

## Fauna and ecology of horseflies (Diptera, Tabanidae) and bloodsucking mosquitoes (Diptera, Culicidae) in Yamal-Nenets Autonomous Area

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The article summarizes the literature review, data, and materials of our research on the species composition of horseflies and bloodsucking mosquitoes of the Yamal-Nenets Autonomous Area. The region's natural conditions favor the mass emergence of bloodsucking dipterans (except for the subzone of the Arctic tundra). Here, there are primary factors that determine the high abundance and species diversity of these insects are combined: the abundance of breeding biotopes (various reservoirs and marsh formations) and the habitat of adults, as well as the presence of a sufficient number of warm-blooded animals - a source of blood saturation. As a result of studies carried out in 2018 on the territory of the Tazovsky, Priuralsky, and Yamal districts of the area, the faunistic list of the Tabanidae family was replenished with one species and one subspecies (*Hybomitra astur* Erichson, 1851 and *Hybomitra nitidifrons nitidifrons* Szilady, 1914), the Culicidae family (*Ae. nigrinus* Eckstein, 1918) and *Aedes behningi* (Martini, 1926)). Twenty-six species currently represent the fauna of horseflies in the area, the fauna of bloodsucking mosquitoes - 29 species, of which nine species of horseflies and 19 species of mosquitoes are found in the tundra zone, 17 species of horseflies, and 21 species of mosquitoes in the forest tundra zone, 25 species in the northern taiga subzone horseflies and 17 species of mosquitoes. The general summer season for horseflies in the area lasts 20-50 days; bloodsucking mosquitoes are active for 75-100 days. The maximum number of horseflies was recorded in the northern taiga, mosquitoes - in the forest-tundra zone.

**Keywords:** Culicidae, flight period, number, species composition, Tabanidae, Yamalo-Nenets autonomous area

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### Introduction

The Yamalo-Nenets autonomous area is located north of Western Siberia between Baydaratsky and Ob Bays Kara Sea (Fig. 1). The Kara Sea washes the northern and northwestern shores of the region and forms bays and peninsulas deep into the mainland between them. The territory of the district covers 122 thousand square kilometers, length 750 kilometers, width 240 kilometers. The nature and structure of eternal strata with formations and veins of underground ice lying on Yamal have no analogs either in our country or abroad. Their maximum thickness often exceeds 300 meters.

The climate of the Yamalo-Nenets Autonomous area is sharply continental. The area is located in the northern part of the West Siberian lowland. On the left side of the Ob River, the extreme west of the area passes through the eastern slopes of the Ural Mountains. The harsh climate of this northern region is highly unfavorable to people to farm - this is an area of the so-called "extreme residence". The breadth of territory, the sharply continental climate, the presence of a plain, and mountains determine the division of the region from north to south, and latitudinal natural geographical zones: tundra, forest-tundra, forest, and mountain. Taking into account agroclimatic features, the tundra zone is divided into three main subzones - arctic tundra, typical (moss-lichen) tundra, and shrub (dwarf birch) tundra (Western Siberia 1963).

The natural conditions of the Yamalo-Nenets Autonomous Area favor the mass outflow of bloodsucking dipteran insects (except for the subzone of the arctic tundra). We registered here the main factors that determine the high number and species diversity of these insects: the abundance of biotopes of the outcrop (various reservoirs and swamp formations) and the habitat of imago (Fig. 2.), as well as the presence of a sufficient number of warm-blooded animals - the source of saturation. The main feeder of bloodsucking dipterans in the region is reindeer.



Fig. 1. Map of Yamalo-Nenets autonomous area.

([https://yandex.com/maps/geo/yamalo\\_nenetskiy\\_avtonomny\\_okrug/53000121/?l=sat%2Cskl&ll=75.926292%2C68.818377&z=5](https://yandex.com/maps/geo/yamalo_nenetskiy_avtonomny_okrug/53000121/?l=sat%2Cskl&ll=75.926292%2C68.818377&z=5))



Fig. 2. Reservoirs are places of production of bloodsucking dipteran insects (photo by Fiodorova O.A.).

The spread of bloodsucking dipterans in the region is determined by the landscape, hydrological regime, and species ecological requirements. The hydrological and weather conditions of the season directly and indirectly affect populations' species composition and dynamics.

## Materials and methods

The work was carried out in 2018 in the field in 3 districts of the Yamal-Nenets Autonomous Area: Yamal, Priuralsky, Tazovsky. Tazovsky District occupies the largest territory in the northeast of the Yamalo-Nenets Autonomous area. Geographically, the district is located deep beyond the Arctic Circle on the right side of the Ob Bay. Yamal District is located in the northern part of the Yamal-Nenets Autonomous Area on the Yamal Peninsula and the islands closest to it, including the largest island of the area - Bely. Priuralsky District is located in the westernmost part of the Yamal-Nenets autonomous area (the territory belongs to the Polar Urals). On the territory of the district, there are a lot of lakes and rivers.

To study the species composition of mosquitoes, adults were collected using a test tube and an entomological net with removable bags (Paliy, 1970; Rasnitsyn & Kosovskikh, 1979). Mosquito counts were carried out according to the method proposed by T.S. Detinova et al. (1978): 10 sweeps of the net with a "figure eight" around itself in 5 repetitions at different points of the biotope. When studying adult horseflies, 20-minute counts with a net were used (Olsufiev & Mosolov, 1964; Detinova et al., 1978). The captured insects were placed on cotton mattresses and in paper envelopes for further examination and transportation.

The camera processing of the material, including the determination of the collected insects, the analysis of their own and literary data, was carried out based on the Tobolsk Complex Research Station of the Ural Branch of the Russian Academy of Sciences. The specific structure of the caught bloodsucking dipterous insects is determined according to attributive tables of L.P. Kukharchuk (1980) and N.G. Olsufiev (1977) using a microscope of Carl Zeiss Stemi SV6.

In the quantitative characterization of species, the dominance index (DI) was used (Beklemishev 1970). To assess the degree of species abundance of horseflies, the scale of K.V. Skuf'in (1949) was used, mosquitoes - the scale of F.A. Skripchenko (2000).

## Results and discussion

The fauna of horseflies (Diptera, Tabanidae) and bloodsucking mosquitoes (Diptera, Culicidae) of the Yamalo-Nenets autonomous area are represented by 55 species (Table 1).

Tundra zone. According to literary data, there is practically no blindness in the arctic and typical tundra (Sazonova, 1949; Olshwang, 1980; Mirzaeva et al., 1984). As a result of research conducted in the summer of 2016 on Bely Island, first-age horsefly larvae were first discovered, it was not possible to establish their species affiliation (Khlyzova et al., 2018). According to literature data (Shchepetkin, 1974; Pavlov & Shchepetkin, 1975), horseflies of 6 species are found in the shrub tundra: *C. nigripes*, *H. sexfasciata*, *H. aequincta*, *H. lurida*, *H. nitidifrons confiformis*, *H. montana montana*.

As a result of studies carried out in the summer of 2018, horseflies were found *H. aequincta*, *H. arpadi*, *H. lundbecki lundbecki*, *H. nitidifrons nitidifrons*, *H. nitidifrons confiformis*, *H. astur*, of these, three species and one subspecies were first recorded in the tundra zone of the Yamal-Nenets autonomous area. Currently, the horsefly fauna is represented by nine species. During the study season, *H. aequincta* and *H. arpadi* were dominant, with a DI of 27.3%.

The flight of horseflies in the tundra usually lasts no more than 20 days, from July 8-16 to July 26 - August 5. In the harsh conditions of the open tundra, the number of horseflies is deficient and unstable. During the general period of flight, they are active for 6-12 days at air temperatures above 12-14 °C. At the same time, single insects attack the reindeer; in 30 minutes, there are up to 4 individuals. With such a low number of horseflies, reindeer in the tundra and the Polar Urals do not cause a significant disturbance.

There are no literature data on bloodsucking mosquitoes in the Arctic tundra of the Yamal-Nenets area. On the Arctic island of Belyi, larvae and adults of mosquitoes of *Aedes* were found in 2014 and 2016. (Gavrichkin et al., 2016; Khlyzova et al., 2018).

In the typical tundra (Cape Povorotny) subzone, E.F. Kiseleva (1927) identified six species of mosquitoes: complex *A. maculipennis*, *Aedes dorsalis*, *A. excrucians*, *A. cyprius*, *A. cinereus* and *C. pipiens*. L.P. Kukharchuk (1981) added nine more species to this list: *A. nigripes*, *A. cantans*, *A. communis*, *A. punctor*, *A. hexodontus*, *A. intrudens*, *A. pullatus*, *A. impiger*, *A. cataphylla*.

As a result of the research carried out in 2018, 12 species of bloodsucking mosquitoes were registered in the tundra, while the faunistic list of mosquitoes in the tundra zone was replenished with four species: *A. pionips*, *A. implicatus*, *A. nigrinus* and *A. diantaeus*. Among the 12 registered species, *A. communis* (DI 29%) prevailed in abundance in the Yamal district, and *A. hexodontus* (DI 29.4%) in the Tazovsky district.

The flight of mosquitoes lasts from mid-June to the end of August, that is, about 75 days; under unfavorable conditions, the total flight period of mosquitoes can be reduced to 40 days - from the middle of the first decade of July to mid-August. The mass flight of mosquitoes is observed from the first decade of July to the end of the first decade of August. During periods of maximum mosquito activity, up to 1,800 individuals attack a person in a 5-minute count.

We established that in the southern tundra of the Yamal district, up to 500 mosquitoes were attacked at one time according to the average mass flight, 4598 individuals according to the maximum data for registration. At the northernmost point of the district - Bovanenkovo, the number of mosquitoes during this period amounted to 270 individuals according to the average registration data, at a wind speed of 10 meters per second, while studies conducted earlier by other authors indicated that wind speed above 7 meters per second has an inhibitory effect on mosquito activity until its complete cessation. In the Tazovsky district, during this period, 46 female mosquitoes attacked a person at one time, and 26 female mosquitoes - a deer. Mosquitoes are the main gnat component of the most significant concern to reindeer in the tundra zone.

**Table 1.** Fauna and distribution of horseflies and bloodsucking mosquitoes of the Yamal-Nenets Autonomous Area

	Species	Natural and climatic zones (subzones)		
		Tundra	Forest tundra	Northern taiga
	Family <b>Tabanidae</b> Latreille, 1802			
	Genus <i>Chrysops</i> Meigen, 1800			
1	<i>C. sepulcralis</i> (Fabricius, 1764)			+
2	<i>C. nigripes</i> Zetterstedt, 1840	+	+	+
3	<i>C. divaricatus</i> Loew, 1858		+	+
4	<i>C. caecutiens</i> (Linnaeus, 1758)			+
5	<i>C. relictus</i> Meigen, 1820		+	+
	Genus <i>Tabanus</i> Linnaeus, 1758			
6	<i>T. maculicornis</i> Zetterstedt, 1842			+
7	<i>T. autumnalis autumnalis</i> Linnaeus, 1761			+
	Genus <i>Atylotus</i> Osten-Sacken, 1876			
8	<i>A. fulvus</i> Meigen, 1820			+
9	<i>A. sublunaticornis</i> (Zetterstedt, 1842)			+
	Genus <i>Hybomitra</i> Enderlein, 1922			
10	<i>H. sexfasciata</i> (Hine, 1923)	+	+	+
11	<i>H. lapponica</i> (Wahlenberg, 1848)		+	+
12	<i>H. astuta</i> (Osten-Sacken, 1876)		+	+
13	<i>H. arpadi</i> (Szilady, 1923)	+	+	+
14	<i>H. tarandina</i> (Linnaeus, 1761)		+	+
15	<i>H. aequetincta</i> (Becker, 1900)	+	+	+
16	<i>H. lurida</i> (Fallén, 1817)	+	+	+
17	<i>H. nitidifrons nitidifrons</i> Szilady, 1914	+		
	<i>H. nitidifrons confiformis</i> Chvala et Moucha, 1971	+	+	+
18	<i>H. ciureai</i> (Seguy, 1937)		+	+
19	<i>H. muehlfeldi</i> (Brauer, 1880)			+
20	<i>H. bimaculata</i> (Macquart, 1826)		+	+
21	<i>H. nigricornis</i> Zetterstedt, 1842		+	+
22	<i>H. lundbecki lundbecki</i> Lyneborg, 1959	+	+	+
23	<i>H. montana montana</i> Meigen, 1820	+	+	+
24	<i>H. astur</i> Erichson, 1851	+		
	Genus <i>Haematopota</i> Meigen, 1803			
25	<i>H. pluvialis pluvialis</i> Linnaeus, 1758		+	+
26	<i>H. subcylindrica</i> Pandelle, 1883			+
	Total species:	9	17	25
	Family <b>Culicidae</b> Meigen, 1818			
	Genus <i>Anopheles</i> Meigen, 1818			
27	complex <i>A. maculipennis</i> Meigen, 1818	+	+	+
	Genus <i>Culiseta</i> Felt, 1904			
28	<i>C. alaskaensis</i> (Ludlow, 1906)		+	+
29	<i>C. bergrothi</i> (Edwards, 1921)			+
30	<i>C. morsitans</i> (Theobald, 1901)			+
	Genus <i>Coquillettidia</i> Dyar, 1905			
31	<i>C. richiardii</i> (Ficalbi, 1889)			+
	Genus <i>Aedes</i> Meigen, 1818			
32	<i>A. dorsalis</i> (Meigen, 1830)	+		
33	<i>A. cantans</i> (Meigen, 1818)	+	+	+
34	<i>A. riparius</i> (Dyar et Knab, 1907)			+
35	<i>A. behningi</i> (Martini, 1926)		+	
36	<i>A. excrucians</i> (Walker, 1856)	+	+	+
37	<i>A. euedes</i> Howard, Dyar et Knab, 1913		+	
38	<i>A. flavescens</i> (Müller, 1764)			+
39	<i>A. cyprius</i> (Ludlow, 1920)	+		
40	<i>A. communis</i> (De Geer, 1776)	+	+	+
41	<i>A. pionips</i> (Dyar, 1919)	+	+	
42	<i>A. punctor</i> (Kirby, 1837)	+	+	+
43	<i>A. hexodontus</i> (Dyar, 1916)	+	+	+
44	<i>A. punctodes</i> (Dyar, 1922)		+	
45	<i>A. nigrinus</i> (Eckstein, 1918)	+		
46	<i>A. diantaeus</i> (Howard, Dyar et Knab, 1913)	+	+	+
47	<i>A. implicatus</i> (Vockeroth, 1954)	+	+	
48	<i>A. intrudens</i> (Dyar, 1919)	+	+	+
49	<i>A. pullatus</i> (Coquillett, 1904)	+	+	+
50	<i>A. nigripes</i> (Zetterstedt, 1838)	+	+	
51	<i>A. impiger</i> (Walker, 1848)	+	+	
52	<i>A. cataphylla</i> (Dyar, 1916)	+	+	+
53	<i>A. churchillensis</i> Ellis et Brust, 1973		+	
54	<i>A. cinereus</i> Meigen, 1818	+	+	+
	Genus <i>Culex</i> Linnaeus, 1758			
55	<i>C. pipiens</i> Linnaeus, 1758	+	+	
	Total species:	19	21	17

**Forest-tundra zone.** According to the literature (Olsufiev, 1935, 1937, 1977; Popov & Zuevsky, 1965; Violovich, 1966, 1967, 1968; Cherepanov et al., 1970; Beltyukova & Mitrofanova, 1971; Shchepetkin, 1974; Pavlov & Shchepetkin, 1975; Olshvang, 1977, 1980; Gagarin, 1982; Sedykh, 1986), 17 species of horseflies live in the forest-tundra zone of the Yamalo-Nenets autonomous area: *C. divaricatus*, *C. nigripes*, *C. relictus*, *H. lapponica*, *H. sexfasciata*, *H. astuta*, *H. arpadi*, *H. tarandina*, *H. aequitincta*, *H. lurida*, *H. nitidifrons confiformis*, *H. ciureai*, *H. bimaculata*, *H. nigricornis*, *H. lundbecki lundbecki*, *H. montana montana*, *H. pluvialis pluvialis*. The number of horseflies in the forest tundra is usually low. For some years, they can be isolated, but sometimes they cause significant anxiety for people and reindeers. A deer in a herd is attacked in 30 minutes to 35, and within a day up to 700 or more horseflies. The total duration of the flight period is 30-40 days: from the middle of the third decade of June - the middle of the second decade of July to the middle of the first - second decade of August. The period of mass activity takes from 5 to 20 days. The period of maximum number is observed sometimes in mid-July, sometimes in late July - early August.

The fauna of bloodsucking mosquitoes in the forest-tundra zone of the area was studied by V.A. Shchepetkin (1972, 1974), P.E. Polyakova & V.D. Patrusheva (1974), N.V. Nikolaeva (1980, 2012), N.V. Nikolaeva & A.V. Gilev (2006). As a result of the work of these researchers, it was established that mosquitoes live on the territory of this natural and climatic zone of complex A. *maculipennis*, *C. alaskaensis*, *A. excrucians*, *A. communis*, *A. punctor*, *A. hexodontus*, *A. intrudens*, *A. pullatus*, *A. impiger*, *A. cataphylla*, *A. nigripes*, *A. euedes*, *A. churchillensis*, *A. punctodes*, *A. implicatus*, *A. cinereus* and *C. pipiens*.

During the research in 2018, 13 species of bloodsucking mosquitoes were registered in the forest tundra of the Yamalo-Nenets Autonomous Area, of which 4 species: *A. cantans*, *A. pionips*, *A. behningi*, and *A. diantaeus* were indicated for this natural and climatic zone of the region for the first time. Among the identified species, *A. communis* prevailed in abundance (DI 34%).

The flight of mosquitoes in the forest tundra begins in the second decade of June. Mass flight is observed from the end of the third decade of June to the end of July. During this period, the number of mosquitoes in a 5-minute count on a deer can reach 2110 individuals. Then the number of mosquitoes decreases, some individuals fly until the end of August.

In the forest tundra of the Priuralsky district in 2018, during the period of mass flight, the number of mosquitoes was 197 individuals registered according to average data. The air temperature during this period was 20 °C, the air humidity was 42%, the wind speed was 8 meters per second.

**Subzone of the northern taiga of the forest zone.** In the northern taiga, according to literature data (Popov, 1932; Olsufiev 1935, 1937, 1977; Sazonova, 1949; Popov, 1959, 1962; Popov & Zuevsky, 1965; Violovich, 1966, 1968; Polyakov, 1985; Olsufiev & Polyakov, 1985; Sergeeva, 1986) there are gadflies of 25 species: *C. sepulcralis*, *C. nigripes*, *C. divaricatus*, *C. caecutiens*, *C. relictus*, *T. maculicornis*, *T. autumnalis autumnalis*, *A. fulvus*, *A. sublunaticornis*, *H. sexfasciata*, *H. lapponica*, *H. astuta*, *H. arpadi*, *H. tarandina*, *H. aequitincta*, *H. lurida*, *H. nitidifrons confiformis*, *H. ciureai*, *H. muehlfeldi*, *H. bimaculata*, *H. nigricornis*, *H. l. lundbecki*, *H. montana montana*, *H. subcylindrica*, *H. pluvialis pluvialis*.

The flight of horseflies in this subzone begins in the second - third decade of June and ends in August's first or even third decade. The total duration of the flight period is just over 50 days, of which the mass flight period fits into 30 days - from the middle of the third decade of June to the middle of the third decade of July. The maximum number reaches 60-70 in 15 minutes, and about 2.5 thousand individuals per day.

According to P.E. Polyakova (1968), in the northern taiga subzone, there are 17 species of mosquitoes: complex *A. maculipennis*, *C. alaskaensis*, *C. bergrothi*, *C. morsitans*, *C. richiardii*, *A. cantans*, *A. riparius*, *A. excrucians*, *A. flavescens*, *A. communis*, *A. punctor*, *A. hexodontus*, *A. diantaeus*, *A. intrudens*, *A. pullatus*, *A. cataphylla* and *A. cinereus*.

Mosquitoes fly from early June to early September. The period of mass flight is observed from the second decade of June to the end of July. At the time of the most significant number, up to 500 individuals are caught in a net during a 3-minute count.

Among the attacking bloodsucking dipterans, the greatest harm to animals in this subzone is caused by horseflies, during the period of high numbers, of which there is a massive incidence of necrobacteriosis in deer.

## Conclusion

Analysis of literature data showed that 25 horsefly species (family Tabanidae) are found on the territory of the Yamalo-Nenets Autonomous Area. We recorded the habitat of one species and one subspecies in the Tazovsky district, which was also the first record for Western Siberia as a whole:

- *H. astur*. Previously, this species was considered Far Eastern and was known from the Primorsky Krai;
- *H. nitidifrons nitidifrons*. Earlier, this East Siberian nominative subspecies was known from Transbaikalia, Yakutia, Priamurye, and Primorsky Krai.

Thus, the horsefly fauna of the area is currently represented by 26 species and two subspecies.

According to the literature, the fauna of bloodsucking mosquitoes of the Yamal-Nenets Autonomous Area is represented by 27 species. As a result of the studies carried out on the territory of the area, the faunistic list of the Culicidae family was replenished with two more species:

- *A. nigrinus* – noted in the Yamal and Tazovsky districts. Previously, this species was known in the European part of Russia, in the Urals, in Siberia - on the territory of the Tomsk and Novosibirsk regions, the Khanty-Mansiysk autonomous area, and the south of the Tyumen region;
- *A. behningi* – noted in the Priuralsky district. The species is widespread and was previously known in the European part of Russia, Urals, Siberia, and the north of the Republic of Kazakhstan. We know about the finds of this species in the Tomsk and Novosibirsk regions, the Khanty-Mansiysk autonomous area, and in the south of the Tyumen Region.

Thus, the fauna of the area bloodsucking mosquitoes is currently represented by 29 species. The general summer season for horseflies in the area lasts 20-50 days, bloodsucking mosquitoes are active for 75-100 days. The maximum number of horseflies was recorded in the northern taiga mosquitoes - in the forest-tundra zone.

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