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New data on spiders (Arachnida: Aranei) of the Central Yamal Peninsula, with notes on biotopic preferences of the dominant species

Новые данные о пауках (Arachnida: Aranei) Среднего Ямала, с заметками о биотопических предпочтениях доминирующих видов

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KEY WORDS: Araneae, Arctic, habitat preferences, species list, tundra, collecting methods.

КЛЮЧЕВЫЕ СЛОВА: Araneae, Арктика, биотопические предпочтения, список видов, тундра, методы сбора.

ABSTRACT: Studying the local fauna of spiders in the vicinity of the Seyakha village (Yamal Peninsula, Siberian Arctic), I identified a total of 47 species belonging to seven families. Five species (*Agyneta decora*, *A. ripariensis*, *Masikia caliginosa*, *Metopobactrus prominulus*, and *Walckenaeria clavicornis*) have been recorded for the fauna of Yamal for the first time. The fauna of the Southern, Central, and Northern Yamal differ in species richness (comprised of a total of 165, 61, and 36 species, respectively). I compared the effectiveness of estimations of the species richness for spiders at high latitudes using pitfall traps and a sifter and found no significant differences between these methods. The composition of the dominant species differed between the sample sets collected using pitfall traps and a sifter, although all of these species were present in both sample sets. I found no clear biotopic preferences for populations of the majority of dominant spider species in the Central Yamal.

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РЕЗЮМЕ: В локальной фауне пауков окрестностей поселка Сеяха (Ямал, Сибирская Арктика) выявлено 47 видов, принадлежащих к 7 семействам. Пять видов (*Agyneta decora*, *A. ripariensis*, *Masikia caliginosa*, *Metopobactrus prominulus*, *Walckenaeria clavicornis*) впервые отмечены для фауны Ямала. Фауна Южного, Среднего и Северного Ямала различаются по видовому богатству (165, 61 и 36 видов соответственно). При оценке эффективности учета видового богатства пауков в высоких широтах с помощью ловушек и сифтера достоверных отличий между этими методами не выявлено. Состав доминирующих видов в материалах для обоих методов различался, хотя все эти виды присутствовали в обоих выборках. Для популяций большинства доминантных видов пауков на Среднем Ямале четких биотопических предпочтений не обнаружено.

Introduction

To date, most of the available data on the spiders of the Siberian Arctic has been obtained from isolated studies conducted at the local level in different sectors of the Arctic. The predominant collection methods were pitfall traps and sifter, as well as manual collection from soil samples or moss and litter samples [Eskov, 1986b, 1988; Eskov, Marusik, 1994; Khruleva, 2009; Tanasevitch, Rybalov, 2015; Marusik, Koponen, 2015; Marusik *et al*., 2016; Tanasevitch, Nekhaeva, 2016; Tanasevitch, Khrisanova, 2016; Tanasevitch, Khruleva, 2017; Khruleva *et al*., 2018; Nekhaeva, 2018, 2020; Tanasevitch *et al*., 2020; etc.]. Between the aforementioned methods, pitfall traps and sifter are easier to use and are suitable for the most commonly occurring groups (surface and litter dwelling species). It is obvious that these methods cannot be directly compared, and as researchers use them in different proportions, the contribution of each method to the final result also differs from study to study. However, since no analysis has been performed on the combined data, effects of the methods on the results are unclear.

The Yamal Peninsula is located in the extreme northwest of West Siberia (Fig. 1). This is the youngest

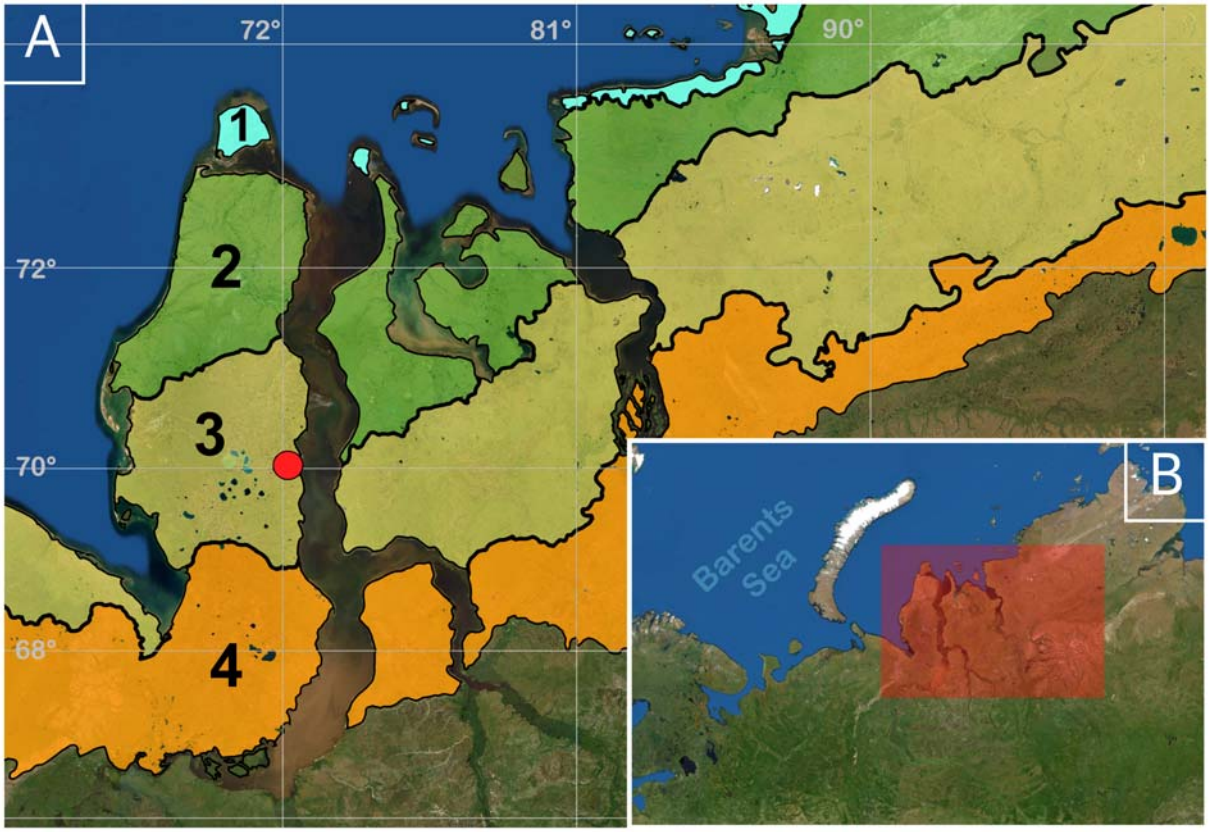

Fig. 1. Map (A) and a view of the studied area (B). The location of Seyakha village is indicated with a circle. Bioclimate subzones are marked with color [according to CAVM Team, 2003; Walker *et al*., 2005]: blue (1) — subzone B; green (2) — subzone C; yellow (3) — subzone D; orange (4) — subzone E.

Рис. 1. Карта (A) и обзор изученного района (B). Расположение поселка Сеяха отмечено кругом. Цветом отмечены биоклиматические подзоны [согласно CAVM Team, 2003; Walker *et al*., 2005]: голубой (1) — подзона B; зеленый (2) — подзона C; желтый (3) — подзона D; оранжевый (4) — подзона E.

region of the Arctic that has been existing in its current state since the beginning of the Late Pleistocene [Rebristaya, 2013]. To date, the spider fauna of the Southern Yamal has been studied the most and, according to expert estimates, includes at least 176 species [Esyunin, Laetin, 2009], while only 38 and 36 species are known for the Central and Northern Yamal, respectively [Holm, 1973; Esyunin, Laetin, 2009; Tanasevitch *et al*., 2009; Tanasevitch, Rybalov, 2015; Tanasevitch, 2017b].

This work presents new data on the local spider fauna of the Central Yamal and analyzes data on the composition of the spider fauna in various parts of Yamal and adjacent territories. In addition, I assess the effectiveness of estimations of the species richness of spiders at high latitudes using pitfall traps and sifter, and also identify and discuss the biotopic preferences of the dominant species.

Materials and methods

Study Area

The Yamal Peninsula is one of the most flat regions of the Arctic (the maximum height is 92 m above mean sea level) [Rebristaya, 2013]. Its length from south to north exceeds 750 km, including the subzones ranging from the northern forest-tundra to the arctic tundra [Rebristaya, 1999]. On the basis of bioclimate zonation, the territory of the Yamal Peninsula is divided in the present study into Southern, Central, and Northern Yamal, which correspond to subzones E, D, and C on the Circumpolar Arctic Vegetation Map [CAVM Team, 2003; Walker *et al*., 2005] (Fig. 1, A).

Spiders were collected from the eastern part of the Central Yamal in the vicinity of Seyakha (Сеяха) village (ca. 70.164391°N, 72.508354°E). The village is located on the right bank of the Seyakha River, which flows into the Gulf of Ob (Fig. 1).

According to the weather station in the Seyakha village, the annual mean air temperature is –9.8°C; the annual amplitude of air temperature is 32.5°C. The growing season, i.e., the period of the mean daily temperatures exceeding +5°C, lasts approximately 69 days (from July to August). August is the warmest month with an average temperature of +7.8°C. The Yamal Peninsula in its entirety belongs to the area of continuous permafrost [Rebristaya, 2013]. The studied locality belongs to the northern Hypoarctic tundra subzone [Yurtsev, 1994], which is similar to subzone D according to the Circumpolar Arctic Vegetation Map [CAVM Team, 2003; Walker *et al*., 2005] (Fig. 1, A).

Table 1. Description of the studied sites in the vicinities of Seyakha village.
Таблица 1. Описание точек сбора в окрестностях пос. Сеяха.

No.	Habitat	Coordinates	Collecting method	t, °C
1	*Dryas* tundra	N70.14056° E72.52494°	PT (7-19.07; 132), Sif	9.3
2	Forb meadow at the slope	N70.14085° E72.52528°	PT (7-19.07; 116), Sif	10.7
3	Snow patch at the foot of the slope	N70.14091° E72.52584°	PT (7-19.07; 120), Sif	6.8
4	Willowshrub with *Sphagnum*	N70.14141° E72.52358°	PT (7-19.07; 120), Sif, HC, Sw	–
5	Peat bog with cloudberries	N70.14123° E72.52236°	PT (7-19.07; 120), Sif	–
6	Sedge-green moss bog with *Sphagnum* spots	N70.14178° E72.52192°	PT (7-19.07; 120), Sif, HC	8.8
7	A strip of willows along the lake	N70.14205° E72.51788°	PT (7-19.07; 120), Sif	–
8	Lake coastline with sedge	N70.14205° E72.51688°	PT (7-19.07; 120)	–
9	Zoogenic biotope (*Lemmus* habitat) in zonal tundra	N70.14766° E72.51563°	PT (7-19.07; 72)	–
10	Undershrub-moss-lichen polygonal tundra (=zonal tundra)	N70.14866° E72.51760°	PT (7-19.07; 120)	8.5
11	Zoogenic meadow with sagebrush at the top of the hill	N70.15242° E72.44421°	PT (8-20.07; 120), Sif	–
12	Marsh-like communities on the Gulf of Ob coast with *Arctophila*	N70.16923° E72.56144°	PT (8-16.07; 120), Sw, HC	–
13	Coastal sedge-cottongrass bog on the Seyakha R. bank	N70.17425° E72.53335°	PT (8-20.07; 106)	–
14	Longstanding drifts on the Seyakha R. bank with rich motley grass	N70.17425° E72.53335°	PT (8-20.07; 106), Sif	–
15	Different places in village vicinities	–	HC	–

Abbreviations: HC — hand collecting, PT — pitfall traps (collecting time and total number of trap-days is given in parenthesis), Sif — sifting moss and litter, Sw — sweeping, t – average daily temperature, ºC (according to the data of the loggers installed in the litter), «–» — no data.

Sample Collection

Spiders were collected from July 6 to July 22, 2020. The main collection methods were pitfall traps and sifting. In addition to these, material was collected by hand and by sweeping. Information on the collection sites and methods is given in Table 1. The pitfall traps were made out of 200 ml plastic cups, 100 mm high with an opening of 65 mm in diameter, filled in by one third with water. The traps were surveyed every two to four days. The material was sorted in the field and fixed in 98% ethanol; then it was transported to the laboratory and identified under a stereomicroscope. The total material accounted for 1612 trap-days; a total of 1910 spider specimens were collected, of which 1198 (62.7%) adult specimens were identified to the species level.

Data Analysis

I evaluated the local species richness in PAST Version 4.04 with the non-parametric species richness estimator Chao2 ± SD [Colwell, Coddington, 1994; Hammer *et al*., 2001]. Juveniles were not used in the calculations, unless otherwise noted.

Faunal similarity between regions was estimated using the Kulczynski index (*K*) for qualitative data (presence/absence). The resemblance matrix was visualized using the UPGMA algorithm.

The significance of differences between the number of species collected by different methods was assessed using *t*-test. Similarity percentage analysis (SIMPER; also performed in PAST 4.04) was used to identify the individual contribution of species to dissimilarities between the two sample sets collected by different methods. In these cases, I used data from biotopes where both methods were used.

"Dominant species" hereafter refers to the species, proportion of which is equal to or greater than 4% of the total number of collected specimens (subdominants and higher on the scale of Engelmann [1978]).

The degree of relative biotopic preferences of individual species is calculated according to the formula

$$F_{ij} = \frac{n_{ij}N - n_i N_j}{n_{ij}N + n_i N_j - 2n_{ij}N_j}, -1 \le F_{ij} \le +1$$

where n_{ij} is the number of individuals of the species *i* in the sample *j* with a sample size N_j;
n_i — number of individuals of the *i*-species in all material with sample size *N*.

If $F_{ij} = 0$, the species is indifferent to habitat; $F_{ij} = +1$, the species lives exclusively here; $F_{ij} = -1$, the species completely avoids habitat [Pesenko, 1982].

Published Data Sources

To assess the degree of faunal similarity of different parts of Yamal with the adjacent territories, I compiled lists of species using data from this study and published data on spider faunas of the northeastern Europe (for Kanin Peninsula, the list includes 75 species; Kolguev Isl., Barents Sea, 25 species; Novaya Zemlya and Vaygach Isl., respectively 25 and 22 species; Dolgiy Isl., Barents Sea, 51 species; Yugorsky Peninsula, 55 species; vicinity of the city of Vorkuta, Komi Republic, 123 species) and Siberia (Northern and Southern Yamal, respectively 36 and 165 species; Shokal-

sky Isl. and Sibiryakova Isl., Kara Sea, respectively 15 and 13 species; northern and southern parts of Gydan Peninsula, respectively 9 and 36 species; Western Taymyr, 60 species) [Esyunin, Efimik, 1996; Osipov, 2003; Tanasevitch, Koponen, 2007; Esyunin, Laetin, 2009; Tanasevitch *et al*., 2009, 2020; Coulson *et al*., 2014; Marusik, Koponen, 2015; Tanasevitch, Rybalov, 2015; Tanasevitch, Khrisanova, 2016; Marusik *et al*., 2016; Tanasevitch, 2017a,b; 2018; Tanasevitch, Khruleva, 2017, with additions; Nekhaeva, 2018; 2020; Nekhaeva *et al*., 2019].

Data on the distribution of individual species were obtained from the sources listed above. For some species, the borders of the distribution ranges were revised based on the latest taxonomic and faunistic studies, data on which were obtained from World Spider Catalog [2021] and Bibliographia on spiders of Russia and post-USSR republics [Mikhailov, 2012, 2019].

Accepted abbreviations

F_{ij} — index of relative biotopic preferences;

K — Kulczynski index;

SIMPER — Similarity percentage analysis.

The nomenclature follows World Spider Catalog [2021]. All materials used in the present study are temporarily stored in my personal collection and to be deposited in the Zoological Museum of the Moscow State University, Russia.

Results

Spider Fauna Local to the Vicinity of Seyakha Village

I identified a total of 47 species (two of which could not be reliably identified to species level) belonging to seven families (Table 2). The expected number for the region is 55±7 species. Linyphiidae was the predominant group on the basis of species richness (85.1%, 40 species). Lycosidae and Thomisidae were represented by two species each, and other families (Tetragnathidae, Gnaphosidae, Araneidae, and Theridiidae) were represented by a single species each. Five species (*Agyneta decora, A. ripariensis, Masikia caliginosa, Metopobactrus prominulus,* and *Walckenaeria clavicornis*) have not been previously recorded for the fauna of Yamal. It should be noted that the records from the vicinity of Seyakha come from one of the northernmost parts of distribution range for three species (*A. decora*, *A. ripariensis*, and *M. prominulus*).

Species Composition of Yamal

In addition to the species collected during this study, 14 more species were previously recorded in the Central Yamal (*Alopecosa hirtipes* (Kulczyński, 1907), *Agyneta allosubtilis* Loksa, 1965, *A. brusnewi* (Kulczyński, 1908), *A. nigripes* (Simon, 1884), *Bathyphantes setiger* F. O. Pickard-Cambridge, 1894, *Erigone remota* L. Koch, 1869, *E. tirolensis* L. Koch, 1872, *Hypselistes jacksoni* (O. Pickard-Cambridge, 1903), *Mecynargus paetulus* (O. Pickard-Cambridge, 1875) , *Oreoneta uralensis* Saaristo et Marusik, 2004, *Oreoneta* sp., *Praestigia groenlandica* Holm, 1967, *Semljicola lapponicus* (Holm, 1939), and *Styloctetor lehtinei* Marusik et Tanasevitch, 1998). A complete list of species found in different parts of Yamal is provided in Supplementary Materials.

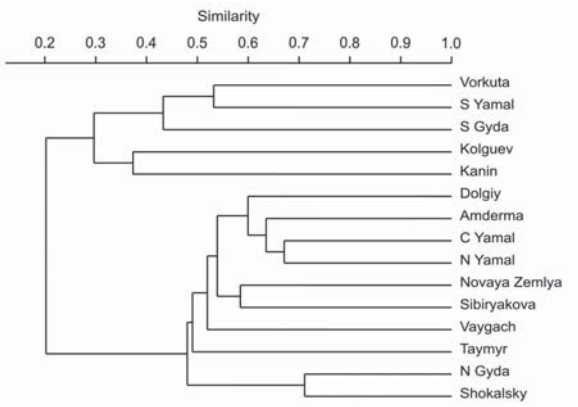

Fig. 2. Dendrogram comparing local spider faunas of northeastern Europe and Siberia (Kulczynski index). Abbreviations: Amderma — Yugorsky Peninsula; C Yamal — Central Yamal; Dolgiy — Dolgiy Island, Barents Sea; Kanin — Kanin Peninsula; Kolguev — Kolguev Island, Barents Sea; N Gyda — north of the Gydan Peninsula; N Yamal — Northern Yamal; Novaya Zemlya — Novaya Zemlya; S Gyda — south of the Gydan Peninsula; Shokalsky — Shokalsky Island, Kara Sea; Sibiryakova — Sibiryakova Island, Kara Sea; S Yamal — Southern Yamal; Taymyr — Taymyr Peninsula; Vaygach — Vaygach Island; Vorkuta — northeast of the Komi Republic (Vorkura vicinity).

Рис. 2. Дендрограмма сходства локальных фаун пауков северо-восточной Европы и Сибири (индекс Кульчинского). Сокращения: Amderma — Югорский п-ов; C Yamal — Средний Ямал; Dolgiy — о. Долгий, Баренцево море; Kanin — п-ов Канин; Kolguev — о. Колгуев, Баренцево море; N Gyda — Северный Гыдан; N Yamal — Северный Ямал; Novaya Zemlya — Новая Земля; S Gyda — Южный Гыдан; Shokalsky — о. Шокальского, Карское море; Sibiryakova — о. Сибирякова, Карское море; S Yamal — Южный Ямал; Taymyr — Таймыр; Vaygach — о. Вайгач; Vorkuta — северо-восток Республики Коми (окрестности г. Воркута).

Thus, according to the present study and the literature data, the spider fauna of Central Yamal consists of no less than 61 species. According to published data, the faunas of the Southern and Northern Yamal include 165 and 36 species, respectively. Total species richness of the whole Yamal Peninsula is at least 200 species [Esyunin, Efimik, 1996; Esyunin, Laetin, 2009; Tanasevitch *et al*., 2009; Tanasevitch, Rybalov, 2015; Tanasevitch, 2017b].

The fauna of Central Yamal is more similar to the fauna of the Northern part of the peninsula than of the Southern part (Fig. 2) (K index was 0.7 and 0.4, respectively, while for Southern and Northern Yamal, it was 0.3). Both Central and Northern Yamal are grouped into one cluster with known local faunas from the extreme northeast of Europe and northwestern Siberia (Fig. 2). Separate groups within this cluster are formed by local faunas with comparable species richness from similar bioclimate subzones (Dolgiy Island, Yugorsky Peninsula, and Central and Northern Yamal, from 36 to 59 species; Novaya Zemlya and Sibiryakova Island, respectively 25 and 13 spe-

Table 2. Spiders collected in the Central Yamal near Seyakha village and their abundance in the surveyed biotopes.
Таблица 2. Пауки, собранные на Среднем Ямале в окр. пос. Сеяха, и их обилие в обследованных биотопах.

Species \ Habitat number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fam. Linyphiidae															
Agyneta decora (O. Pickard-Cambridge, 1871)		5	3	10	7	8	2	1						3	
Agyneta rippariensis Tanasevitch, 1984						1									
Arcterigone pilifrons (L. Koch, 1879)				1											
Bathyphantes gracilis (Blackwall, 1841)							2	2							
Bathyphantes humilis (L. Koch, 1879)				3	1	1	7	11	1			4	1	2	2
Collinsia holmgreni Thorell, 1871)		46	118	2			7	1			5			1	3
Collinsia spetsbergensis (Thorell, 1871)														1	
Dactylopisthes video (Chamberlin et Ivie, 1947) *														1	
Diplocephalus barbiger (Roewer, 1955)			6			2						1		5	2
Erigone arctica palaearctica Brændegaard, 1934			2									1		12	3
Erigone longipalpis (Sundevall, 1830)												4			2
Erigone psychrophila Thorell, 1871 *						1						1			
Erigone whymperi O. Pickard-Cambridge, 1877													1		
Gibothorax tchernovi Eskov, 1989						1	1	15	1			17	12	30	1
Hilaira glacialis (Thorell, 1871)	4			27	12	1	7		7	2					
Hilaira incondita (L. Koch, 1879)			2									3	10	7	3
Hilaira nubigena Hull, 1911 *						1									
Hilaira proletaria (L. Koch, 1879)				1		17	1	1	1			2			
Masikia caliginosa Millidge, 1984												11	104	1	

Note: Habitat number corresponds to that in Table 1. Species marked with an asterisk (*) were represented by females only.

Table 2 (continued).
Таблица 2 (продолжение).

Species \ Habitat number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fam. Linyphiidae															
Masikia indistincta (Kulczyński, 1908)				23	4	32	1	3	1			1	5	29	
Mecynargus tundricola Eskov, 1988		2		8	28					4					
Metopobactrus prominulus (O. Pickard-Cambridge, 1873)				5	3					1					
Mughiphantes sobrius (Thorell, 1871) *									3						3
Oreoneta ?leviceps (L. Koch, 1879) *						1									
Paraglyphesis polaris Eskov, 1991 *				1		1								1	
Pelecopsis mengei (Simon, 1884)							1								
Pelecopsis parallela (Wider, 1834)				4	3	2							3	5	1
Pseudocyba miracula Tanasevitch, 1984							1							1	
Semljicola alticola (Holm, 1950)			1	21	1	3	36	3				2		20	6
Semljicola arcticus (Eskov, 1989)	1	1			7					1					
Semljicola barbiger (L. Koch, 1879)		2	3	29	24	4	2		5						2
Semljicola simplex (Kulczyński, 1908)		2	2	17	2									5	
Silometopoides sphagnicola Eskov et Marusik, 1992				3		4		1					1	2	
Tarsiphantes latithorax Strand, 1905		43	6												
Tmeticus nigriceps (Kulczyński, 1916)								2						1	4
Tubercithorax subarcticus (Tanasevitch, 1984)	9	9									4	1			
Wabasso hilairoides Eskov, 1988 *						1									
Walckenaeria clavicornis (Emerton, 1882)				1	9										
Linyphiidae gen. sp. 1 *														1	
Linyphiidae gen. sp. 2 *						1						1		1	

Table 2 (continued).
Таблица 2 (продолжение).

Species \ Habitat number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Fam. Lycosidae															
Alopecosa mutabilis (Kulczyński, 1908)				3	2				1						5
Pardosa septentrionalis (Westring, 1861)				2		1		1	3		1				1
Fam. Tetragnathidae															
Pachygnatha clercki Sundevall, 1823		3	2	4	7	8	11	7	9	2		3	2	5	2
Fam. Thomisidae															
Ozyptila arctica Kulczyński, 1908		1													
Psammitis albidus (Grese, 1909) *										1	4				
Fam. Gnaphosidae															
Micaria constricta Emerton, 1894	3	4					2								
Fam. Araneidae															
Larinioides cornutus (Clerck, 1757) *				1											
Fam. Theridiidae															
Theridiidae gen.sp.															1j
Total adult	17	118	145	166	110	91	81	48	32	11	14	52	139	134	40
Total species	4	11	10	20	14	20	14	12	10	6	4	14	9	21	15

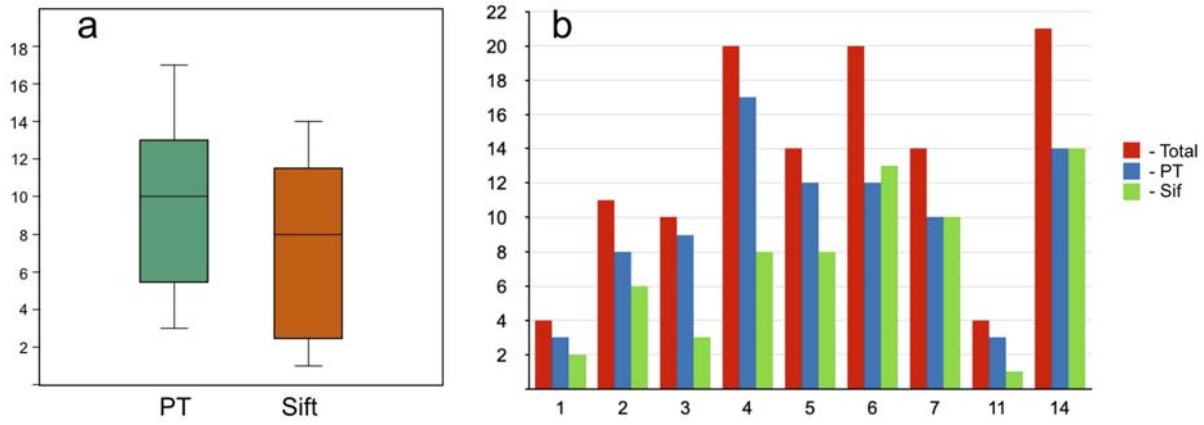

Fig. 3. The effectiveness of estimation of the species richness of spiders using pitfall traps (PT) and sifter (Sif): (a) box plot and (b) the number of species collected in separate habitats (numbers of biotopes on the abscissa axis as in Table 1).

Рис. 3. Эффективность оценки видового богатства пауков с помощью почвенных ловушек (PT) и сифтера (Sif): (a) диаграмма размаха и (b) число видов, собранное в отдельных биотопах (номера биотопов по оси абсцисс как в Таблице 1).

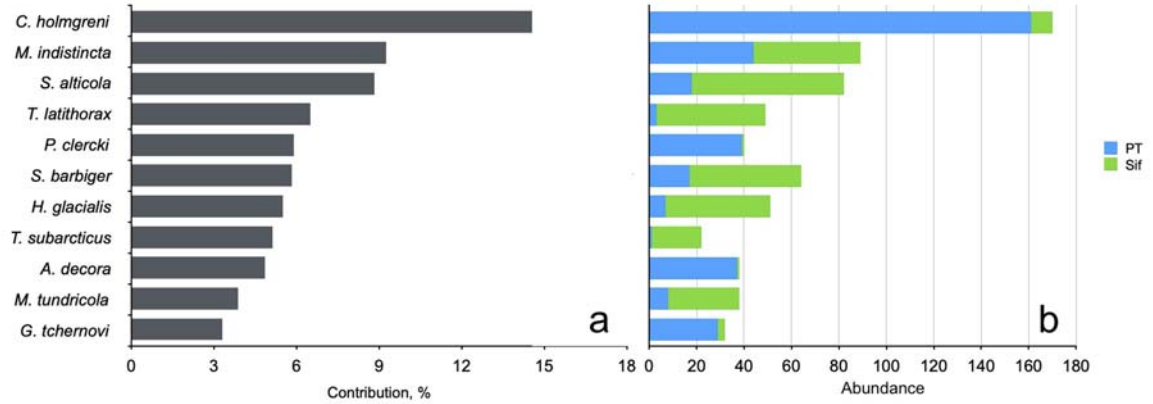

Fig. 4. The individual contribution of species to dissimilarities between the two sample sets collected by pitfall traps (PT) and sifter (Sif): (a) relative species contribution to differences between samples (SIMPER). Only species that contribution >3% are depicted; (b) number of individual species collected by different methods.

Рис. 4. Вклад видов в различия между пробами, собранными с помощью почвенных ловушек (PT) и сифтера (Sif): (a) относительный вклад видов в различия между образцами (SIMPER). Изображены только виды, вклад которых >3%; (b) численность видов при использовании разных методов.

cies; Shokalsky Island and North of the Gydan Peninsula, respectively 15 and 9 species). Southern Yamal, same as the southern part of the Gydan Peninsula, was grouped in the same cluster with the faunas of the Eastern European tundra (Fig. 2).

Pitfall Traps vs Sifting: Spider Diversity and Composition of Dominant Species

The pitfall traps captured a total of 35 species (Chao2 = 44±5), 12 of which were collected exclusively by that method. The material collected by sifter contained 31 species in total (Chao2 = 39±6), eight of which were collected exclusively by this method. The number of species collected by pitfall traps in a given habitat varied from three to seventeen, and the number of species collected using a sifter varied from one to fourteen (Fig. 3). In general, a greater number of species were caught by pitfall traps in each of the studied habitats (Fig. 3, b) (see Supplementary Materials).

There were no significant differences between the numbers of species collected using different methods ($t = 1.01$, $p = 0.31$). It should be noted, however, that the dataset of samples collected using pitfall traps is more balanced and has lower variance (Fig. 3, a).

In total, 23 out of 43 collected species were caught by both methods; SIMPER indicated that 11 of these 23 species contributed the most to the difference between two sample sets obtained by different methods (Fig. 4, a). Altogether these species determine 75.7% of the differences. All of them were collected by both traps and sifting. However, the composition of the dominant species differs for both collecting methods (the only exception is *Masikia indistincta*) (Fig. 4, b). For example, in the pitfall traps, such species as *Collinsia*

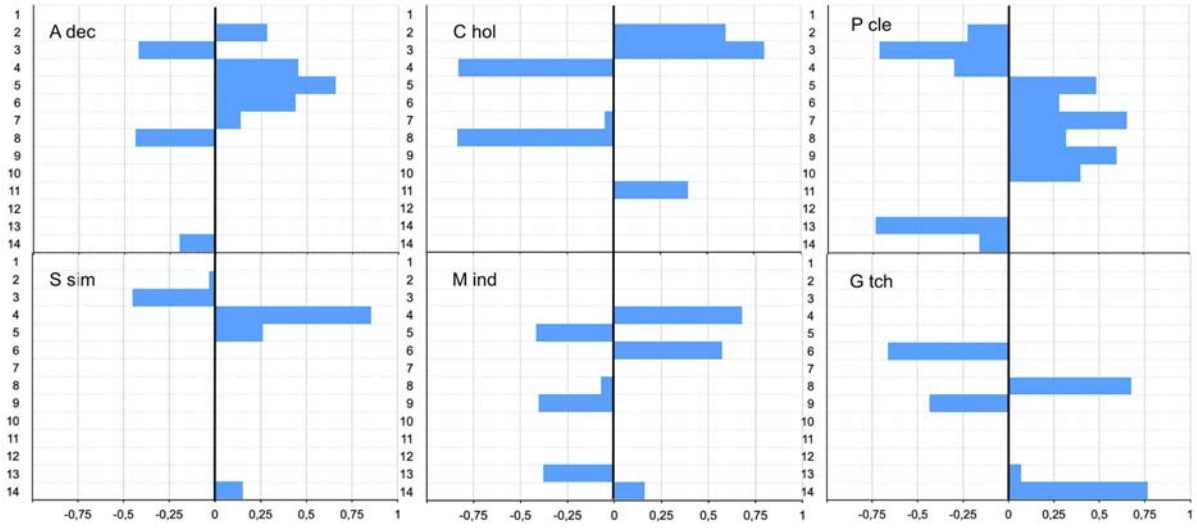

Fig. 5. The relative biotopic preferences of the dominant species of spiders collected by pitfall traps in the vicinity of Seyaha village. The abscissa shows the values of the *Fij* index, and the ordinate shows the biotope numbers, as in Table 1. Abbreviations: A dec — *Agyneta decora*; C hol — *Collinsia holmgreni*; G tch — *Gibothorax tchernovi*; M ind — *Masikia indistincta*; P cle — *Pachygnatha clercki*; S sim — *Semljicola simplex.*

Рис. 5. Относительная биотопическая приуроченность доминантных видов пауков, собранных почвенными ловушками в окрестностях пос. Сеяха. По оси абсцисс — значения индекса *Fij*, по оси ординат — номера биотопов как в Таблице 1. Сокращения: A dec — *Agyneta decora*; C hol — *Collinsia holmgreni*; G tch — *Gibothorax tchernovi*; M ind — *Masikia indistincta*; P cle — *Pachygnatha clercki*; S sim — *Semljicola simplex*.

holmgreni (32% of the total number of specimens collected by this method), *Masikia indistincta* (9%), *Pachygnatha clercki* (8%), *Agyneta decora* (7%), *Gibothorax tchernovi* (6%), and *Semljicola simplex* (5%) were represented by the highest number of specimens; while in the sifting material, species with the most specimens collected were *Semljicola alticola* (17%), *S. barbiger* (13%), *Tarsiphantes latithorax* (13%), *Hilaira glacialis* (12%), *M. indistincta* (12%), *Mecynargus tundricola* (8%), and *Tubercithorax subarcticus* (6%).

Biotopic Preferences of Dominant Species

Figures 5–7 show data on the biotopic preferences of the dominant species. The index F_{ij} exceeds 0.7 for some species in certain biotopes. In the pitfall traps, *Collinsia holmgreni* was the most abundant in the snow patch (F_{ij} = 0.8); *Semljicola simplex*, in the willow-shrub (F_{ij} = 0.85); *Gibothorax tchernovi*, along the river banks (F_{ij} = 0.77) (Fig. 5). In the sifting material, *Semljicola alticola* reached the highest abundance in the willows near the lake (F_{ij} = 0.7); *Tarsiphantes latithorax*, in the meadow (F_{ij} = 1) and in the snow patch (F_{ij} = 0.7); *Tubercithorax subarcticus*, in the *Dryas* tundra and zoogenic meadow (F_{ij} = 0.9 for both biotopes); *Mecynargus tundricola*, in the peat bog (F_{ij} = 0.9); *Masikia indistincta*, in the bog (F_{ij} = 0.8) and in the drifts along the river (F_{ij} = 0.7) (Figs 6 and 7).

Discussion

General Commentary on the Fauna

According to the araneogeographic zonation of the Northern Holarctic, Yamal, like the whole of Western Siberia, is a transitional region between the Angarian and European regions [Eskov, 1988]. K. Eskov [1986b, 1988] suggested that species from Siberia have the best conditions to penetrate into Northern Europe due to the influence of zonal factors. New data on the local spider faunas of the northeastern part of the Russian Plain and Yamal Peninsula confirmed this conclusion [Mazura, 2000; Mazura, Esyunin, 2001; Tanasevitch, Koponen, 2007; Esyunin, Laetin, 2009; Tanasevitch, Nekhaeva, 2014; Tanasevitch, Rybalov, 2015; Tanasevitch, Khruleva, 2017; Makarova *et al*., 2019; Nekhaeva, 2020; ets.]. For example, many Siberian spider species were found in the Northeastern Europe. For the Yugorsky Peninsula, the proportion of such species in the fauna was 54% [Tanasevitch, Khruleva, 2017]; in the Bolshezemelskaya tundra, 31% [Makarova *et al*., 2019]; in the Pechora delta, 18% [Mazura, 2000]; on the Kanin Peninsula, 8% [Nekhaeva, 2020]; and in the southeastern part of the Belomorsko-Kuloyskoe Plateau (Pinezhsky Nature Reserve), 3% [Tanasevitch, Nekhaeva, 2014]. In addition, two species with a Siberian distribution range (*Perregrinus deformis* (Tanasevitch, 1982) and *Kikimora palustris* Eskov, 1988) were also found in the Northern Fennoscandia [Koponen *et al*., 2002; Nekhaeva, 2012]. These species determine the similarity between the spider fauna of the northern part of Western Siberia and the spider fauna of the European tundra.

High proportion of Siberian species in the fauna of the Northeastern Europe was also noted for other animals. It has been suggested that during the last glaciation, the distribution ranges of the majority of such

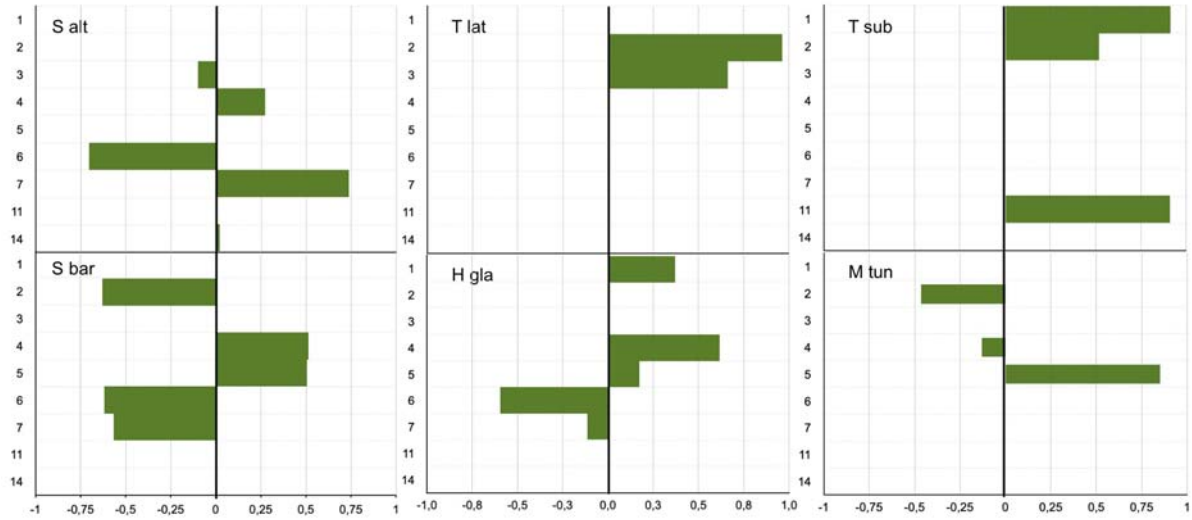

Fig. 6. The relative biotopic preferences of the dominant species of spiders collected by sifter in the vicinity of Seyaha village. The abscissa shows the values of the *Fij* index, and the ordinate shows the biotope numbers, as in Table 1. Abbreviations: S alt — *Semljicola alticola*; S bar — *Semljicola barbiger*; T lat — *Tarsiphantes latithorax*; M tun — *Mecynargus tundricola*; T sub — *Tubercithorax subarcticus*; H gla — *Hilaira glacialis*.

Рис. 6. Относительная биотопическая приуроченность доминантных видов пауков, собранных с помощью сифтера в окрестностях пос. Сеяха. По оси абсцисс — значения индекса *Fij*, по оси ординат — номера биотопов как в Таблице 1. Сокращения: S alt — *Semljicola alticola*; S bar — *Semljicola barbiger*; T lat — *Tarsiphantes latithorax*; M tun — *Mecynargus tundricola*; T sub — *Tubercithorax subarcticus*; H gla — *Hilaira glacialis*.

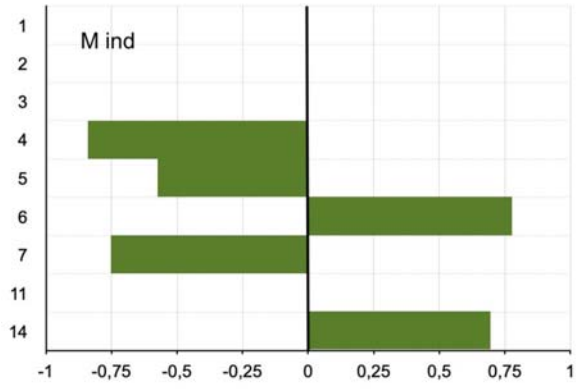

Fig. 7. The relative biotopic preferences of *Masikia indistincta* collected by sifter in the vicinity of Seyaha village. The abscissa shows the values of the *Fij* index, and the ordinate shows the biotope numbers, as in Table 1.

Рис. 7. Относительная биотопическая приуроченность *Masikia indistincta*, собранных с помощью сифтера в окрестностях пос. Сеяха. По оси абсцисс — значения индекса *Fij*, по оси ординат — номера биотопов как в Таблице 1.

species were much wider, and their modern European parts are of residual nature (see Makarova *et al*. [2019]).

Methodological Aspect

Pitfall traps captured species better when either the local fauna of Central Yamal in its entirety or only individual habitats were considered (Fig. 3). The number of species caught only by pitfall traps also exceeded the number of species caught only by the sifter (moreover, in the latter case, all species were represented by single specimens) (see Supplementary Materials). However, I found no significant differences between the number of species collected using pitfall traps and a sifter. At the same time, the nonparametric estimation of species richness as calculated for each method separately is almost the same. It can be preliminarily concluded that both methods are effective for pioneer studies of the spider fauna at high latitudes (at least in subzone D, Fig. 1).

The difference in the composition of dominant species is obviously due to the collection of specimens from the populations of different microhabitats. It is known that the inhabitants of the litter are less diverse, but more specific than the surface-dwelling species [Huhta, 1971]. Thus, the dominant species from the sifting material were comprised mostly of small (except for *Hilaira glacialis*) linyphiids inhabiting moss and litter. It is important to note that all dominants were present in the materials collected using both methods. Therefore, it is necessary to consider the collection method in ecological studies: in particular, when studying the structure of communities or assessing the biotopic distribution of individual species both at the community level and across the entire range.

Features of the Biotopic Distribution of Dominants

I found no clear biotopic preferences for the populations of the majority of the dominant spider species in the Central Yamal. Only *Tarsiphantes latithorax* and *Mecynargus tundricola* are probably stenotopic. The former species was most abundant in the forb meadow, and the latter, in the peat bog. *Collinsia*

holmgreni appears to prefer the snow patch, where the majority of its specimens were collected. The increased number of *C. holmgreni* individuals in the forb meadow is probably an artifact caused by the proximity of these biotopes. For other species, I can note selectivity in regards to the type of inhabited biotopes (for example, on the basis of the degree of moisture or the presence of a pronounced moss cover). For example, *Gibothorax tchernovi* prefers coastal waterlogged habitats; *Agyneta decora*, *Semljicola simplex*, *S. barbiger*, *Hilaira glacialis*, and *Masikia indistincta* inhabited mainly boggy habitats with pronounced moss cover; *Tubercithorax subarcticus* prefers the *Dryas* tundra and zoogenic meadow; *S. alticola* prefers willow thickets. *Pachygnatha clercki* appears to be eurytopic.

The ability of spiders to inhabit a wide range of habitats was also noted for the spiders of Europe [Duffey, 2005], Siberia [Eskov, 1981; 1986a, b], and when comparing the topical distribution of spiders in various Arctic regions of Eurasia [Khruleva *et al*., 2018]. At the same time, K. Eskov [1981] emphasizes that, despite a wide biotopic plasticity for most species, a preference for a certain type of biotopes where spiders reach the greatest abundance could be noted. This observation is consistent not only with my data on the spiders of Central Yamal, but also the data on the spider populations on the spit in Kolyuchin Bay (Chukotka), where most of the species are confined to wet areas [Khruleva *et al*., 2018]. In other parts of the distribution range in the Eurasian sector of the Arctic, the same species prefer similar habitats [Khruleva *et al*., 2018]. For example, *G. tchernovi* and *Masikia caliginosa* inhabited mainly coastal waterlogged habitats in the surveyed areas of the northern Palearctic [Tanasevitch, Nekhaeva, 2016; Tanasevitch, Khruleva, 2017; Nekhaeva, 2018; Nekhaeva *et al*., 2019].

Obviously, high biotopic plasticity is one of the factors determining the success of spiders at high latitudes [Duffey, 2012]. For example, it has been established that the confinement of individual species even to the largest landscape units (for example, taiga or floodplain) in Southern Yamal is lower than in Mirnoye (the middle course of the Yenisei River) [Eskov, 1981, 1986b]. Differences in biotopic preferences (extreme in some cases) in different parts of the distribution range, as known for European [Duffey, 2005] and Siberian spiders [Eskov, 1981, 1986b], seem to be expressed weakly at high latitudes. In the Arctic, the influence of physical factors increases as the conditions become more extreme [Chernov, 1989]. These factors can in turn determine the selectivity of species for certain types of inhabited communities.

Supplementary data. The following materials are available online (in one file).

Table S1. List of spider species found in different parts of Yamal.

Table S2. Spider collection effectiveness with pitfall traps (PT) and sifter (Sif).

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