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Spiders (Arachnida, Aranei) of the High Arctic Shokalsky Island (73°N), the Kara Sea, Russia

Пауки (Arachnida, Aranei) высокоарктического острова Шокальского, Карское море, Россия

Anna A. Nekhaeva
Анна А. Нехаева

A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospekt 33, Moscow 119071, Russia. E-mail: adrealinea@gmail.com
Институт проблем экологии и эволюции имени А.Н. Северцова РАН, Ленинский проспект 33, Москва 119071, Россия.

KEY WORDS: Araneae, Arctic island, fauna, protected territory, salt marshes, tundra.
КЛЮЧЕВЫЕ СЛОВА: Araneae, арктический остров, фауна, охраняемая территория, приморские марши, тундра.

ABSTRACT. Small Arctic islands are poorly accessible territories having specific faunas. Although many of them are included in conservancy areas, virtually nothing is known about their invertebrate faunas. In the present paper, the first results of a comprehensive study of species diversity, density and activity of spiders undertaken on the Shokalsky Island (73ºN) situated in the Kara Sea are provided. Spider species collected during this survey belong to the families Linyphiidae (13 species) and Tetragnathidae (one); all of them are known from the adjacent continental regions. Compared to faunas of small islands in the Barents Sea, the araneofauna of the Shokalsky Island is impoverished, which is due to the homogeneity of its habitats and colder climate.

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РЕЗЮМЕ. Небольшие арктические острова — это труднодоступные территории со специфичной фауной. Хотя многие из них входят в состав заповедников, данные о составе их фаун беспозвоночных, по большей части, отсутствуют. В настоящей работе представлены первые результаты комплексных исследований разнообразия, плотности и активности пауков, выполненных на острове Шокальского (73° с.ш.), расположенном в Карском море. Виды пауков, найденные в ходе исследования, принадлежат к семействам Linyphiidae (13 видов) и Tetragnathidae (1); все они известны с прилежащих континентальных регионов. Аранеофауна острова Шокальского обеднена в сравнении с фаунами небольших островов Баренцева моря, что обусловлено однообразностью местообитаний и более холодным климатом.

Introduction

An Arctic fauna is species-poor, mainly consisting of widespread species due to a relatively young age of Arctic landscapes and harsh environmental conditions [Brochmann *et al.*, 2003]. Yet, life there requires profound morpho-physiological and ecological adaptations [Danks, 1981, 2004]. The invertebrate fauna of Arctic islands is rather specific because its formation differed from that of mainland faunas [Gislason, 2005; Alsos *et al.*, 2009; Coulson *et al.*, 2013]. To date, species composition of only a few Arctic islands and/or archipelagos, such as Greenland [Marusik *et al.,* 2006; Böcher *et al.*, 2015], Svalbard [Coulson *et al.,* 2014], Wrangel Island [Stishov, 2004; Novichkova, Chertoprud, 2015] and Ellesmere Island [Leech, 1966; Brodo, 2000], have been inventoried to certain extent. Available faunistic data from other Arctic archipelagos in the Palaearctic Region (e.g., Novaya Zemlya, Severnaya Zemlya, Novosibirskie Islands) are fragmentary and/or based on the materials that were mainly obtained during the initial period of Arctic exploration at the end of the 19th – the beginning of the 20th centuries [Økland, 1928; Holm, 1973; Marusik *et al.*, 1993; Coulson *et al.*, 2014; Tanasevitch, 2017a,b].

All the aforementioned regions are large and isolated terrains, whereas the majority of Arctic islands are rather small and have a much lesser habitat diversity. Yet, islands located near the mainland are influenced by a greater species expansion from the continent [Bolotov, Shutova, 2006; Nekhaeva, Nekhaev, 2011; Baranov, Nekhaev, 2017]. However, special faunistic studies in such islands are extremely rare in the Arctic and were carried out mainly in the Barents Sea region [Makarova, Makarov, 2006; Makarova *et al.*, 2010; Nekhaeva, Nekhaev, 2011; Nartshuk, 2014; Makarova *et al.*, 2015; Marusik *et al.*, 2016]. Little is known about invertebrate faunas of the extreme north of Siberia and especially of islands in Siberian seas because of

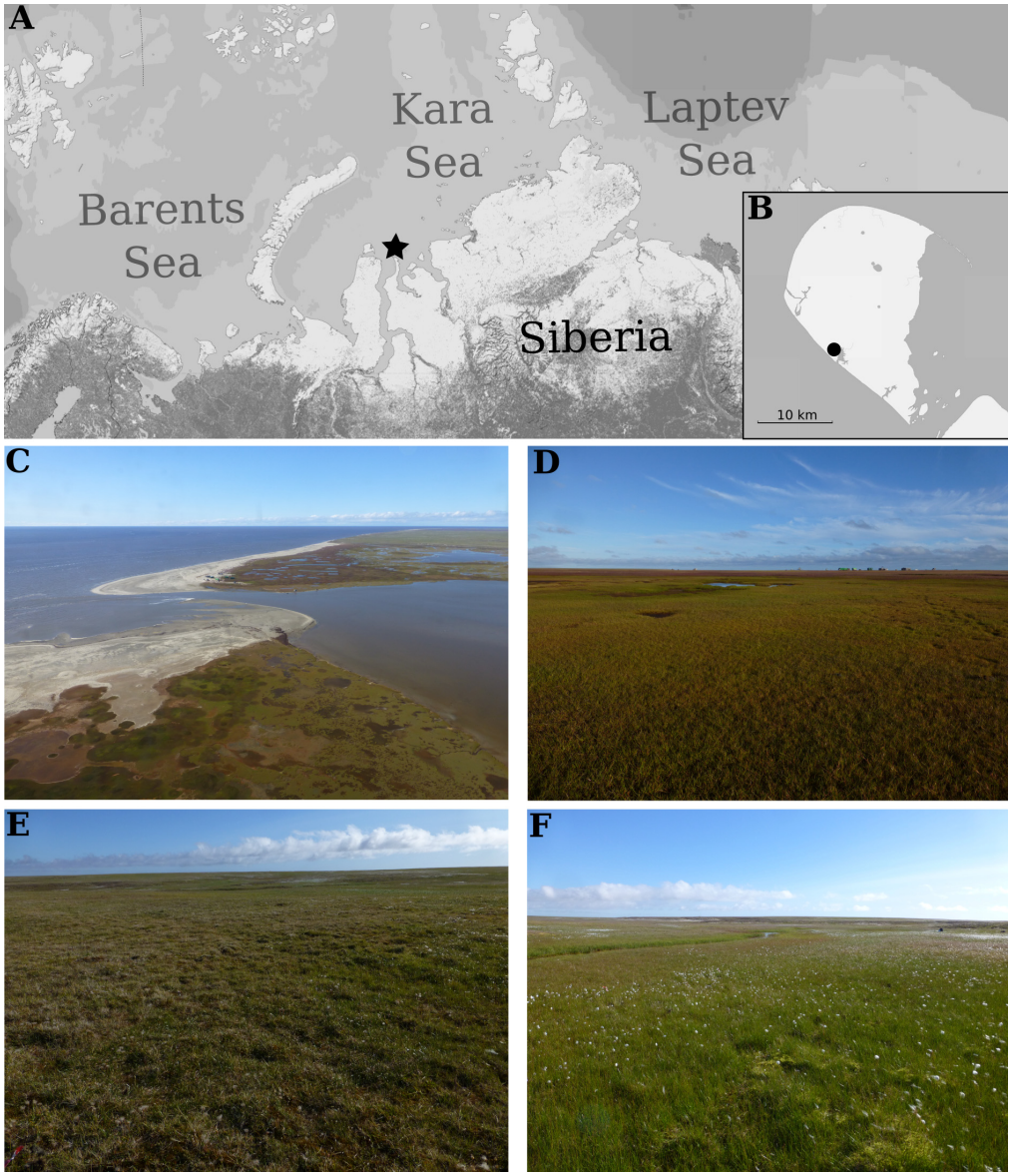

Fig. 1. Map and a view of the studied area. A — map of northern Eurasia with the Shokalsky Island (marked with a star); B — map of the Shokalsky Island, with the location of field station of the Gydansky Nature Reserve (circle); C, D — salt marshes; E — sedge-moss tundra, F — moss-cottongrass bog.

Рис. 1. Карта и обзор изученной территории. A — карта северной Евразии с указанием места расположения о. Шокальского (звезда); B — карта о. Шокальского с указанием места расположения кордона Гыданского заповедника (круг); C, D — соленые марши; E — осоково-моховая тундра, F — мохово-пушицевое болото.

their poor accessibility [Novichkova, 2016; Novichkova, Chertoprud, 2017; Tanasevitch, 2017b].

This paper presents results of the first survey of a spider fauna of the High Arctic Shokalsky Island (73ºN) situated in the Kara Sea (Western Siberia), being part of the Gydansky Nature Reserve. No earlier spider record from that island has been published to date.

Material and methods

Sampling area

The Shokalsky Island (остров Шокальского, Shokalskogo Isl., Schokalsky Isl.) is situated in the southern part of the Kara Sea, NE of the Yamal Peninsula (полуостров Ямал) in Arctic Russia (Fig.1A). It is separated from the Yavai Peninsula (полуостров Явай) by the Gydansky Strait (Гыданский пролив) which does not exceed 5 km in its width. The island and the adjacent waters are part of the Gydansky Nature Reserve. The island is ca. 30 km long and ca. 20 km wide, its total area is about 495 km² [Rebristaya, 2002; Gorchakovskiy, 2015a]. It is flat with the maximal elevation of about 10 m above sea level. The ground is composed of permafrost and subterranean ice. An average annual air temperature is –10 °C to –12 °C. July and August are the warmest months with

an average temperature of +5 °C. The mean duration of the frostless period is 55–70 days [Kalyakin *et al.*, 2000].

The island is situated in the northern part of the arctic tundra subzone of the tundra belt [Yurtsev, 1994]. Its vegetation is dominated by mosses and herbaceous plants (especially grasses, sedges, cottongrasses), while lichens are not abundant [Rebristaya, 2002]. Maritime halophilic vegetation (viz., *Puccinellia phryganodes* (Trin.) Scribn. et Merr. and *Carex subspathacea* Wormsk. ex Hornem.) occurs on beaches along the entire seashore [Rebristaya, 2002]. Island ecosystems are not transformed by human activities, providing suitable sites for nesting of many birds and/or for goose moulting, with the highest bird densities being observed in river valleys and deltas where they intensively feed [Gorchakovskiy, 2015b; Dubrovsky *et al.*, 2016].

Sampling and sample processing

Terrestrial arthropod fauna was sampled from 1st to 23rd August 2016. Samples were taken from the SW part of the island around the field station of the Gydansky Nature Reserve (Fig. 1B). A number of different but the most characteristic island habitats were studied (Figs 1C–F): viz., the tundra with *Carex* spp., green mosses, *Dryas* sp. and *Salix* spp. (Fig. 1E); the bog with *Poa* spp., cottongrasses and *Sphagnum* spp. (Fig. 1F); the surroundings of Arctic fox's burrow which are distinct by a variety of herbaceous plants; heath community dominated by *Dryas* sp.; shore algae drifts; and three types of the salt marsh communities (Figs 1C, D; salt marshes are dried land areas of sea costs covered with halophilic vegetation, which are formed on alluvial deposits and are subject of regular underflooding by sea water [Sergienko, 2008; Koroleva *et al.*, 2011]). The first (lowest) marsh level is situated closer to the sea and dominated by *P. phryganodes*, the second (median) one dominated by *C. subspathacea*, and the third (highest) is the most distant from the sea. Yet, a goose moulting site was surveyed at the second (median) marsh level.

The following collecting methods were used: taking soil samples (25 × 25 cm), sifting moss and litter, setting up pitfall traps (200 ml plastic cups with a 2–4% formaldehyde solution and a drop of detergent as a preservative), sweeping and hand-collecting. Some of the research sites were flooded for several days during storms and some pitfall traps were destroyed by Arctic foxes and geese. For this reason, a full set of collecting methods was impossible to apply in all the studied habitats, and therefore an exact estimation of comparative abundance and species diversity was impossible.

Twenty-five soil samples were taken from different habitats and sorted out by hands or by means of a sifter; more than 600 trap-days were processed. The material was sorted out during the fieldwork in accordance with a collecting method and preserved in 98% ethanol. Then it was transported to a laboratory and identified under a stereomicroscope.

A total of 1606 specimens was collected, of which 786 adult specimens were identified to species. The nomenclature follows WSC [2018]. All the studied material will be deposited in the Zoological Museum of the Moscow State University, Russia (curator — K.G. Mikhailov).

The evaluation of local species richness was performed in PAST Version 3.15 with the non-parametric species richness estimator Chao2 [Colwell, Coddington, 1994; Hammer *et al.*, 2001]. Spider density and dynamic activity were calculated with considering juvenile specimens.

Results

Thirteen species of Linyphiidae were identified among the collected material (Table 1). A juvenile *Pachygnatha* specimen apparently belonging to a new species (Azarkina and Marusik, pers. comm.) was also collected. The taxonomic status of *Masikia* aff. *indistincta* found during this study is yet unclear and requires further studies, as there are visible differences in the shape of its male palpal tibia and the conformation of its embolic division and epigyne from true *M. indistincta* (Kulczyński, 1908). Thus, altogether 14 spider species have been recorded, with this figure being equal to the estimated species richness: Chao2 = 14±2.

The species number in the studied habitats varied from three to nine (Table 1). The highest species diversity was observed in the tundra and the third (highest) sea marsh level. The most common and abundant species occurring in almost all the studied sites were *M.* aff. *indistincta* (270 specimens), *Erigone psychrophila* (178) and *Hilaira glacialis* (163). The former two species were most numerous in wet habitats (salt marshes and bogs), whereas the latter one seems to show no preference to moisture. The rest of spider species were not so frequent, with *Diplocephalus barbiger*, *Tmeticus nigriceps* and *Semljicola alticola* being presented by singletons only.

The spider density in salt marshes tends to increase with a distance from the sea (Table 2): spiders were not found in the first (lowest) marsh level, whereas their density was 48 and 416 ind./ m^2 in the second and third marsh levels respectively. At the goose moulting site, the spider density was higher than in the marshes that were not affected by birds. The highest spider activity and its maximal meaning (235 ind./100 trap-days) were also observed in the marshes.

Discussion

This is the first study of spiders in the Shokalsky Island. All the species found on the island are common and rather widespread in the Arctic (Table 1), except for *E. a. palaearctica* having an east European range. However, the majority of these species are confined to the tundra zone, with only three of them (*E. psychrophila, H. proletaria* and *H. incondita*) extending their

Table 1. A total number of adult (♀/♂) and juvenile spider specimens collected from different habitats on the Shokalsky Isl.
Таблица 1. Общее количество взрослых (♀/♂) и ювенильных экземпляров пауков, собранных в различных местообитаниях на о. Шокальского

Species/Habitat	M-2	M-2g	M3	Dr	T	FB	B	In	Total	Range
Collinsia spetsbergensis (Thorell, 1871)	–	–	–	8/11	7/1	6/2	–	–	21/14	Hol
Diplocephalus barbiger (Roewer, 1955)	–	–	–	–	–/2	–	–	–	–/2	Sib-Nea
Erigone arctica palaearctica Braendegaard, 1934	–	–	1/–	–	–/1	9/9	–	–	10/10	E Eu
Erigone psychrophila Thorell, 1871	10/3	1/2	54/84	–	1/2	–	8/11	–/2	74/104	Hol
Gibothorax tchernovi Eskov, 1989	–	–	2/9	–	–	–	–	–	2/9	Sib
Hilaira glacialis (Thorell, 1871)	1/1	–	7/25	1/4	46/35	–/4	19/17	3/–	77/86	Sib
Hilaira proletaria (L. Koch, 1879)	2/-	–	1/1	–	–	–	5/9	–	8/10	Sib-W Nea
Hilaira incondita (L. Koch, 1879)	–	–	2/1	–	1/–	–	5/1	–	8/1	Sib-Nea
Masikia aff. *indistincta* (Kulczyński, 1908)	1/1	5/1	44/145	–	13/3	1/3	22/29	–/2	86/184	?
Mecynargus tundricola Eskov, 1988	–	1/–	2/1	–	21/20	–	1/–	–	26/21	Sib
Semljicola alticola (Holm, 1950)	–	–	–	–	–	–	–	1/–	1/–	Pal
Semljicola arcticus (Eskov, 1989)	–	–	–	2/1	14/14	–	–	–	16/15	Sib
Tmeticus nigriceps (Kulczyński, 1916)	–	–	–/1	–	–	–	–	–	–/1	Sib
Linyphiidae gen.sp. juv	24	17	323	23	177	38	190	27	819	
Pachygnatha sp. juv	–	–	1	–	–	–	–	–	1	
Total number of specimens	43	27	704	50	358	72	317	35	329/457 1606	
Total number of species	4	3	9	3	9	4	6	4		

Abbreviations. Habitats: M2 — the second (median) salt marsh level, M-2g — the goose moulting site in the second salt marsh level, M3 — the third (highest) salt marsh level, Dr — the heath community dominated by *Dryas* sp., T — the sedge-moss tundra, FB — Arctic fox's burrow, B — moss-cottongrass bog, In — shore algae drifts, «–» — species or sex absent from the habitat. Range: Hol — Holarctic, Pal — Palaearctic, Sib — Siberian, Sib-Nea — Siberian-Nearctic, Sib-W Nea — Siberian-West Nearctic, E Eu — East European.

Сокращения. Биотопы: M2 — марши второго уровня, M-2g — гусиный линник на марше второго уровня, M3 — марши верхнего (третьего) уровня, Dr — дриадник, T — осоково-моховая тундра, FB —песцовая нора, B — мохово-пушицевое болото, In — выбросы водорослей на литорали, «–» — вид или пол отсутствует в местообитании. Ареал: Hol — Голарктический, Pal — Палеарктический, Sib — Сибирский, Sib-Nea — Сибирско-Неарктический, Sib-W Nea — Сибирско-Западнонеарктический, E Eu — Восточноевропейский.

Table 2. Spider density and activity in selected studied habitats.
Таблица 2. Плотность и активность пауков в некоторых обследованных местообитаниях.

Habitat	M-1	M-2	M-2g	M-3	Dr	FB	M-2	T	B
Day	18.VIII	18.VIII	21.VIII	18.VIII	13.VIII	13.VIII	11.VIII		
Method	h/s	h/s	h/s	h/s	sift	sift	sift	–	–
Ind./m^2	0	48	84	416	28	80	112*	–	–
Ind./100 trap-days	–	144	–	235	70	51	–	74	49

Abbreviations. Habitats: M1 — the first (lowest) sea marsh level, other abbreviations as in Table 1. Methods: h/s — hand sorting of soil samples, sift — sifting of soil samples, «–» — no data. **Note.** Density per m^2 calculated on the basis of data from four soil samples 25x25 cm; * — calculations based on one sample 25x25 cm.

Обозначения. Биотопы: M1 — марш нижнего уровня, остальные обозначения как в Таблице 1. Методы: h/s — ручная разборка почвенных проб, sift — просеивание почвенных проб, «–» — нет данных. **Примечание.** Плотность на квадратный метр рассчитана на основе данных из четырех почвенных проб размером 25x25 см; * — вычисления выполнены на базе одного образца 25x25 см.

Table 3. Species richness revealed in the studied habitats by different methods.
Таблица 3. Видовое богатство, выявленное в сообществах с помощью разных методов.

Method/Habitat	M-2	M-2g	M-3	Dr	T	FB	B
p/t	2	1	6	3	8	4	5
s/s	4	2	3	–	–	–	–
sift	0	–	3	1	5	2	3
h/c	–	0	9	–	4	1	0
sw	–	–	1	–	–	–	–

Abbreviations. p/t — pitfall traps, s/s — soil samples, sift — sifting of moss and litter, h/c — hand collecting, sw — sweeping, «–» — no data, other abbreviations as in Table 1.

Сокращения. p/t — почвенные ловушки, s/s — почвенные пробы, sift — сифтование мха и подстилки, h/c — ручные сборы, sw — кошение энтомологическим сачком, «–» — нет данных, другие сокращения как в Таблице 1.

ranges southward [Marusik, Eskov, 2009; Esyunin, 2015].

All the recorded species are also known from the adjacent continental areas of northern Yamal and Gydan Peninsula [Marusik, Koponen 2015; Tanasevitch, Rybalov, 2015; Tanasevitch, Khrisanova 2016]. Noteworthy is the absence of island representatives of Lycosidae, Thomisidae and Gnaphosidae which are known from northern Yamal. Thus, the spider fauna of the Shokalsky Island apparently represents a kind of impoverished fauna of the adjacent mainland.

The taxonomic spider diversity of the Shokalsky Island is rather low compared to small islands of the Barents Sea, such as Bolshoy Aynov (70°N) and Dolgiy Island (69°N) where 17 and 52 species were recorded respectively [Nekhaeva, Nekhaev, 2011; Marusik *et al.*, 2016]. This is probably due to the habitat homogeneity in the Shokalsky Island (e.g., almost the total absence of shrubs and undershrubs, and a poor development of the moss cover), which is not typical for the aforementioned islands in the Barents Sea. Moreover, the climate of the Barents Sea region is milder due to warming effect of the Gulf Stream.

In the present study, not all collecting methods were used in all the studied sites (Table 3). Nevertheless, the species richness of the tundra spider community is equal to that of the third marsh level (Table 1). Spider diversity and density indeed increase from the first (lowest) to the third (highest) levels of salt marshes (Table 2). A similar tendency was revealed for spiders and other terrestrial arthropods from salt marshes of the north-west coast of France and those of the North and Baltic Seas [Desender, Maelfait, 1999; Irmler *et al.*, 2002; Pétillon *et al.*, 2008; Haynert *et al.*, 2017]. The maximal spider activity in salt marshes was also reported for shores of the Baltic and Barents Seas, and it was explained by a high quantity of suitable spider preys (springtails and chironomids) [Palmgren, 1972; Nekhaeva, 2015]. The absence of spiders at the first (lowest) marsh level could be due to the scarcity of vegetation and a strong influence of periodical tidal flooding and/or underflooding by sea water during storms. Yet, other causative factors cannot be excluded.

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References

Alsos I.G., Gillespie L., Marusik Y.M. 2009. Arctic islands, biology // Gillespie R.G., Clague D.A. (eds.). Encyclopedia of Islands. Berkeley: University of California Press. P.47–55.

Baranov V., Nekhaev I. 2017. Impact of the bird-manure caused eutrophication on the abundance and diversity of chironomid larvae (Diptera; Chironomidae) in lakes of the Bolshoy Aynov Island (Russia, Barents Sea) // CHIRONOMUS Journal of Chironomidae Research. No.30. P.72–75.

Böcher J., Kristensen N.P., Pape T., Vilhelmsen L. 2015. The Greenland entomofauna: an identification manual of insects, spiders and their allies. Brill. 881 p.

Bolotov I.N., Shutova E.V. 2006. Patterns of formation of island fauna of butterflies (Lepidoptera, Diurna) at the northern forest boundary in the region of pleistocene continental glaciation (by the example of White Sea islands) // Biology Bulletin. Vol.33. No.3. P.260–268.

Brochmann C., Gabrielsen T.M., Nordal I., Landvik J.Y., Elven R. 2003. Glacial survival or tabula rasa? The history of North Atlantic biota revisited // Taxon. Vol.52. No.3. P.417–450.

Brodo F. 2000. The insects, mites, and spiders of Hot Weather Creek, Ellesmere Island, Nunavut // Geological Survey of Canada, Bulletin. Vol.529. P.145–173.

Coulson S.J., Convey P., Aakra K., Aarvik L., Ávila-Jiménez M.L., Babenko A., Biersma E.M., Boström S., Brittain J.E., Carlsson A.M., Christoffersen K., De Smet W.H., Ekrem T., Fjellberg A., Füreder L., Gustafsson D., Gwiazdowicz D.J., Hansen L.O., Holmstrup M., Hullé M., Kaczmarek Ł., Kolicka M., Kuklin V., Lakka H.-K., Lebedeva N., Makarova O., Maraldo K., Melekhina E., Ødegaard F., Pilskog H.E., Simon J.C., Sohlenius B., Solhøy T., Søli G., Stur E., Tanasevitch A., Taskaeva A., Velle G., Zawierucha K., Zmudczyńska-Skarbek K. 2014. The terrestrial and freshwater invertebrate biodiversity of the archipelagoes of the Barents Sea; Svalbard, Franz Josef Land and Novaya Zemlya // Soil Biology and Biochemistry. Vol.68. P.440–470.

Coulson S.J., Fjellberg A., Gwiazdowicz D.J., Lebedeva N.V., Melekhina E.N., Solhøy T., Erséus C., Maraldo K., Miko L.,

Schatz H., Schmelz R.M., Søli G., Stur E. 2013. Introduction of invertebrates into the High Arctic via imported soils: the case of Barentsburg in the Svalbard // Biological Invasions. Vol.15. No.1. P.1–5.

Danks H.V. 1981. Arctic arthropods. A review of systematics and ecology with particular reference to the north American fauna. 608 p.

Danks H.V. 2004. Seasonal adaptations in arctic insects // Integrative and Comparative Biology. Vol.44. No.2. P.85–94.

Desender K., Maelfait J.P. 1999. Diversity and conservation of terrestrial arthropods in tidal marshes along the River Schelde: a gradient analysis // Biological Conservation. Vol.87. No.2. P.221–229.

Dubrovsky V.Y., Shiryaev D.M., Korostelev N.B., Chertoprud E.M. 2016. [Avifauna of Shokalsky Island in postbreeding period] // Zoologichesky Zhurnal. Vol.95. No.3. P.344–347 [in Russian with English summary].

Esyunin S.L. 2015. [The spider (Aranei) fauna of the Urals: diversity, structure, typification] // Caucasian Entomologicall Bull. Vol.11. No.2. P.237–257 [in Russian with English summary].

Gislason G.M. 2005. Origin of freshwater fauna of the North-Atlantic islands: present distribution in relation to climate and possible migration routes // Internationale Vereinigung für Theoretische und Angewandte Limnologie Verhandlungen. Vol.29. No.1. P.198–203.

Gorchakovskiy A.A. 2015a. [The Polar Bear on the Shokalskiy Island (the Yamal-Nenets autonomous district)] // Fauna Urala i Sibiri. No.1. P.134–140 [in Russian with English summary].

Gorchakovskiy A.A. 2015b. [Birds of the Shokalskiy Island and the Yavay Peninsula (the Yamal-Nenets autonomous district)] // Fauna Urala i Sibiri. No.2. P.48–60 [in Russian with English summary].

Hammer Ø., Harper D.A.T., Ryan P.D. 2001. PAST: Paleontological statistics software package for education and data analysis // Palaeontologia Electronica. Vol.4. No.1. P.1–9.

Haynert K., Kiggen M., Klarner B., Maraun M., Scheu S. 2017. The structure of salt marsh soil mesofauna food webs – The prevalence of disturbance // PloS ONE. Vol.12. No.12: e0189645.

Holm Å. 1973. On the spiders collected during the Swedish expeditions to Novaya Zemlya and Yenisey in 1875 and 1876 // Zoologica Scripta. Vol.2. No.2–3. P.71–110.

Irmler U., Heller K., Meyer H., Reinke H.-D. 2002. Zonation of ground beetles (Coleoptera: Carabidae) and spiders (Araneida) in salt marshes at the North and the Baltic Sea and the impact of the predicted sea level increase // Biodiversity & Conservation. Vol.11. No.7. P.1129–1147.

Kalyakin V.N., Romanenko F.A., Molochaev A.V., Rogacheva E.V., Syroechkovskii E.E. 2000. [Gudansky Nature Reserve] // Pavlov D.S., Sokolov V.E., Syroechkovskii E.E. (eds.). Zapovedniki Sibiri. Moscow: Logata Press. P. 47–55 [in Russian with English summary].

Koroleva N.E., Chinenko S.V., Sortland B. 2011. [Marshes, beaches, and brackish water vegetation of Murmanskiy, Terskiy and East of Kandalakshskiy bereg (Murmansk region, Russia)] // Fitoraznoobrazie Vostochnoi Evropy. No.9. P.26–62 [in Russian with English summary].

Leech R.E. 1966. The Spiders (Araneida) of Hazen Camp 81º49'N, 71º18'W // Quaestiones entomologicae. Vol.2. P.153–212.

Makarova O.L., Makarov K.V. 2006. True bugs (Heteroptera) from the Arctic Dolgii Island, the Barents sea // Entomological Review. Vol.86. No.4. P.423–432.

Makarova O.L., Ermilov S.G., Yurtaev A.A., Mansurov R.I. 2015. The first data on the soil mites (Acari) of the Arctic Belyi Island (Northern Yamal, the Kara Sea) // Entomological Review. Vol.95. No.6. P.805–810.

Makarova O.L., Osadtchy A.V., Melnikov M.V. 2010. Gamasid mites (Parasitiformes, Mesostigmata) in nests of passerine birds on the Arctic Seven Islands Archipelago, the Barents Sea // Entomological Review. Vol.90. No.5. P.643–649.

Marusik Yu.M., Böcher J., Koponen S. 2006. The collection of Greenland spiders (Aranei) kept in the Zoological Museum, University of Copenhagen // Arthropoda Selecta. Vol.15. No.1. P.59–80.

Marusik Yu.M., Koponen S. 2015. New biogeographical records of spiders and harvestmen (Arachnida: Araneae & Opiliones) from West Siberia, including an annotated list of species // Entomologica Fennica. Vol.26. No.4. P.165-170.

Marusik Yu.M., Koponen S., Makarova O.L. 2016. A survey of spiders (Araneae) collected on the arctic island of Dolgiy (69°122 N), Barents Sea // Arachnology. Vol.17. No.1. P.10–24.

Marusik Yu.M., Eskov K.Yu. 2009. [Spiders (Arachnida: Aranei) of the tundra zone of Russia] // Babenko A.B., Matveeva N.V., Makarova O.L., Golovatch S.I. (eds.). Vidy i soobshchestva v ekstremalnykh usloviyakh. Moscow-Sofia: KMK Scientific Press and Pensoft Publishers. P.92–123 [in Russian with English summary].

Marusik Yu.M., Eskov K.Yu., Koponen S., Vinokurov N.N. 1993. A check-list of the spiders (Aranei) of Yakutia, Siberia // Arthropoda Selecta. Vol.2. No.2. P.63–79.

Nartshuk E.P. 2014. Fruit flies (Diptera: Drosophilidae) of the Russian Arctic // Zoosystematica Rossica. Vol.23. No.2. P.256-263.

Nekhaeva A.A. 2015. Spider (Arachnida, Aranei) assemblages of some habitats from the Kola Gulf Coast: phenological aspect // Entomological Reviw. Vol.95. No.4. P.544-556.

Nekhaeva A.A., Nekhaev I.O. 2011. On the spider fauna of Bolshoy Aynov Island (Barents Sea) (Arachnida: Aranei) // Arthropoda Selecta. Vol.20. No.4. P.319–322.

Novichkova A. 2016. The first data on the freshwater microcrustaceans of Shokalsky Island (Russian Arctic) // Biodiversity Data Journal. No.4: e10930.

Novichkova A.A., Chertoprud E.S. 2015. Fauna of microcrustaceans (Cladocera: Copepoda) of shallow freshwater ecosystems of Wrangel Island (Russian Far East) // Journal of Natural History. Vol.49. No.45–48. P.2955–2968.

Novichkova A.A., Chertoprud E.S. 2017. Cladocera and Copepoda of Shokalsky Island: new data from northwest Siberia // Journal of Natural History. Vol.51. No.29–30. P.1781–1793.

Økland F. 1928. Land- und süsswasserfauna von Nowaja Semlja: Versuch einer tiergeographischen Monographie eines Arktischen Gebiets. Oslo (Kristiania): A.W. Brøggers Boktrykkeri. 125 S.

Palmgren P. 1972. Studies on the spider populations of the surroundings of the Tvarminne Zoological Station, Finland // Commentationes Biologicae. Societas Scientiarum Fennica. Vol.52. P.1–133.

Pétillon J., Georges A., Canard A., Lefeuvre J.-C., Bakker J.P., Ysnel F. 2008. Influence of abiotic factors on spider and ground beetle communities in different salt-marsh systems // Basic and Applied Ecology. Vol.9. No.6. P.743–751.

Rebristaya O.V. 2002. [Vascular plants of Schokalsky Island (Kara Sea)] // Botanicheskiy Zhurnal. Vol.87. No.6. P.29–40 [in Russian with English summary].

Sergienko L.A. 2008. [Flora and vegetation of the Russian coast of the Arctic and adjacent territories]. Petrozavodsk: Izdatelstvo PetrGU. 225 p. [in Russian]

Stishov M.S. 2004. [Wrangel Island – the standard of nature and natural anomaly]. Yoshkar-Ola: Izdatelstvo Mariiskogo poligrafkombinata. 596 p. [in Russian]

Tanasevitch A.V. 2017a. Spiders (Aranei) of the Novaya Zemlya Archipelago and the Vaygach Island, Russia // Arthropoda Selecta. Vol.26. No.2. P.145–153.

Tanasevitch A.V. 2017b. New records of spiders (Aranei) from the Russian Arctic // Arthropoda Selecta. Vol.26. No.1. P.77–82.

Tanasevitch A.V., Khrisanova M.A. 2016. First data on the spiders (Aranei) from the northern Gydan Peninsula, Russia // Arthropoda Selecta. Vol.25. No.1. P.115–118.

Tanasevitch A.V., Rybalov L.B. 2015. Fauna and distribution of spiders (Aranei) of the arctic tundra in northern Yamal Peninsula, Russia // Arthropoda Selecta. Vol.24. No.2. P.215–230.

WSC 2018. World Spider Catalog. Version 19.5. Natural History Museum Bern, online at: http://wsc.nmbe.ch, accessed on 11.07.2018. doi: 10.24436/2

Yurtsev B.A. 1994. Floristic division of the Arctic // Journal of Vegetation Science. Vol.5. No.6. P.765–776.

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