

FAUNA AND ECOLOGY OF DOLICHOPODIDAE (DIPTERA) FROM WRANGEL ISLAND NATURE RESERVE (CHUKOTKA, RUSSIA)

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Original data on five Dolichopodidae species from the Wrangel Island resulted from the 2006 and 2015 surveys in the Wrangel Island State Nature Reserve are presented. Two sites in the northern variant of the typical tundra subzone in the central part of the Wrangel (i.e. the middle course of the River Mamontovaya and the upper reaches of the River Neizvestnaya) have been thoroughly studied by use of net sweeping (both seasons) and yellow pan traps (only 2015). In total, about 780 specimens have been sampled on the Wrangel Island. The yellow pan traps have gathered the most part of material, i.e. about 650 specimens. One of the collected species, *Dolichopus humilis* appears to be the only circum-arctic species of the group. Other species, *Chrysotus komovi*, *Dolichopus terminasiana*, *Hydrophorus alpinus*, and *Rhamphium beringiense* have mainly a hypoarctic distribution. The latter is the rarest species in the material obtained. It is suggested that the high abundance of dolichopodids during the 2015 survey is related to favourable summer weather conditions due to climate warming since the beginning of the 21st century. *Chrysotus komovi* and *Dolichopus terminasiana* are recorded for the first time from the Chukotka Autonomous District. Photographs of habitus and habitats for species recorded from the Wrangel Island are provided.

Key words: Arctic, Diptera, Dolichopodidae, ecology, fauna, new record, Palearctic Region, Wrangel Island

Introduction

The mainly predatory long-legged flies (Dolichopodidae) form a large, cosmopolitan family of true flies with about 8000 described species in about 260 genera (Grichanov, 2017). The family is one of significant, but poorly studied components of the tundra biome dipterofauna (Danks, 1981; Chernov, 1995). A few works are devoted to the dolichopodid species diversity in tundra landscapes. For example, 27 species have been collected in the south-eastern Taimyria (southern tundra and adjacent stations of forest-tundra and northern taiga (Barkalov, 2012). Ten species have been reported from Nenetsia (Grichanov, 2006), including *Hydrophorus signifer* Coquillett, 1899 from the Kolguyev Island and *Hydrophorus alpinus* Wahlberg, 1844 from the Dolgii Island. Ten species have been found in the Yakutian northernmost natural zone (Grichanov & Bagachanova, 2018). The local dolichopodid fauna in the nearctic «Low Arctic» can contain to 20 species (MacLean, 1975). Few species have been reported from the northern part of the tundra biome. The Canadian «High Arctic» (Ellesmere Island) includes only two species of the family (Danks, 1981; Brodo, 2000), i.e., the holarctic *Dolichopus dasyops* Malloch, 1919, and *D.*

humilis Van Duzee, 1921. Four species are known from Greenland (Pollet, 2015), all from the genus *Dolichopus*, i.e. the holarctic *D. dasyops*, *D. humilis* and *D. plumipes* (Scopoli, 1763), and the nearctic *D. groenlandicus* Zetterstedt, 1843. Four widely distributed polyzonal species are known in the Icelandic fauna (Andersson, 1967), including *Campsicnemus armatus* (Zetterstedt, 1849), *Dolichopus plumipes*, *Hydrophorus viridis* (Meigen, 1824), and *Syntormon pallipes* (Fabricius, 1794). The long-legged flies have not been reported from Spitsbergen and Novaya Zemlya (Økland, 1928; Coulson & Refseth, 2004; Coulson, 2007). The data on dolichopodids from the Arctic islands of Asia are limited to the recent records of two species from Wrangel Island (Negrobov et al., 2012; Gruzdev et al., 2014).

Resolution №189 of the Council of Ministers of the Russian Soviet Federative Socialist Republic was adopted on March 23, 1976, for the establishment of the Wrangel Island State Nature Reserve for the purpose of conserving the unique natural systems of Wrangel and Herald Islands and the surrounding waters. Wrangel Island is located in the Chukotka Autonomous District (AD) at the boundary between the East-Siberian and Chukchi Seas (Fig. 1). The is-

land is ~150 km long and ~75 km wide; the highest point is the Mt. Sovetskaya (1096 m a.s.l.). Due to the mountainous relief of this island, there is a sharp gradient of mesoclimatic conditions with average July temperature varying from 1°C on the northern coast to 6–8°C in the centre (Svatkov, 1970; Alifimov, 2007). A distinct summer weather warming on the island has been noted since the beginning of 21st century (see data from www.thermograph.ru and www.pogodaiklimat.ru). The climate differs greatly between parts of the island, a feature clearly visible in their characteristic plant communities. In the eastern part of Wrangel Island, the vegetation is dominated by impoverished moss and lichen or grass and moss, whereas in the western part the proportion of grasses, small shrubs and forbs increases, while that of mosses and lichens diminishes. Wrangel Island lies in the arctic tundra subzone (including its northern and southern variants). In the warmest central area, the vegetation is represented by the northern variant of typical tundra; the cool and foggy northeastern and southwestern sea coasts exhibit southern variants of the polar desert zone (Kholod, 2013). Regarding the invertebrate fauna of Wrangel Island, 585 species have been registered here, including 161 species of Diptera among 282 insect species (Gruzdev et al., 2014).

Material and Methods

The Dolichopodidae have been collected from several localities on Wrangel Island (Fig.

1). Its central part (the northern variant of typical tundra) has been surveyed in detail. In this warmest area dry habitats with forb-dryad, shrub-grass and polydominant grass communities are widespread (Petrovsky, 1985). Only some areas with additional moistening (such as an intermontane basin situated at the upper reaches of the River Neizvestnaya) are characterised by the prevalence of shrub-sedge-moss and willow-moss communities (Sekretareva, 1998). The other areas studied (the middle course of the River Mamontovaya and the Pervaya Mountain) are covered with mainly dry grass and dryad tundra, with shrub-sedge-moss communities at humid plots. The environs of the Somnitelnaya Bay in the southern part of the Island (the southern variants of arctic tundra subzone; July average temperature is about 4°C) are covered with mainly shrub-sedge-moss communities.

In total, about 780 specimens have been sampled by second author of this paper on Wrangel Island by use of yellow pan traps, pitfall traps and standard sweep net. Fourteen specimens belonging to two species have been collected in 2006, and about 760 specimens belonging to five species in 2015. The yellow pan traps (used in 2015) have gathered most of the material, i.e. about 650 specimens. Generally, the landscapes have been monitored from the end of May till mid-August; nevertheless, all flies have been collected between the end of June and early August.

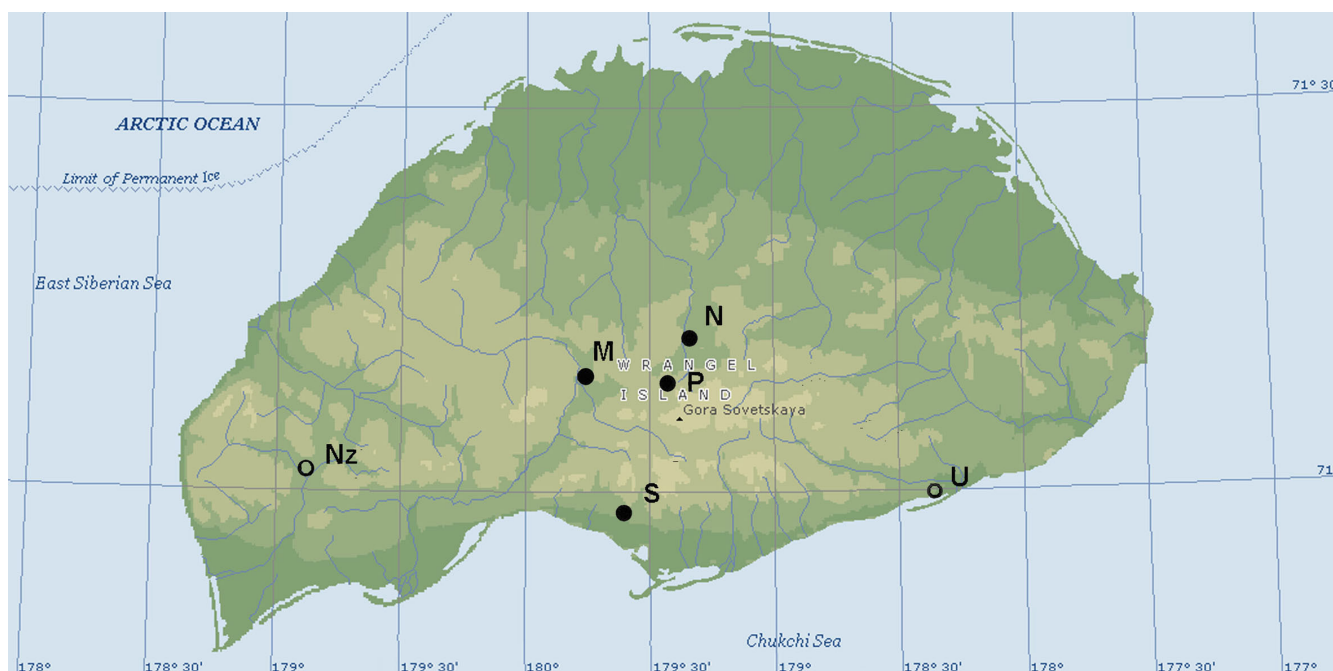


Fig. 1. Points of collecting dolichopodids on Wrangel Island. Solid circles (2006 and 2015): M – Middle flow of the River Mamontovaya; N – Upper reaches of the River Neizvestnaya; P – Mt. Pervaya; S – Somnitelnye Mts. Open circles: Nz – Middle flow of the River Neozhidannaya (2016); U – Ushakovskoe village, a record of *Rhamphium beringiense* (1975).

Net sweeping (more often 100 sweeps) has been used in different biotopes of a landscape, with 43 samples in 2006 and 131 samples in 2015. The plastic pitfall traps filled with water have been placed at the same biotopes, 10 traps in each model site. The yellow pan traps have been placed in two localities of the central part of the Island, 3 traps in each biotope listed below. The middle course of the River Mamontovaya (71°09'32.7" N, 179°45'22.9" W, 158 m a.s.l.) included the following four biotopes (with trapping dates in brackets):

1 – low sandy-pebble floodplain with sparse plant beds (2–4 July);

2 – damp plot in the river valley covered with entire willow-grass-moss community and sparse willow bushes (2–4 July, 22–24 July);

3 – moderately humid plot of the first terrace above the floodplain covered with willow-dryad-forb community (2–4 July);

4 – dry plot on sandy-pebble floodplain covered with willow-forb community (2–4 July, 22–24 July).

The upper reaches of the River Neizvestnaya (71°12'59.1" N, 179°19'20.2" W, 121 m a.s.l.) included the following six biotopes (with trapping dates in parentheses):

5 – low pebble floodplain with oozy alluviums and sparse plant beds (6–13 July);

6 – damp bank of a small lake covered with entire grass-moss communities (6–15 July, 29 July – 3 August);

7 – dampish hummocky depression at a lake covered with entire willow-sedge-moss community (6–15 July, 28 July – 3 August);

8 – moderately humid loamy hummocky ridge covered with lichen-willow-dryad-sedge-moss communities (6–15 July, 24 July – 3 August);

9 – moderately dry southern edge of river terrace covered with dryad-grass-forb community (4–15 July, 24 July – 3 August);

10 – dry gravel southern edge of river terrace covered with forb-sedge «tundra-steppe» community (4–15 July, 24 July – 3 August).

The general species distribution is given after Negrobov et al. (2013) and Grichanov (2017). Type localities are provided, countries are listed as grouped by large regions and then alphabetically. The specimens have been studied with a Zeiss Discovery V-12 stereomicroscope and AxioCam MRc5 camera attachment. Photos of some habitats for species newly recorded from Wrangel Island are provided. The specimens

will be deposited in the collections of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZIN), and the Zoological Museum of Moscow State University, Moscow, Russia (ZMMU).

New records of Dolichopodidae

***Chrysotus komovi* Negrobov, Barkalov et Selivanova, 2014** (Fig. 2).

Material examined. Upper reaches of the River Neizvestnaya: 1♀, biotope 6, sweeping, 6.07.2015; 106♂♀, same locality, yellow pan traps, 6–15.07.2015; 61♂♀, biotope 7, yellow pan traps, 6–15.07.2015; 1♀, biotope 8, sweeping, 4.07.2006; 1♀, same locality, 6.07.2015; 48♂♀ same locality, yellow pan traps, 6–15.07.2015; 1♀, same locality, yellow pan traps, 24.07–3.08.2015; 22♂♀, biotope 9, yellow pan traps, 4–15.07.2015; 26♂♀, biotope 10, yellow pan traps, 4–15.07.2015; 1♀, same locality, pitfall traps, 5–12.07.2015.

Distribution. Type locality: Russia: Krasnoyarskiy Krai, Taimyr Reserve, Ary-Mas field station, left bank of River Novaya. Palaearctic: Russia (Taimyria). Firstly recorded from the Chukotka AD. The species is also present on the Chukotka mainland (Grichanov, unpublished).

Remarks. The species is very close to *Chrysotus gramineus* (Fallén, 1823), which was reported from the whole Palaearctic Region (Grichanov, 2017) including Chukotka mainland (Negrobov & Chalaya, 1991). It is also very close to the European *C. angulicornis* Kowarz, 1874; these three species differ reliably in the shape of phallus only (see figures in Kahanpää & Grichanov, 2006: Fig. 1; Negrobov & Chandler, 2006: Fig. 3; Negrobov et al., 2014: Fig 1F). Therefore, the old Far Eastern records of *C. gramineus* must be confirmed, because they can belong to *C. komovi*. Unfortunately, the genitalia of nearctic *Chrysotus* species have not been studied. Several species of the genus inhabit Alaska (Grichanov, 2017), but their habitus do not correspond with that of *C. komovi* (see Van Duzee, 1924).

Habitats. In all, 268 specimens were collected from five biotopes at the upper reaches of the River Neizvestnaya. Only one specimen was found in 2006 by use of the net sweeping; whereas most of the 2015 material was gathered by use of yellow pan traps. Adults of the species were abundant in all biotopes studied except for the pebble floodplain. Their population density was especially high in damp sites in the first half of July.



Fig. 2. *Chrysotus komovi*, male habitus (in ethanol).

***Dolichopus humilis* Van Duzee, 1921** (Fig. 3).

Material examined. Upper reaches of the River Neizvestnaya: 1♂, biotope 5, yellow pan traps, 6–13.07.2015; 45♂♀, biotope 6, yellow pan traps, 6–15.07.2015; 32♂♀, biotope 7, yellow pan traps, 6–15.07.2015.

Distribution. Type locality: USA: Alaska-Yukon Territory boundary. Nearctic: USA (Alaska), N Canada, Denmark (Greenland); Palaearctic: Russia (Chukotka, Taimyr, N Yakutia, Yamalia). Holarctic Arctic.

Habitats. In all, 78 specimens were collected from three biotopes at the upper reaches of the River Neizvestnaya. The species was gathered only by use of yellow pan traps placed in damp sites.



Fig. 3. *Dolichopus humilis*, male habitus (dried).

***Dolichopus terminasiana* Negrobov, Selivanova et Maslova, 2011** (Fig. 4).

Material examined. Upper reaches of the River Neizvestnaya: 64♂♀, biotope 6, yellow pan traps, 6–15.07.2015; 23♂♀, biotope 7, yellow pan traps, 6–15.07.2015; 107♂♀, biotope 8, yellow pan traps, 6–15.07.2015; 1♀ same locality, yellow pan traps, 24.07–3.08.2015; 40♂♀, biotope 9, yellow pan traps, 4–15.07.2015; 61♂♀, biotope 10, yellow pan traps, 4–15.07.2015.

Distribution. Type locality: Magadan region, Aborigen peak, 100 km N Ust-Omchug, Annachag ridge, River Olen'. Palaearctic: Russia (Magadan, Yakutia). Firstly recorded from the Chukotka AD. The species is also present on the Chukotka mainland (Grichanov, unpublished).

Habitats. In all, 296 specimens were collected from five biotopes at the upper reaches of the River Neizvestnaya. Adults of the species were abundant in all biotopes studied except for the pebble floodplain.

***Hydrophorus alpinus* Wahlberg, 1844** (Fig. 5).

Reference. Gruzdev et al., 2014: 23 (Wrangel Is.; no material provided).

Material examined. Middle flow of the River Mamontovaya: 1♂, floodplain willow bushes, litter, 29.06.2006; 3♂, damp plot in the river valley with grass-willow-moss cover, sweeping, 9.07.2006; 7♂♀, same locality, sweeping, 5.08.2015; 1♂1♀, dry plot in the river valley with forb-dryad cover, sweeping, 12.07.2006; 1♂, biotope 2, pitfall traps, 19–31.07.2006; 9♂♀, same locality, sweeping, 2.07.2015; 59♂♀, same locality, sweeping, 23.07.2015; 12♂♀, same locality, sweeping, 5.08.2015; 1♂4♀, biotope 4, sweeping, 30.07.2006; 3 ex., same locality, sweeping, 2.07.2015; 2♀, same locality, sweeping 5.08.2015; 2 ex., same locality, yellow pan traps, 22–24.07.2015. Mt. Pervaya: 1♂, the damp runoff on the slope of hill with a dryad-grass-moss cover, sweeping, 13.07.2015; 1 ex., same locality, litter, 13.07.2015. Upper reaches of the River Neizvestnaya. 9♂♀, biotope 6, sweeping, 6.07.2015; 3 ex., same locality, sweeping, 28.07.2015; 9♂♀, same locality, yellow pan traps, 6–15.07.2015; 5 ex., same locality, yellow pan traps, 28.07–3.08.2015; 1 ex., biotope 7, yellow pan traps, 6–15.07.2015. Somnitelnye Mts: 1♂, damp base of the hill with hummocky shrub-sedge-moss cover, litter, 17.07.2015.

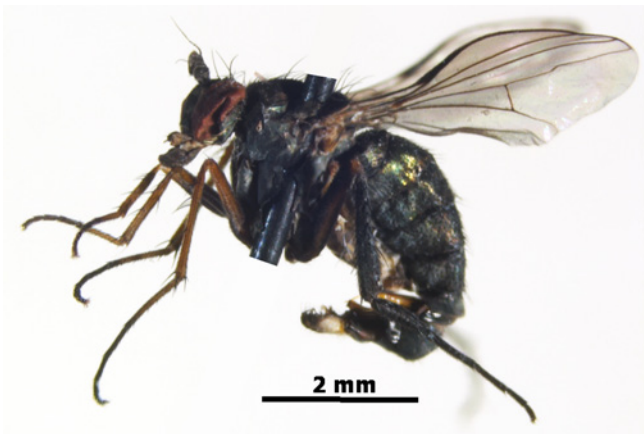


Fig. 4. *Dolichopus terminasiana*, male habitus (dried).

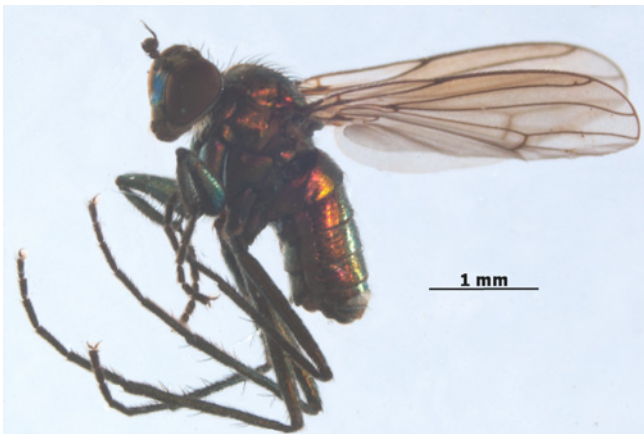


Fig. 5. *Hydrophorus alpinus*, male habitus (in ethanol).

Distribution. Type locality: Sweden: «Walli et Snjerack prope Quickjock». Nearctic: Canada, USA; Palaearctic: Finland, Norway, Russia (Arkhangelsk, Chukotka, Leningrad, Murmansk, Nenetsia, Yakutia, Yamalia), Sweden. Holarctic Arctic-boreal.

Remarks. The species was reported from Wrangel Island by Gruzdev et al. (2014) after the material collected in 2006 and published here for the first time. It is a rather common fly in Yakutian forest-tundra, inhabiting swamp meadows, sedge swamps, swamp hollows, willow beds, banks of rivulets, lakes and ponds (Grichanov & Bagachanova, 2018).

Habitats. In all, 136 specimens were collected from nine biotopes at the upper reaches of the River Neizvestnaya, the middle reaches of the River Mamontovaya, the Mt. Pervaya and Somnitelnye Mts. *Hydrophorus alpinus* was the only species found in several sites of the Island. At the River Mamontovaya, it was swept and trapped in humid stations at river bank and on dry plots of high floodplain and adjacent terraces not far from the water edge. The species was most abundant at the end of July/early August, when the adults of a new generation were collected soon after emerging, having poorer

pigmented wings. The largest number in sweeps was recorded at water along a channel shore (18 specimens per 100 sweeps). At the upper reaches of the River Neizvestnaya, it was collected only in humid biotopes at a small lake shore, being swept and trapped in early July/early August, i.e. during the whole period of 2015 survey.

***Rhaphium beringiense* Negrobov et Vockeroth, 1979 (Fig. 6)**

Reference. Negrobov et al., 2012: 76 (1♀, Wrangel Is.).

Material examined. Upper reaches of the River Neizvestnaya. 4♂, 1♀, biotope 5, yellow pan traps, 6–13.07.2015.

Distribution. Type locality: Russia: Magadan region, River Hazjin. Nearctic: USA (Alaska); Palaearctic: Russia (Republic of Altai, Chukotka, Kamchatka, Magadan, Taimyria).

Remarks. The species was recorded from Wrangel Island by a female (Negrobov et al., 2012). Here we confirm its presence on the island.

Habitats. *Rhaphium beringiense* is a rare species, only once being collected in 2015, on a low pebble floodplain with oozy alluviums and sparse plant beds at the River Neizvestnaya.

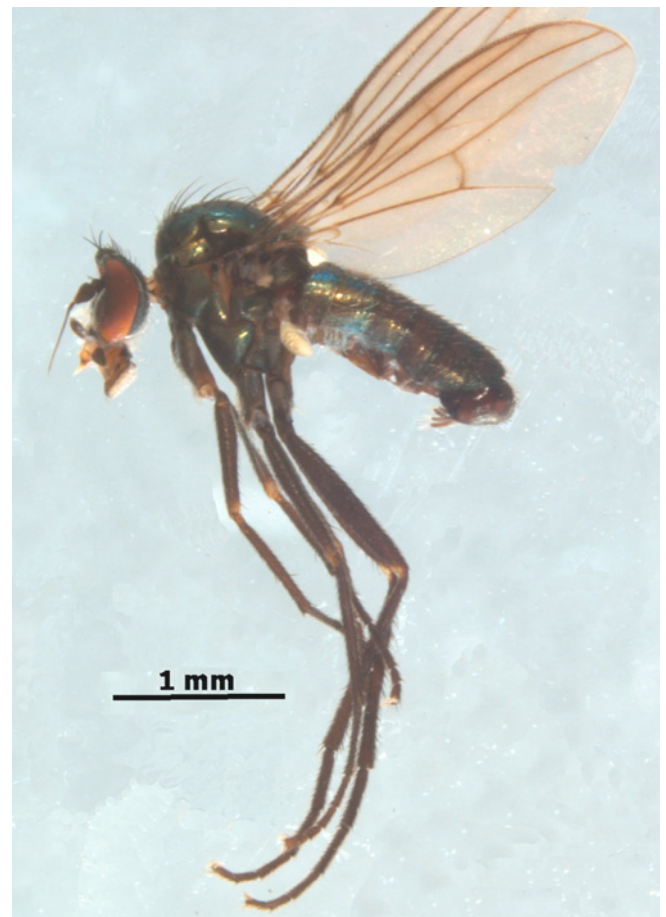


Fig. 6. *Rhaphium beringiense*, male habitus (in ethanol).

Discussion

The biota of Wrangel Island is characterised by unusually high species diversity as compared to other arctic environments. It is generally rich in endemic, rare, and relict species (Yurtsev, 1987; Stishov, 2004; Khruleva, 2009). These features are determined by a long-term development of the island's terrestrial ecosystems during the Pleistocene. Therefore, the presence of taxa unknown from other «High Arctic» islands is a characteristic of the Wrangel entomofauna (Khruleva, 2007; Nartshuk & Khruleva, 2011; Sorokina & Khruleva, 2012). Dolichopodidae as a whole are not found on Spitsbergen, Novaya Zemlya, Severnaya Zemlya nor New Siberian Islands. The Canadian-Greenland sector of the «High Arctic» is inhabited by species of only *Dolichopus* genus (Danks, 1981; Pollet, 2015), whereas four genera are found on Wrangel Island. *Dolichopus humilis* appears to be the only circum-arctic species of the group, inhabiting tundra ecosystems within Siberian and Nearctic sectors of the Arctic. In contrast, although

also holarctic, the closely related *Dolichopus latipennis* Fallén, 1823 occurs mainly in boreal areas (Negrobov & Grichanov, 2013). The other species (*Chrysotus komovi*, *Dolichopus terminasiana*, *Hydrophorus alpinus*, and *Rhamphium beringiense*) have mainly a hypoarctic distribution.

Only two sites in the central part of Wrangel Island have been thoroughly studied by use of both net sweeping and yellow pan traps, which have brought the main dolichopodid material, i.e. the middle course of the River Mamontovaya (Figs. 7–8) and the upper reaches of the River Neizvestnaya (Figs. 9–13). The two points are located at a distance of about 20 km from each other; nevertheless, one and five species respectively have been there revealed. The different species number at those sites can be related with their different landscape-climatic conditions. Thus, for example, areas at the River Neizvestnaya are characterised by the warmest mesoclimate (Alfimov, 2007) and by the presence of a lot of humid habitats favourable for the long-legged flies.



Fig. 7. Middle flow of the River Mamontovaya. General view of the landscape, 29 July 2006.

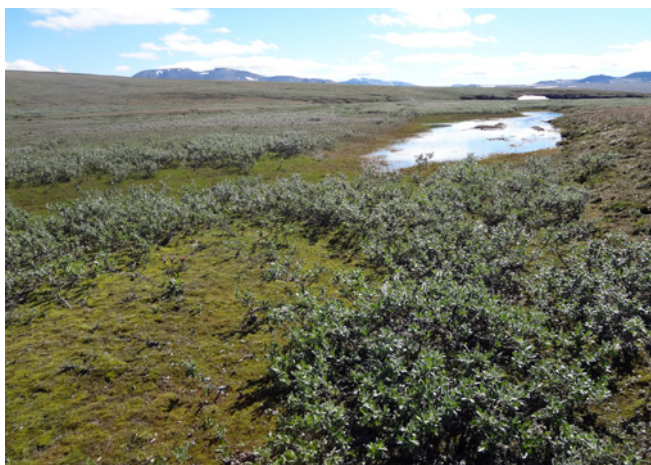


Fig. 8. Middle flow of the River Mamontovaya. Damp plot in the river valley with willow-grass-moss community and sparse willow bushes, 2 July 2015. The site with the largest number of *Hydrophorus alpinus*.



Fig. 9. Upper reaches of the River Neizvestnaya. General view of the landscape, 12 July 2015.



Fig. 10. Upper reaches of the River Neizvestnaya. Low pebble floodplain with oozy alluviums and sparse plant beds, 5 July 2006; a habitat for *Rhamphium beringiense*.



Fig. 11. Upper reaches of the River Neizvestnaya. Damp bank of a small lake covered with entire grass-moss communities, 7 July 2015. The site with the largest number of *Chrysotus komovi*, *Dolichopus humilis* and *Hydrophorus alpinus*.



Fig. 12. Upper reaches of the River Neizvestnaya. Zonal type plant communities, 24 June 2015. A place where *Chrysotus komovi* and *Dolichopus terminasiana* meet high abundance.



Fig. 13. Upper reaches of the River Neizvestnaya. «Tundra-steppe» plant community, 23 June 2015; a habitat where *Chrysotus komovi* and *Dolichopus terminasiana* meet high abundance too.

It is worth noting that the other sites of central and southern parts of Wrangel Island have been sporadically surveyed in 2015. *Hydrophorus alpinus* has been also found in areas at the Pervaya Mt. and Somnitelnye Mts. (Fig. 1). The yellow pan traps have been placed by courtesy of L.F. Volkova (Pevek) in 2016 in the cold south-western part of the island (at middle flow of the Neozhidannaya River, the northern variant of arctic tundra subzone); not any dolichopodid fly has been collected. No dolichopodids have been found within the Diptera material collected by K.B. Gorodkov on Wrangel Island in 1966, 1971, and 1972 (ZIN collections; Dr. E.P. Nartshuk, pers. comm.). On the other hand, Dr. A.V. Barkalov (Novosibirsk) has found a female *Rhamphium beringiense* in the rather cold south-eastern part (Ushakovskoe village) in 1975 (Negrobov et al., 2012).

It is difficult to draw a definitive conclusion on the dolichopodid distribution within Wrangel Island's territory. Nevertheless, apparently, most species occur rather locally on the Island. According to the 2015 data, this distribution is typical even for its warmest part. We can assume that their high abundance that year is related to the climate warming in the Siberian sector of Arctic, which provided them favourable conditions during the preceding summer seasons.

Acknowledgments

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ФАУНА И ЭКОЛОГИЯ DOLICHOPODIDAE (DIPTERA) ЗАПОВЕДНИКА «ОСТРОВ ВРАНГЕЛЯ» (ЧУКОТКА, РОССИЯ)

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Представлены оригинальные данные по пяти видам мух-зеленушек (Dolichopodidae), собранным в 2006 и 2015 гг. в государственном заповеднике «Остров Врангеля». Наиболее подробно изучены два района центральной части острова Врангеля (среднее течение реки Мамонтова и верхнее течение реки Неизвестная, северный вариант подзоны типичных тундр). Основными методами сбора были энтомологические укусы (оба сезона) и желтые тарелки (только 2015 г.). Всего отловлено около 780 мух, из них около 650 – в желтые тарелки. Один из собранных видов, *Dolichopus humilis*, видимо, является единственным циркумполярным арктическим представителем этого семейства. Остальные виды – *Chrysotus komovi*, *Dolichopus terminasiana*, *Hydrophorus alpinus* и *Rhamphium beringiense* – имеют преимущественно гипоарктическое распространение. Лишь последний вид в материале 2015 г. представлен единичными экземплярами. Высокая численность прочих видов долихоподид, возможно, связана с наблюдающимся в последние годы (с начала 21 в.) потеплением климата на острове Врангеля. *Chrysotus komovi* и *Dolichopus terminasiana* впервые указываются для Чукотского автономного округа. Приведены фотографии внешнего облика собранных на острове видов, а также местообитаний, в которых они встречались.

Ключевые слова: Dolichopodidae, Арктика, двукрылые, новые указания, остров Врангеля, Палеарктика, фауна, экология