic tundra	Belyi Island (Yamal)	–0.3	+4.1	+5.3	+1.9	–10.4	372	160	258
Arctic tundra	Dikson Island (Taimyr)	+0.1	+4.6	+5.0	+1.3	–11.5	392	112	274

The basis of our field work was the method of "concrete floras" (Tolmatchev 1974). At each locality, all habitats were searched until no new species were found in similar habitats within 10 km. At four sites (Laiyakha, Poilovayakha, Khonorasale, and Matyisale), a detailed study of intralandscape structure of plant species diversity was conducted. Based on similarity in slope position, snow regime, surface moisture, soil composition, and especially similarity in vegetation, we classified habitats into different habitat types. The list of vascular plant species from each habitat type is considered its "partial flora" (Yurtsev 1987). Species typical of a partial flora form its "floristic core" and are of major importance for the characteristic of the partial flora. Species are divided into 2 categories: (1) "specific elements," which only occur in certain habitat types and are species that are diagnostic of a habitat type, including constant and faithful species, and faithful but rare ones; and, (2) "nonspecific elements" or "active species," which are regularly found in different habitat types (Khitun 1989).

Results and Discussion

Taxonomic Diversity

The West Siberian Arctic is known for its floristic poverty. Total vascular plant species richness is 358 for Yamal (Rebristaya 1990), 273 for Tazovsky (Rebristaya and others 1989), about 400 for Gydan (Khitun and Rebristaya 1998), and about 460 for the whole Yamal-Gydan region, according to "The Arctic Flora of the U.S.S.R." (1961-1987). Floras of adjacent territories are richer in species number: 475 in Bolshezemelskaya Tundra (Rebristaya 1977), 650 in Taimyr ("The Arctic Flora of the U.S.S.R." 1961-1987). The paucity of species in the West Siberian floras may be explained by the geological youth of the area: its Quaternary history was characterized by alternation of sea transgressions and regressions, when the terrain was reinhabited by plants from adjacent mainland (Sisko 1977). Alternatively, lack of relief, lack of some soil types (such as calcareous), and widespread peaty, poorly drained, acid soils (pH about 4.0-4.5), which are not suitable for many arctic species, also decrease species richness.

As is shown in table 2, the floras of the southern hypoarctic tundra are richer than the arctic tundra to the north. Of the southern hypoarctic tundra flora, the "Khevesyo" local flora of Yamal is the poorest, while local floras of Tazovsky and Gydansky are richer, as is the "Nyamdoyu" of the Bolshezemelskaya Tundra. The Taimyr flora "Kresty" is located more northerly but is richer (241 spp.) than most of the West Siberian ones. For the West Siberian local floras in the southern hypoarctic tundra subzone, large participation of the Cyperaceae family, poor presence of the Caryophyllaceae (compared to Taimyr), absence of Saxifragaceae (and in some floras Brassicaceae), and presence of Rosaceae among the ten largest families are characteristic

Table 2—Location and taxonomic diversity of studied West Siberian local floras and local floras of adjacent regions

Local flora	Region	Subzone	Coordinates N.L.	Coordinates E.L.	Number of Species	Number of Genera	Number of Families	Author
Nyamdoyu	Bolshezemelskaya Tundra	Southern hypoarctic tundra	68° 14'	62° 38'	210	113	42	Rebristaya 1977
Khevesyo	Yamal	Southern hypoarctic tundra	68° 35'	73° 20'	187	92	38	Khitun and Rebristaya 1998
Laiyakha	Tazovsky	Southern hypoarctic tundra	68° 08'	74° 50'	215	98	42	Rebristaya and others 1989
Poilovayakha	Tazovsky	Southern hypoarctic tundra	68° 15'	76° 25'	187	96	42	Rebristaya and others 1989
Chugoryakha	Gydansky	Southern hypoarctic tundra	69° 07'	74° 40'	210	97	42	Rebristaya and Khitun 1994
Kresty	Taimyr	Southern hypoarctic tundra	70° 50'	89° 45'	241	111	44	Matveeva and Zanokha 1986
Kharasavei	Yamal	Arctic tundra	71° 10'	67° 10'	125	63	27	Rebristaya (unpubl.)
Belyi Island	Yamal	Arctic tundra	73° 15'	71° 30'	75	34	16	Rebristaya 1995
Khonorasale	Gydansky	Arctic tundra	71° 25'	73° 10'	174	75	30	Khitun and Rebristaya 1998
Matyuisale	Gydansky	Arctic tundra	71° 56'	76° 32'	152	63	27	Khitun and Rebristaya 1998
Dikson	Taimyr	Arctic tundra	73° 30'	80° 35'	138	66	25	Matveeva and Zanokha 1997

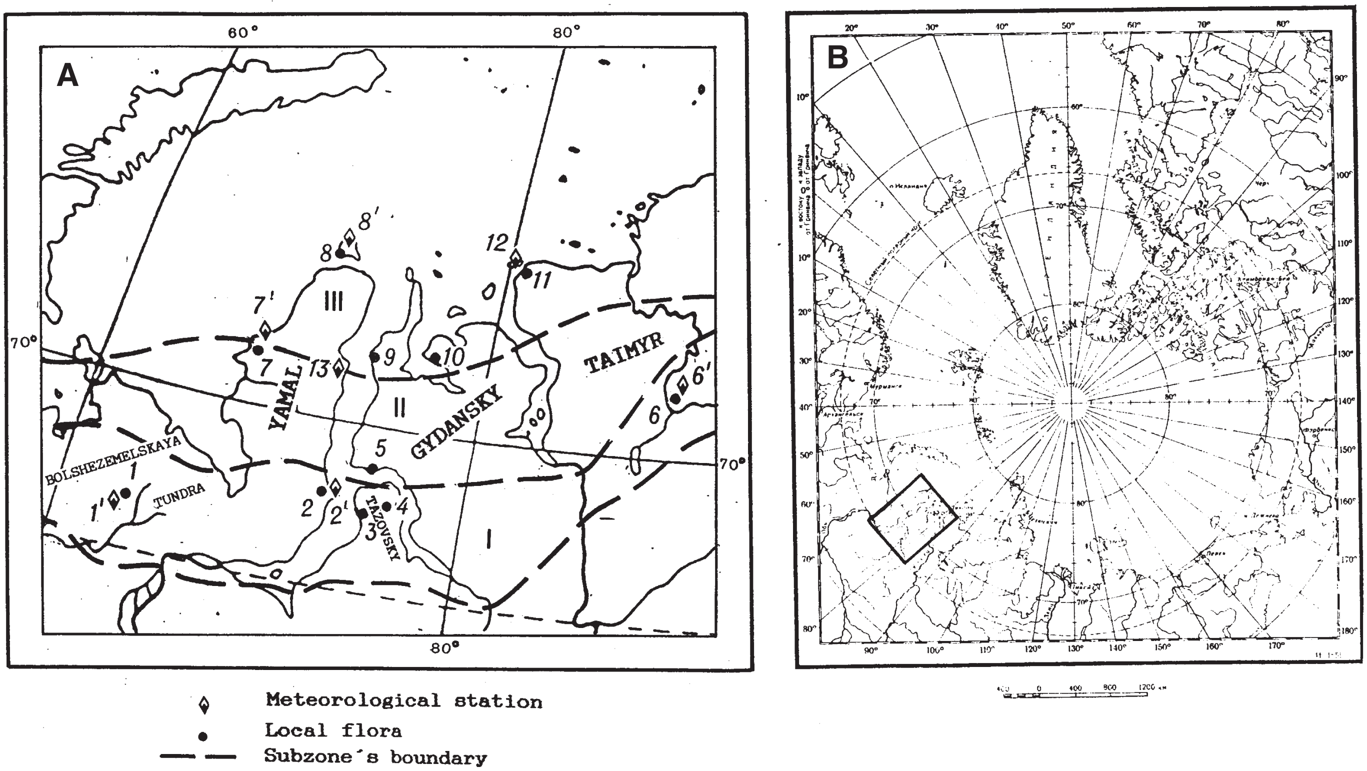

Figure 1— (A) Location of the local floras studied.1 = Nyamdoyu, 2 = Khevesyo, 3 = Laiyakha, 4 = Poilovayakha, 5 = Chugoryakha, 6 = Kresty, 7 = Kharasavei, 8 = Belyi Island, 9 = Khonorasale, 10 = Matyuisale, 11 = Dikson; location of meteorological stations mentioned in table 1: 1' = Korotaikha, 2' = Mys Kamenny, 6' = Kresty, 7' = Kharasavei, 8' = Belyi Island, 12 = Dikson Island, 13 = Tambei. The thick dotted lines indicate the borders between subzones (Yurtsev 1994): I = southern hypoarctic tundra; II = northern hypoarctic tundra; III = arctic tundra. (B) Location of study area within the Circumpolar Arctic.

(table 3). Grasses (Poaceae) absolutely prevail in all studied floras. In the arctic tundra subzone in Gydan, as well as in Yamal and in Taimyr, participation of Caryophyllaceae, Brassicaceae, and Saxifragaceae families are very high, but the portion of Cyperaceae in the West Siberian floras remains higher than in Taimyr. The number of families decreased significantly from 42 in the southern hypoarctic tundra to 27 to 30 in the arctic tundra mainly due to disappearance of single-species families. The number of genera also decreased due to the disappearance of single-species genera, whereas in a few genera (Draba, Saxifraga), the number of species in the arctic tundra increased greatly (from 2 to 3 to 11 to 12). Gydan local floras in the arctic tundra are the richest, while the Belyi Island flora is the poorest of all known floras in this subzone. This could not be explained only by ecotope monotony and severe environments; probably the flora's poverty is connected with the lower rates of species migration to the island (Rebristaya 1995).

Local floras of the West Siberian Arctic are characterized by a high level of similarity: similarity indices range between 75 to 85 percent within a subzone and 55 to 60 percent between subzones (Soerensen-Chekanovsky index was used: i = 2C/A+B, where A and B are the total number of taxa in two comparing floras and C is the number of shared taxa). Similarity with local floras from adjacent sectors of the Arctic within the same subzone is about 60 percent. Interestingly, arctic Gydan floras have an even higher similarity, with the Taimyr southern flora "Kresty" (about 60 percent), than with the Taimyr arctic flora (45 percent). A few amphioceanic species (*Epilobium alpinum*, *Veronica alpina*, *Gnaphalium supinum*) occurring in Yamal, Tazovsky, and Bolshezemelskaya Tundra are absent in the southern part of Gydan. A large group of arctic-alpine herbs (*Gastrolychnis apetala, Androsace triflora, Astragalus umbellatus, Saxifraga bronchialis, Senecio resedifolius*), absent in Yamal, is present in Gydan, as well as in Taimyr and Bolshezemelskaya Tundra. Several species (*Ranunculus monophyllus, Pedicularis oederi, Arctous alpina, Hedysarum arcticum*) that do not spread northward from the subzone of northern hypoarctic tundra in Yamal occur in Gydan in the arctic tundra subzone. On the whole, more than 80 species (such as *Gastrolychnis apetala, Carex supina, Lychnis sibirica, Orthilia obtusata*) are rather rare, sporadically spread Holocene or Pleistocene relics. Two species (*Castilleja arctica, Pedicularis hyperborea*) are endemic to the West Siberian sector. Though general taxonomic diversity decreases to the north (187 to 215 species in the southern hypoarctic tundra versus 125 to 174 in the arctic tundra), species richness in partial floras of corresponding habitats does not decrease (table 4) due to a change in species activity and expansion of species with broad ecological amplitudes (mainly arctic and arcto-alpine species) to the majority of biotopes, replacing boreal species.

Table 3—Number of species in the leading families in the local floras in the West Siberian Arctic.

Family	Southern hypoarctic tundra				Arctic tundra			
	Khevesyo	Laiyakha	Poilovayakha	Chugoryakha	Kharasavei	Khonorasale	Matyuisale	Belyi Island
Poaceae	27	30	23	33	26	28	22	20
Cyperaceae	13	18	16	14	12	15	16	14
Asteraceae	17	19	16	16	7	14	9	1
Caryophyllaceae	12	14	11	13	12	16	16	7
Scrophulariaceae	12	12	10	13	3	6	6	1
Ranunculaceae	11	11	11	11	9	11	11	7
Salicaceae	11	11	12	11	6	9	8	3
Juncaceae	7	10	7	11	4	5	5	3
Rosaceae	7	10	6	9	6	5	5	3
Brassicaceae	10	5	4	9	11	17	15	7
Ericaceae	7	9	8	5	2	4	2	1
Saxifragaceae	6	6	5	6	6	11	14	6
Polygonaceae	4	5	5	5	5	5	4	2

Intralandscape Diversity of Local Floras

Biodiversity, according to Whittaker (1965) can be divided into "alpha-diversity", the diversity of species within habitat; "beta-diversity", the diversity between different habitats; and "gamma-diversity", the total diversity of a whole geographically or ecologically defined region. The last is the most important index for the determination of biodiversity because it includes both of the other measures. In general, the chances for greater gamma diversity are better in more heterogeneous environments (Navech 1994). Though we distinguished from 17 to 21 habitat types in each locality studied (table 4), they are small-scale landscape units—microecotopes. In the Arctic, even small differences in relief cause differences in ecological conditions and, hence, in the vegetation. But in the West Siberian Arctic, due to its general flatness and low altitudes, these differences are not so great; therefore, many different landscape positions (such as flat plateaus of watersheds and floodplains) have similar vegetation and, accordingly, high similarity indices.

According to their floristic similarity, habitat types can be joined in 60 certain groups, or classes, of habitats. Their number is restricted to 10 in the southern hypoarctic tundra and six in the arctic tundra. Taking into account that some habitat types are quite rare and sporadically spread, we can conclude that gamma-diversity is very low in this region even compared to other sectors of the Arctic. Partial floras of different habitat types number 12 to 74 species. The average level of similarity between partial floras inside each local flora is 30 to 40 percent in the southern hypoarctic tundra and 50 to 60 percent in the arctic tundra, but maximal coefficients reach 80 percent. Similarity between partial floras of corresponding habitats within a subzone reaches 85 percent, while between subzones it is about 30 percent.

The richest habitats (numbering about 70 species) occur throughout the area on slopes (especially south-facing) and moist foothills, with dwarf-shrub-herbaceous communities or herbaceous meadows. In the southern hypoarctic tundra, a few habitat types are joined based on the presence of high (up to 3 m tall) upright willow or alder shrubs; they, naturally, are absent in the arctic tundra, and instead dwarf-shrub (polar willow, mountain avens)-herbaceous communities (habitat types 7 and 8) are widespread. The richest habitats also contain the most rare species. Therefore, when considering human land use, they should be of special concern for protection. Zonal habitats are intermediate in species abundance; they become notably richer in the arctic tundra. Oligotrophic habitats—sandy beaches, clayey landslides, wet hollows in polygonal bogs—are among the poorest everywhere in the area and contain many specialized r-strategy species and very specific aquatic habitats. Aquatic habitats are the most species poor; their partial floras differ greatly from all others, but they are very similar in both subzones.

The Role of Active Species

Active species, representing about 15 percent in southern local floras, contribute from one-fourth to two-thirds of partial floras of different habitat types. Their composition is almost identical in Laiyakha and in Poilovayakha. Hypoarctic shrubs and dwarf-shrubs prevail among them: willows (*Salix glauca, S. pulchra*), dwarf-birch (*Betula nana*), and ericoid dwarf-shrubs, along with several graminoids (*Calamagrostis neglecta, C. lapponica, Carex arctisibirca*). In the arctic tundra, the role of active species increases. Representing about 20 percent of the arctic floras of Gydan, active species contribute up to 75 percent of partial floras (mean = 55 percent). Their composition differs greatly from active species of the southern hypoarctic tundra, but it is alike in both arctic floras. Many arctic-alpine herbs (such as *Alopecurus alpinus, Luzula confusa, Draba* spp., *Parrya nudicaulis, Saxifraga* spp., *Eritrichium villosum, Myosotis asiatica, Pedicularis oeder*) are among the active species in the arctic tundra.

The highest proportion of specific elements in the southern hypoarctic tundra was recorded on steep slopes, on foothills, in alder thickets, in wet meadows, and in aquatic habitats. Many of these species, which are rare and sporadically spread in the southern hypoarctic tundra, become active in the arctic tundra. For example, *Salix polaris* is restricted to snowbeds in the southern hypoarctic tundra, but in the arctic tundra it occurs in almost all habitat types

Table 4—Intralandscape diversity of local floras: habitat types and total amount of species in partial floras (PF), in their floristic core (FC), and number of rare species (R).

		Southern hypoarctic tundra						Arctic tundra					
		Laiyakha			Poilovaykha			Khonorasale			Matyuisale		
Habitat type	Name	PF	FC	R	PF	FC	R	PF	FC	R	PF	FC	R
1	Flat plateaus and gentle slopes of watersheds with zonal communities	51	26	1	31	21	0	48	28	2	60	35	1
2	Convex marginal parts of the flat tops of the hills with frost-boiled tundra	35	23	1	32	22	0	48	23	6	57	32	2
3	Convex, better drained, slightly elevated surfaces on river terraces higher than floodplain level	35	20	0	26	18	0	60	37	3	54	28	1
4	Shallow, poor drained depressions on river terraces and flat bottoms of wide hollows	29	19	0	25	20	1	39	20	0	35	20	0
5	Long gentle foothills	30	22	1	32	21	0	55	32	0	47	25	2
6	Peat high-centered polygons in polygonal bogs	25	18	1	30	23	3	36	25	1	38	20	1
7	Steep sandy short slopes of hills with dwarf-shrub-grass communities	70	41	5	45	31	1	61	30	7	50	29	3
8	Steep, clayey or sandy well-drained slopes of hills or deep ravines with herbaceous meadows	69	51	14	54	38	7	73	49	14	58	35	4
9	Drained parts of floodplain with dwarf-shrub herbaceous communities	55	33	7	41	27	4	33	19	0	37	20	1
10	Sand beaches, sand blow-outs on hills' tops with sparce vegetation	32	20	1	24	21	0	37	23	3	25	15	1
11	Steep sandy failures of active banks of the rivers	—	—	33	16	1	56	28	3	26	14	1	
12	Alder thickets on convex parts of hills' slopes	40	23	5	45	21	3	—	—	—	—	—	—
13	Alder parkland on river terraces	48	24	2	49	26	1	—	—	—	—	—	—
14	Clayey landslides with pioneer vegetation	36	19	4	42	25	3	56	25	5	40	26	1
15	Old entirely recovered landslides' amphitheatres	56	27	0	—	—	—	39	20	0	—	—	—
16	Little hollows on slopes and foothills with snowbed vegetation	69	41	4	61	40	4	55	27	5	50	28	3
17	Willow copses on concave parts of slopes with up-right *S. lanata*, *S. glauca* (up to 2,5 m height)	54	34	7	57	30	4	—	—	—	—	—	—
18	Gentle slopes with low willows (<1 m height in Southern hypoarctic tundra and <15 cm height in Arctic tundra)	42	22	0	31	20	1	57	31	3	60	38	5
19	Wet sedge meadows in lake depressions or in river valleys	52	34	3	32	26	3	37	27	2	37	24	2
20	Wet oligotrophic graminoid-moss hollows in polygonal bogs	20	12	0	16	9	0	28	17	0	22	13	2
21	Tussock heath-moss peaty bogs in river valleys	22	12	4	22	12	2	—	—	—	—	—	—
22	Aquatic habitats	15	13	1	16	14	1	12	12	0	16	13	0
23	Coastal marshes	—	—	—	—	—	—	31	17	11	20	13	5

and is very abundant in many of them; *Alopecurus alpinus* is sporadic on river terraces in the southern hypoarctic tundra but is one of the most widespread species in the arctic tundra, as is *Luzula confusa, Myosotis asiatica, Saxifraga cernua, S. hieracifolia, Lagotis minor*, and other species.

Geographical Structure of Local and Partial Floras

The ratio of geographical groups differs significantly between subzones in both local floras as a whole and in partial floras: hypoarctic and boreal species prevail in partial floras (up to 70 percent) in the southern hypoarctic tundra; arctic-alpine and arctic species replace them in the arctic tundra (fig. 2). In the southern local floras, the hypoarctic fraction represents about 35 percent of the flora, and it contributes up to 60 percent of partial floras in habitats with zonal vegetation (habitat types 1 through 6). Boreal species occupy an important position in local floras in the southern hypoarctic tundra. They prevail in intrazonal habitats, which are rather widespread in the areas studied. The highest proportions of boreal species (up to 35 to 40 percent of partial floras) were recorded in alder and willow thickets (habitat types 12, 13, 17, and 18), on sandy slopes (habitat type 7), and in wet meadows (habitat type 19). Many are codominants in certain communities (*Calamagrostis langsdorffii, Rubus arcticus* in habitat type 12, *Caltha palustris, Comarum palustre, Menyanthes trifoliata* in habitat type 19). The Arctic fraction is less important both in local floras and in partial floras. The largest proportion of arctic-alpine species (30 percent of the partial flora) was recorded in habitat types 1 and 2. Arctic species prevail in aquatic habitats (habitat type 22), in wet hollows (habitat type 18), and on sands (habitat type 10), but their absolute number is highest on herbaceous slopes (habitat type 8). In the arctic tundra, the arctic fraction prevails in local floras (about 65 to 70 percent) and all partial floras (up to 75 percent). Though the arctic

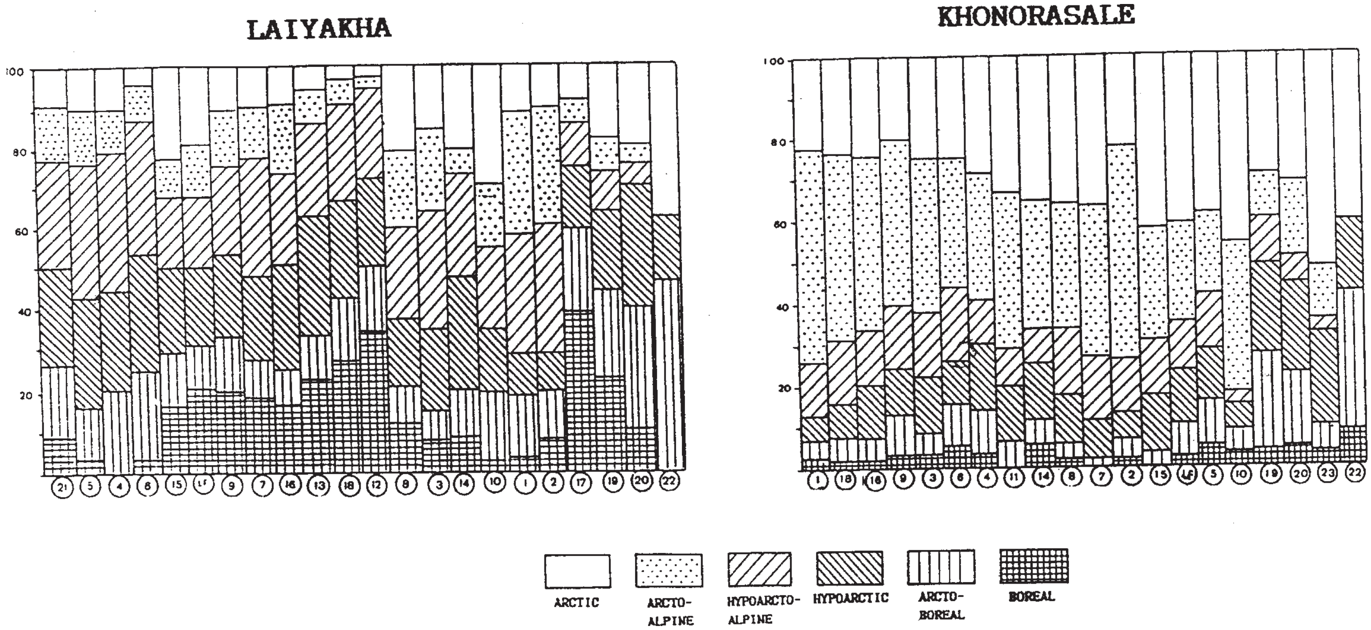

Figure 2—Proportions of geographical elements in partial floras and in local floras on a whole in the southern hypoarctic tundra subzone (left) and in the arctic tundra subzone (right).

element is more prevalent in local floras, in partial floras arctic-alpine species prevail more often. As previously mentioned, many arctic-alpine species narrowly spread in the southern hypoarctic tundra become active and dominant in many habitat types in the arctic tundra. The prevalence of boreal species decreases dramatically in the arctic tundra; their contribution to partial floras of all habitat types is less than 10 percent. The proportion of the hypoarctic fraction also decreases, contributing 25 to 30 percent in all types, except wet ones.

Conclusions

The West Siberian Arctic is characterized by low ecological heterogeneity and, therefore, low plant species diversity at all levels: alpha-, beta-, and gamma-diversity. Essential similarity in floristic composition between different habitat types is caused partly by monotonous lowland relief and partly by widespread species with broad ecological amplitudes. The relevance of such (active) species increases to the north, and hence, the continuity of floras structure increases, too. The number of species in partial floras of different subzones does not differ, while total species diversity declines in local floras in the arctic tundra. At the same time, species composition of partial floras of corresponding habitats differ greatly between subzones. In the majority of habitat types, only about 30 percent of partial floras remain the same in both subzones, and essential changes in the ratio of geographical elements take place, while partial floras of corresponding habitats within each subzone display high levels of similarity. Hypoarctic and boreal species prevail in partial floras in the southern hypoarctic tundra; arctic-alpine species replace them in the arctic tundra.

Among species that we refer to as rare, the major portion is formed by arctic species at the southern limit of their range or boreal species at their northern limit. They may be quite common within the main part of their range, so from the circumpolar point of view, they cannot be considered rare. But, taking into account the general poverty of West Siberian floras, we must value the biodiversity contribution of each species. Under conditions of expanding human industrial activities toward the north, in this naturally very unstable and fragile area, we have to struggle for preservation of each of its endemic species. Adventitious species (weeds accompanying people) are still rare in the area, but their expansion is a potential hazard—one that is already being experienced in the vicinities of the oldest settlements in the adjacent regions (Druzhinina and Zharkova 1979). Fortunately, there is still very little human activity in Gydan, while in Yamal, we have already observed the loss of rare species in intensively explored areas near the Bovanenkovo gas field. The problem of conserving rare species is connected with the problem of conservation of species-rich habitats and also rare or unique habitats. Knowledge of their distribution (both rare species and rare habitats) in the region is important for organization of nature reserves or protected areas, and information on the partial floras of biotopes is necessary for successful restoration after technogenic disturbances. Recently, a decree was signed declaring the organization of a new nature reserve in the north part of the Gydansky peninsula. Both of the local floras studied here are within its territory.

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