

Blood-Sucking Diptera Insects (Insecta: Diptera) in Tyumen Region: Species Composition and Features of Seasonal Population Dynamics

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ABSTRACT

The article presents the results of the study of the species composition of the fauna of the blood-sucking Diptera insects of the Tyumen region (Russian Federation). The studies were carried out from 2004 to 2022 in three subzones: forest with subzones of southern taiga and aspen-birch forests and forest-steppe. It was discovered that the fauna is represented by 109 species and 4 subspecies: horseflies – 35 species and 4 subspecies, mosquitoes – 41 species, blackflies – 16 species, biting midges – 17 species. The total summer period of insects in this group is 140-170 days. Depending on the meteorological conditions of the spring-summer season, the start and end dates of summer may shift by 1-2 decades. The activity of horseflies and blackflies is observed during the daytime, and mosquitoes and biting midges are twilight insects and attack mainly in the morning and evening hours. The main abiotic factors determining the nature of the diurnal rhythm of activity of Diptera insects are air temperature and illumination.

Keywords: Horseflies, Mosquitoes, Blackflies, Biting midges, Tyumen region.

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INTRODUCTION

The territory of the Tyumen region is located in the West Siberian lowland and has a fairly extensive river system, there is also a large area of lakes and swamps of various types. In the spring, as a result of snow melting and flooding, a significant number of temporary reservoirs are formed on rivers [1]. All these conditions are favorable for the development of blood-sucking Diptera insects - horseflies, mosquitoes, black flies, and biting midges.

The study of blood-sucking insects in the region was carried out mainly in the 60 and 70s of the last century when the development of new oil and gas-bearing areas began [2-4]. At the same time, studies were conducted on the fauna and ecology of blood-sucking Diptera in the south of the Tyumen region [5, 6]. Later, at the end of the 20th and beginning of the 21st centuries, work was carried out on the study and introduction of

new means and methods of protecting cattle from the attack of blood-sucking Diptera insects, in which issues of fauna and ecology of Diptera insects were also touched upon to varying degrees. However, a comprehensive comparative study of the species composition, breeding sites, seasonal population dynamics, daily rhythm of activity, and landscape-biotope association of this group of insects has not been conducted in the Tyumen region.

Currently, climate change processes are taking place on the planet, which occur more intensively on the territory of Russia than in many other countries of the world [7]. In this regard, the conditions for the existence of insects are changing, habitat areas are expanding, and phenological shifts are observed. These factors, combined with an increase in the likelihood of the importation of pathogens of dangerous exotic diseases into the country (an increase in the volume of population migration, and the

purchase of imported livestock) indicate the need for systematic monitoring of the species composition and ecology of blood-sucking Diptera insects that can participate in the spread of human and animal diseases.

The purpose of the research: to study the species composition, features of seasonal population dynamics, and the daily rhythm of activity of horseflies (family Tabanidae), mosquitoes (family Culicidae), blackflies (family Simuliidae), and biting midges (family Ceratopogonidae) Tyumen region.

MATERIALS AND METHODS

The territory of the Tyumen region is located in two landscape-geographical zones: forest with subzones of the southern taiga and aspen-birch forests and forest-steppe [8]. The studies were conducted in all three subzones from 2004-2022. Collections and records of the number of horseflies were carried out both permanently on the same pasture systematically once every 5-7 days during the summer period, and once on different pastures with the help of yule traps, which were installed for the whole day (from dawn to dusk), and also with the help of a standard entomological net.

When collecting images of mosquitoes, black flies, and biting midges, an entomological net with removable pouches was used [9]. Unlike a standard entomological net, it has a conical shape and a hole in the top of the cone, to which a removable pouch is sewn from a well-blown material is attached. Insects are caught when fanning with a net around themselves or an animal, making 10 strokes. Each swing consists of two movements of the net in the form of an "eight", capturing the upper body and legs. Full accounting consists of 10 repetitions (10 times 10 strokes), and the intensity of the attack is determined by the average number of individuals per 10 strokes. When studying the seasonal dynamics of the population, records were carried out during the entire summer period twice a decade. When studying the daily rhythm, insect counts were carried out during the day with an interval of 2 hours.

The identification of the species of horseflies was carried out according to the definitive tables of N.G. Olsufyev (1977), mosquitoes – according to the definitive tables of Gutsevich with co-authors

(1970) and Kukharchuk (1980), blackflies - according to the determinants of Patrusheva (1982) and Yankovsky (2002), biting midges – Mirzayeva (1989) [10-15]. The species names are given in accordance with the modern taxonomy of these insect groups, lists of valid species names, and catalogs of the world fauna [8, 16-18].

RESULTS AND DISCUSSION

The fauna of horseflies (family Tabanidae) of the region is represented by 35 species and 4 subspecies belonging to 6 genus: *Chrysops*, *Tabanus*, *Atylotus*, *Hybomitra*, *Heptatoma*, and *Haematopota*. According to the degree of abundance in all natural zones, the dominant species are *Hybomitra ciureai* (Seguy, 1937), *H. bimaculata* (Macquart, 1826), *H. lundbecki* Lyneborg, 1959, *Haematopota pluvialis* Linnaeus, 1758, in addition to them, the dominant group includes in the southern taiga - *Hybomitra muehlfeldi* (Brauer, 1880), in aspen-birch in the forests - *Tabanus bromius* (Linnaeus, 1758), *Atylotus fulvus* Meigen, 1820, *A. rusticus* (Linnaeus, 1767), *Haematopota subcylindrica* Pandelle, 1883 and in the forest-steppe - *Tabanus bovinus* (Linnaeus, 1758), *T. bromius*, *H. subcylindrica*.

In the subzone of the southern taiga, horseflies fly from the third decade of May to mid-August, in the subzone of deciduous aspen-birch forests – from the last decade of May to the end of the second decade of August, in the forest-steppe zone - from the end of the second decade of May to the end of August.

Horseflies are light-loving and heat-loving insects, females attack for blood-sucking in the daytime and at temperatures above +13 °C [19]. The active attack of horseflies on the feeder in the region lasts on average from 9 to 21 hours with a maximum of 12-16 hours. The leading factor determining the rhythm of the daily activity of horseflies is illumination, as only during daylight hours horseflies can navigate in flight and find prey [20-24].

Horseflies inhabit open biotopes – meadows, pastures, clearings, and forest edges. Under the canopy of the forest, there are only isolated individuals who flew there after the feeder (human or warm-blooded animal). Horseflies practically do not fly into the premises.

Blood-sucking mosquitoes (family Culicidae) of the region are represented by 41 species of 5

genus: *Anopheles*, *Culiseta*, *Coquillettidia*, *Aedes*, and *Culex*. *Aedes cantans* (Meigen, 1818) dominates in all natural and climatic zones of the region, depending on meteorological conditions, the dominant group may include *Aedes punctor* (Kirby, 1837) in the subzone of the southern taiga, *Aedes cinereus* Meigen, 1818 and *A. punctor* in the aspen-birch forest subzone, and *Coquillettidia richiardii* (Ficalbi, 1889) in the forest-steppe zone, *Aedes caspius* (Pallas, 1771), *Aedes albescens* (Edwards, 1921).

Mosquitoes fly in the southern taiga from the second decade of May to the end of September – beginning of October, in the subzone of small-leaved aspen-birch forests - from the first decade of May to the beginning of October, in the forest-steppe - from the end of April to the second decade of October.

Mosquitoes are twilight insects, in all natural and climatic zones of the Tyumen region they are most active in the evening and morning hours, and with a high number of female mosquitoes actively attack under the canopy of the forest around the clock. There are two peaks in the daily rhythm of trophic activity of female blood-sucking mosquitoes of all landscape and climatic zones of the region: morning (3-7 hours) and evening (21-23 hours). It has been established that the duration of the daily activity of mosquitoes depends on the level of their number, the higher the number, the longer the daily activity.

The analysis of meteorological conditions during the daily records showed that the active attack of female mosquitoes on the feeder is observed at a temperature of +12.6 ... +30 °C, relative humidity 33-100%, and illumination 0-37000 lux. During the maximum activity of mosquitoes, the air temperature was +12.6 ... +26 °C, the relative humidity was 54-100%, and the illumination was 0-8600 lux. The rapid transition from daylight to dusk and from night darkness to dawn has a stimulating effect on female mosquitoes. During the day, the activity of mosquitoes is suppressed by high temperatures and bright sunlight, and at night – by lowering the temperature and the onset of darkness. Heavy rain and dew have a significant effect on the activity of mosquitoes. Light rain does not have a depressing effect on most species of mosquitoes in the region. The relative humidity of the air in the range from 50 to 99% is optimal for mosquito attacks.

Blood-sucking mosquitoes actively attack both in the open area and under the canopy of the forest. The species of mosquitoes registered by us on the territory of the Tyumen region can be conditionally divided into three groups according to their association with various stations: species that actively attack under the canopy of the forest; species that attack only in open areas; and species that actively attack in both biotopes. The third group is the richest in species. *A. cantans* has the greatest ecological plasticity in relation to living in various stations [6]. Female mosquitoes actively fly into rooms where they attack humans and animals living there. Mosquitoes of the genus *Anopheles* and *Culex* have pronounced endophilicity.

Fauna of blood-sucking blackflies (family Simuliidae) The Tyumen region is represented by 16 species belonging to 1 genus *Simulium*. According to the degree of abundance of species in the subzone of the southern taiga and the forest-steppe zone, *S. maculatum* (Meigen, 1804) prevails, and in the subzone of aspen-birch forests - *S. pusillum* Fries, 1824 [25].

In the southern taiga, blackflies actively fly from the third decade of May to the beginning of September, in the subzone of small-leaved aspen-birch forests - from the third decade of May to the end of September, in the forest-steppe - from the second decade of May to the beginning of October.

Blackflies are daytime insects, and the period of their activity is limited to daylight hours. In the conditions of the Tyumen region, they fly from 05 to 23 hours. There are no blackflies at night. The active flight of midges during our research was observed at air temperatures from +10 ... +30 °C, relative humidity from 33 to 100%, illumination from 20 to 62,000 lux, and wind speeds up to 2.5 m/s.

The attack of female blood-sucking blackflies on the feeder is observed both in the open and in the forest. Most of the species of midges living in the region prefer to attack in open areas, where their numbers are 1.4-4.5 times higher than in the forest. Two species – *S. nigrum* (Meigen, 1804) and *S. venustum* Say, 1823. prefer to attack under the canopy of the forest. *S. venustum* is particularly clearly confined to the forest, the number of this species in open areas is 9 times lower than in the forest [7]. Blackflies fly into the premises very rarely and do not attack there.

Blood-sucking biting midges (family Ceratopogonidae) in the region are represented by 17 species belonging to the same genus *Culicoides* [26]. *C. punctatus* (Meigen, 1804) dominates in all climatic zones of the region.

The flight of biting midges in the southern taiga was recorded from the end of May to the beginning of October, in the subzone of small-leaved aspen-birch forests - from the third decade of May to the end of the first decade of October, in the forest-steppe zone - from the end of May to mid-October.

Biting midges are most active at temperatures from +7 ... +19 °C and illumination 1-6000 lux. Biting midges are twilight insects, depending on abiotic factors, the activity of woodlice lasts from 20 to 10 hours with maxima at 22-23 and 5-7 hours in the absence of summer during the day. In cloudy weather, they attack during the day. In late summer and early autumn, with the emergence of a greater temperature difference at night and during the day, and a reduction in the light period, the daily rhythm of the activity of biting midges changes. At this time, biting midges are active during the day, and at night, because of low temperatures, they do not attack feeders.

Under the canopy of the forest, blood-sucking biting midges practically do not occur, they prefer open terrain, while they are characterized by a high degree of endophilicity - they fly into rooms where they actively attack humans and animals.

CONCLUSION

As a result of many years of research, it has been established that the fauna of blood-sucking Diptera insects of the Tyumen region is represented by 109 species and 4 subspecies. The total summer period of insects of this group in the southern taiga is about 140 days, in the aspen-birch forests subzone - 160 days, and in the forest-steppe zone - 170 days. Depending on the meteorological conditions of the season, the start and end dates of summer may shift by 1-2 decades. The activity of horseflies and blackflies is observed during the daytime, and mosquitoes and biting midges are twilight insects and attack mainly in the morning and evening hours. The main abiotic factors determining the nature of the diurnal rhythm of the activity of Diptera insects in the conditions of the Tyumen region

are air temperature and illumination.

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