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Current fauna of parasitic flies of Yamalo-Nenets Autonomous Region

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The fauna of blood-sicking two-winged insects of the Yamalo-Nenets Autonomous District is represented by 116 species. Hybomitra aequetincta, H. arpadi, H. lundbecki, H. nitidifrons nitidifrons, H. nitidifrons confiformis, Hybomitra astur. Thus, the fauna of gadflies of the district is represented by 26 species and 2 subspecies, and 16 species and 1 subspecies are known as potential carriers of dangerous diseases of humans and animals. The faunal list of mosquitoes of the region is represented by 29 species, incl. Replenished with 2 species - O. nigrinus and O. behningi, 24 species of midges, incl. 1-Simulium paramorsitans, biting midges with 33 species, incl. 1 species -*Culicoides punctatus*. This species was first indicated both for the tundra zone and for the region. The dominant species of horseflies were H. aequetincta and H. arpadi with an EID of 27.3%. Among the 12 registered species of mosquitoes, O. communis (ID 29%) prevailed in the Yamal District (ID 29%), and O. hexodontus in the Tazovsky District. (EID 29.4%). Among the identified species of midges, Simulium paramorsitans dominated in numbers, in the Yamal region with an ID of 80.7%, and in the Tazovsky region -90.5%. In the tundra in the south of the Yamal region, during the mass flight, up to 500 individuals of mosquitoes were simultaneously attacked by an average of 4598 individuals by the maximum data recorded. In the more northern point of the region, Bovanenkovo, the number of mosquitoes during this period was 270 individuals according to the average registration data, at a wind speed of 10 m/s. In the Tazovsky district, 46 female mosquitoes simultaneously attacked a man at a time, and 26 deer at a time. In the more northern part of the region - in Bovanenkovo, the number of midges according to the average data was 70 individuals, while the wind speed at the time of the survey reached 10 m / s, and for the midges this wind is a serious obstacle for active summer. In the Tazovsky district during this period, the number of midges was significantly lower and amounted to 131 individuals, according to the maximum data for recording per person and 56 individuals - per deer. The maximum number of biting midges (*C. punctatus*, up to 130 individuals registered for 5 minutes) was observed over the Arctic Circle in Yar-Sale in late August. The main component of the midges, the most disturbing reindeer in the tundra zone, are mosquitoes, and in some periods - midges. When studying the distribution of dedemagena tarandi under the conditions of the subarctic tundra of the Tazovsky region in 2018, the reindeer 'extensinvasiveness averaged 66.7 ± 1.6% with an invasion intensity of 9.4 ± 1.2 larvae. In the Priuralsky and Yamalsky districts, on average, the deer incidence of pathogens of edema nausea is slightly lower -34.6 and 28.8% by extension, with an invasion intensity of 9.4 ± 1.6 and 8.6 ± 1.2 larvae, respectively, in our opinion, due to the massive conduct of early chemotherapy. However, the invasion of deer that did not undergo therapeutic measures remains high - up to 100%, with AI - 18.5 ± 1.7 larvae. The release of larvae to pupation in 2018 was observed in August, which was not recorded in the literature. Thus, the first insects appeared near deer from 6.30-7 hours, and the last at 21 hours. From the second half of August, insect activity was noted from 9.30-11 am (the peak of activity was at 13-14 o'clock and at 16-18 h, respectively). The highest activity and the number of gadflies is observed at illumination of 45-90 thousand lux and a temperature of 18-28°C. In the days of high activity and abundance, more than 10 female gadflies attacked the control deer in a 30-minute count. Early education (III decade of November - I decade of December) on the skins of fistulas and a significant amount of larvae of II age attract attention, which, in our opinion, can also be associated with a change in climatic conditions.

Key words: Blood-sucking two-winged insects; gadflies; mosquitoes; midges; biting midges; gadflies; fauna; dominance index; abundance; extensiveness of invasion

Introduction

Yamalo-Nenets Autonomous Region is located in the North of Western Siberia between Baydaratskaya and Ob Bays of the Kara Sea. The Kara Sea washes the Northern and North-Western shores and forms bays deeply intruding into the continent and peninsulas between them – Yamal, Malyi Yamal, Gydan and Mamonta. The territory of the region is 122 thousand km2, its length is 750 km and width is 240 km. The nature and structure of permafrost with layers and veins of underground ice, lying in Yamal, is unique in our country and abroad. Their maximum thickness often exceeds 300 m. There are many lakes, rivers, rich in such delicious fish as muksun, whitefish, and the Ob Bay has beluga and seal. The region's area abounds with different animals and birds.

Human interference with the nature of the North has many negative consequences. This is particularly true for exploration, construction, extractive operations in Yamal. Very large reserves of natural resources, such as oil and gas, are explored in the region, which amount is 3 times more than in all other regions of Russia combined. The region is the leader in raw hydrocarbons production. Any changes in the environment: air pollution, soil, poor water quality, forests and shrubs disappearance, decrease in species diversity of animals and birds leads to a disaster of the Northern vulnerable nature.

Yamalo-Nenets Autonomous Region has severely continental climate. The region is located within the northern part of the West Siberian Plain. The region's extreme west, on the left side of Ob River, lies across the eastern slopes of the Urals. The harsh climate of this northern region is extremely unfavorable for farming by humans – it is an area of so-called "extreme living conditions".

The vastness of areas, severely continental climate, plains and mountains determine the region's division from North to South, and the latitudinal physicogeographical zones: tundra, tundra forest, forest and mountain. Given the agroclimatic characteristics, the tundra zone is divided into three main subzones - Arctic tundra, typical (moss-and-lichen) tundra and shrub (bushy) tundra. Only the northernmost part of the forest zone – the northern taiga subzone - is in the territory of the region. The mountain range is divided into the Polar and Nether-Polar Urals (Western Siberia, 1963).

General patterns of blood-sucking Diptera distribution is determined by the landscape and hydrological regime of areas, as well as by environmental requirements of species. Hydrological and weather conditions of the season have a direct and indirect impact on the species composition and population dynamics together with changes in the ratio of gnat components.

The environmental conditions in Yamalo-Nenets Autonomous Region are favourable to the mass breeding of blood-sucking flies (except for Arctic tundra subzones), here are combined the primary factors causing the high abundance and species diversity of these insects: dominance of breeding habitats (different ponds and bog formation) and adult insect habitation, as well as the presence of a sufficient number of warm-blooded animals – an engorgement source.

Blood-sucking Diptera known under the popular name "gnat" include horse-flies (family Tabanidae), mosquitoes (family Culicidae), midges (family Simuliidae), sandflies (family Ceratopogonidae). In the region, the reindeer is a primary feeder of blood-sucking Diptera. The region is home to a wild population of reindeer, and has more than 550 thousand domesticated animals of this species. Currently, the urgent task is to preserve and develop the reindeer breeding, especially now, during the active Arctic exploration. Reindeer are an essential components of this fragile ecosystem, besides, the well-being of the region's indigenous inhabitants depends largely on reindeer breeding. Along with the increasing anthropogenic interventions, parasitic diseases and attacks of blood-sucking Diptera have a significant impact on the well-being of reindeer herding (Prokopyev, 1979; Sizikov, 2005; Samandas, 2011).

The harmful effect of blood-sucking Diptera is determined by their painful bites, blood loss, saliva poisoning that is transferred when blood sucking, subsequent inflammatory processes in the bite sites. The gnats' parasitizing is manifested through bodily reaction with fervescence, rapid pulse and breathing, that is, leads to reduced general condition, as well as to a decrease in resistance. Deer have been reported to have died as a result of a massive mosquitoes' attack, which are a major component of gnat in northern regions (Prokopyev, 1979).

The mass gnat parasitizing causes severe disturbance for animals, accompanied by numerous defensive movements that requires considerable energy, an interruption of their normal grazing behavior and recreation. During the summer months, reindeer are attacked around-the-clock by blood-sucking Diptera, making it impossible for them to fully use pasture forage. The strong disturbance coming from the gnat attack and running for cover often result in different injuries contributing to infection with necrobacillosis and even abortion of pregnant animals. The harmful effects of blood-sucking Diptera are also compounded by the fact that they are carriers of many infectious and infective diseases of humans and animals.

The study of fauna, abundance and features of insect ecology of the gnats' complex on the territory of Yamalo-Nenets Autonomous Region was mainly carried out during the exploration of new oil and gas bearing in the last half of the 20th century.

Purpose. To study the current fauna of parasitic insects of Yamalo-Nenets Autonomous Region and the species abundance – potential carriers of dangerous human and animal pathogens.

Materials and Methods

The work was performed in the field in Yamalo-Nenets Autonomous Region (Yamalsky, Priuralsky, Tazovsky Districts). Tazovsky District has the largest area in the north-east of Yamalo-Nenets Autonomous Region. The geographical area is located deep above the Arctic Circle on the right side of the Ob Bay. Yamalsky District is located in the northern part of Yamalo-Nenets Autonomous Region in the Yamal Peninsula and the nearest Islands, it includes also the largest island of Yamalo-Nenets Autonomous Region – Bely. Priuralsky District is located in the westernmost part of Yamalo-Nenets Autonomous Region (the territory belongs to the Polar Urals). There are a lot of lakes and rivers in the District.

Office treatment of material, including the determination of the insects collected, analysis of own and literature data, was carried out at the All-Russian Scientific Research Institute of Veterinary Entomology and Arachnology and Tobolsk Complex Scientific Station. To study the species composition of blood-sucking two-winged insects, the adults were collected using a standard butterfly net, butterfly net with removable pouches (Paliy, 1970; Detinova et al., 1978; Rasnitsyn, Kosovskikh, 1979) and test tubes, Monchadsky's and Berezantsev's bell (Berezantsev, 1952; Rasnitsyn, 1974).

The dominance index was used for the quantitative characteristics of species (Beklemishev, 1970). To assess the degree of abundance of species of horseflies, the Skufjin L.V. (1949) scale was used, of mosquitoes - the Skripchenko F.A. (2000) scale, of midges and sandflies - the Engelmann H.-D. (1978) scale.

Twenty-minute counts by net were used when studying the abundance of adult horseflies (Olsufyev, Mosolov, 1964; Detinova et al., 1978). The censuses of mosquitoes, midges and sandflies were performed by the method proposed by T.S. Detinova et

al. (1978): 10 of-eight sweeps of the butterfly net around yourself in 5 replications at different points of habitat. The insects caught were placed on cotton mattresses and in paper envelopes for further study and transportation.

The species composition of the caught blood-sucking two-winged insects was determined by keys of L.P. Kukharchuk)1980), I.A. Rubtsov (1956), V.D. Petrusheva (1982), A.V. Yankovsky (2002), N.G. Olsufyev (1977), A.G. Mirzaeva (1989) and "Keys to the insects of the European part of the USSR" (1970) using MSP-1 and Carl Zeiss Stemi SV6 microscopes.

To date, the lists of species of blood-sucking Diptera taking today's nomenclature into account have been clarified (Harbach, 2013, Borkent, 2012, Peter, Adler 2019) and taxonomic analysis of fauna has been made. Oedemagenosis of reindeer was diagnosed inter vivos when detecting lumps in lumbar and sacrum region (November-June), postmortem, during planned slaughter (November-December).

Results

Fauna of blood-sucking Diptera

The fauna of blood-sucking Diptera of Yamalo-Nenets Autonomous Region includes 116 species (table 1).

Table 1. Fauna and distribution of blood-sicking dipterous insects of the Yamalo-Nenets Autonomous Area.

№ п/п	Specie	natural and climatic subzones		
		tundra	forest-tundra	Northern taiga
	Horseflies (family Tabanidae)			
1	*Chrysops sepulcralis* F.			+
2	*Chrysops nigripes* Zett.	+	+	+
3	*Chrysops divaricatus* Lw.*		+	+
4	*Chrysops caecutiens* L.*			+
5	*Chrysops relictus* Mg.*		+	+
6	*Tabanus maculicornis* Ztt.*			+
7	*Tabanus autumnalis autumnalis* L.*			+
8	*Atylotus fulvus* Mg.*			+
9	*Atylotus sublunaticornis* Ztt.			+
10	*Hybomitra sexfasciata* Hine*	+	+	+
11	*Hybomitra lapponica* Wahlbg.*		+	+
12	*Hybomitra astuta* O.S.		+	+
13	*Hybomitra arpadi* Szil.	+	+	+
14	*Hybomitra tarandina* L.		+	+
15	*Hybomitra aequetincta* Beck.	+	+	+
16	*Hybomitra lurida* Flln.*	+	+	+
17	*Hybomitra nitidifrons nitidifrons* Szil.	+		
18	*Hybomitra nitidifrons confiformis* Chv. Et M.*	+	+	+
19	*Hybomitra ciureai* Seg.*		+	+
20	*Hybomitra muehlfeldi* Br.*			+
21	*Hybomitra bimaculata* Macq.*		+	+
22	*Hybomitra nigricornis* Ztt.*		+	+
23	*Hybomitra lundbecki lundbecki* Lyn.*	+	+	+
24	*Hybomitra montana montana* Mg.*	+	+	+
25	*Hybomitra astur* Erichs.	+		
26	*Haematopota pluvialis pluvialis* L.*		+	+
27	*Haematopota subcylindrica* Pand.			+
	Всего видов:	9	17	25
	Mosquitoes (family Culicidae)			
28	комплекс *Anopheles maculipennis**	+	+	+
29	*Culiseta alaskaensis* Ludl.*		+	+
30	*Culiseta bergrothi* Edw.			+
31	*Culiseta morsitans* Theob.			+
32	*Coquillettidia richiardii* Fic.*			+
33	*Ochlerotatus dorsalis* Mg.*	+		
34	*Ochlerotatus cantans* Mg.	+	+	+
35	*Ochlerotatus riparius* D.K.			+
36	*Ochlerotatus behningi* Mart.		+	
37	*Ochlerotatus excrucians* Walk.*	+	+	+
38	*Ochlerotatus euedes* H.D.K.*		+	
39	*Ochlerotatus flavescens* Mull.*			+

40	*Ochlerotatus cyprius* Ludl.*	+		
41	*Ochlerotatus communis* Deg.*	+	+	+
42	*Ochlerotatus pionips* Dyar.	+	+	
43	*Ochlerotatus punctor* Kirby*	+	+	+
44	*Ochlerotatus hexodontus* Dyar.	+	+	+
45	*Ochlerotatus punctodes* Dyar.		+	
46	*Ochlerotatus nigrinus* Eck.	+		
47	*Ochlerotatus diantaeus* H. D. K.	+	+	+
48	*Ochlerotatus implicatus* Vock.	+	+	
49	*Ochlerotatus intrudens* Dyar.	+	+	+
50	*Ochlerotatus pullatus* Coq.	+	+	+
51	*Ochlerotatus nigripes* Zett.*	+	+	
52	*Ochlerotatus impiger* Walk.	+	+	
53	*Ochlerotatus cataphylla* Dyar.	+	+	+
54	*Ochlerotatus churchillensis* E.B.		+	
55	*Aedes cinereus* Mg.*	+	+	+
56	*Culex pipiens* L.	+	+	
	Всего видов:	19	21	17
	Midges (family Simuliidae)			
57	*Prosimulium kolymensis* Patrusheva	+		
58	*Prosimulium hirtipes* Fries		+	
59	*Stegopterna trigoni* Lund.	+		
60	*Cnephia pallipes* Fries	+	+	
61	*Metacnephia tredecimata* Edw.	+		
62	*Metacnephia trigoniformis* Yankovsky	+		
63	*Metacnephia pectinata* Patrusheva	+		
64	*Metacnephia korsakovi* Rubz.	+		
65	*Metacnephia edwardsiana* Rubz.	+		
66	*Metacnephia tabescentifrons* End.	+		
67	*Byssodon maculatus* Mg.*	+	+	+
68	*Cnetha arcticum* Rubz.	+		
69	*Cnetha bicornis* Dor., Rubz. Et Vlas.	+	+	
70	*Cnetha pugetensis* Dyar et Shan.	+		+
71	*Cnetha silvestris* Rubz.	+	+	+
72	*Cnetha verna* Macq.	+	+	+
73	*Eusimulium aureum* Fries		+	
74	*Schoenbaueria brachyarthra* Rubz.	+	+	
75	*Schoenbaueria gigantea* Rubz.	+	+	
76	*Schoenbaueria pusilla* Fries*	+	+	+
77	*Schoenbaueria rangiferina* Rubz.	+	+	
78	*Schoenbaueria subpusilla* Rubz.	+	+	
79	*Schoenbaueria tshernovskii* Rubz.	+		
80	*Boopthora erythrocephala* De Geer*		+	
81	*Parabyssodon transiens* Rubz.		+	
82	*Gnus corbis* Twinn	+	+	
83	*Odagmia ornata* Mg.*	+	+	
84	*Archesimulium tuberosum* Lund.	+		
85	*Archesimulium vulgare* Dor., Rubz. et Vlas.	+	+	
86	*Simulium rostratum* Lund.*	+	+	+
87	*Simulium paramorsitans* Rubz.	+	+	
88	*Simulium venustum* Say*	+	+	
89	*Simulium longipalpe* Belt.*	+	+	+
90	*Simulium truncatum* Lund.	+	+	
91	*Simulium tuberosum* Lund.	+		
92	*Simulium tumulosum* Rubz.	+		
93	*Simulium murmanum* Edw.		+	
94	*Simulium posticatum* Mg.		+	
95	*Simulium palustre* Rubz.			+
	Всего видов:	32	24	8
	Sandflies (family Ceratopogonidae)			
95	*Culicoides punctatus* Mg.	+		+

96	*Culicoides riethi* Kieff.		+	
97	*Culicoides helveticus* Cal., Krem. Et Det.		+	+
98	*Culicoides manchuriensis* Tok.		+	+
99	*Culicoides stigma* Mg.		+	
100	*Culicoides circumscriptus* Kieff.		+	+
101	*Culicoides salinarius* Kieff.		+	+
102	*Culicoides sibiricus* Mirzaeva		+	+
103	*Culicoides pulicaris* L.		+	+
104	*Culicoides grisescens* Edw.		+	+
105	*Culicoides obsoletus* Mg.		+	+
106	*Culicoides fascipennis* St.		+	+
107	*Culicoides pallidicornis* Kieff.		+	+
108	*Culicoides chiopterus* Mg.			+
109	*Culicoides gornostaevae* Mirzaeva			+
110	*Culicoides reconditus* Campbell et Pelham-Clinton			+
111	*Culicoides subfascipennis* Kieff.			+
112	*Culicoides sensillatus* Mirzaeva			+
113	*Culicoides albicans* Winnertz			+
114	*Culicoides sphagnumensis* Williams			+
115	*Culicoides nubeculosus* Mg.			+
116	*Culicoides stigma* Mg.			+
	All species Всего видов:	1	12	20
	Total:	**61**	**74**	**70**

Note: * - species registered as carriers of pathogens of humans and animals.

Number and flight duration of blood-sucking two-winged Diptera

Tundra zone

The flight of horseflies in the tundra usually lasts a maximum of 20 days from July 8-16 to July 26 – August 5 (table 2). The number of horseflies is very low and unstable under harsh conditions of the open tundra. During the total period of flight, they are active for 6-12 days at temperatures above 12-14°c. In doing so, reindeer are attacked by single insects and in 30 minutes their number is up to 4 individuals. With such a low number, the horseflies do not cause significant disturbance for reindeer in the tundra and the Polar Urals.

The flight of mosquitoes lasts from mid-June to the end of August, that is, about 75 days, under adversity, the total flight period of mosquitoes can be reduced up to 40 days – from the middle of the first 10 days of July to mid-August. The mass mosquito flight is seen from the first 10 days of July to the end of the first 10 days of August. During periods of peak in mosquito activity, 1800 individuals attack a person per five-minute registration.

Studies carried out in 2018 established that in the tundra in the south of Yamalsky District during a mass flight, up to 500 mosquitoes according to the average data and 4,598 individuals according to the maximum data attacked a person per registration. In the northernmost point of district, Bovanenkovo, the abundance of mosquitoes during this period amounted to 270 individuals according to the average data per registration, at a wind speed of 10 m/s, while studies conducted earlier by other authors showed that the wind speeds higher than 7 m/s reduce the flight activity of mosquitoes up to its complete stop. In Tazovsky District, a person was attacked by 46 female mosquitoes at one time during this period and a deer - by 26.

In the polar Urals, midges fly from the end of July to the first 10 days of September, in the Nadymsky tundra - from the first 10 days of July to the first 10 days of September. In the Polar Urals, the period of mass flight lasts 6 days (from the end of the second to the middle of last 10 days of August), in the tundra – 20 days from the second half to the end of August with a population peak on August 24. According to the average data, during the activity season, in the Polar Urals, a deer is attacked by 166, in the Nadymsky tundra by 458, with a maximum of 471 and 1105 individuals per a five-minute registration, respectively.

Studies carried out in 2018 established that in the tundra in the south of Yamalsky District during a mass flight, up to 40-60 individuals of midges according to the average data and 585 individuals according to the maximum data attacked a person per registration, in the more northern part of district, in Bovanenkovo, the abundance of midges amounted to 70 individuals according to the average data, and at the time of registration, the wind speed reached 10 m/s, for midges such wind is a serious obstacle for active flight. In Tazovsky District, during this period, the number of midges was significantly lower and amounted to 131 individuals according to the maximum data on a person per registration and 56 individuals – on deer.

During the summer season of 2018, a registration was undertaken to study the circadian activity rhythm of blood-sucking midges in the tundra of Tazovsky District from 11.06 to 12.06. The number of midges in the open area throughout the day from 8 to 22 o'clock was at a high level, varying from 90 to 140 individuals per registration. At night, midges were absent or rare. In addition, at night, individuals of only a mass species of Byssodon maculatus were encountered. The decline in activity at 16 o'clock was due to increased wind. The greatest number of midges was at 8-12 and 18-22 o'clock, with a maximum of 26 and 28 individuals per registration in the open area, respectively. It should be noted that this registration of circadian activity was conducted under increased wind conditions, which is a limiting factor. During the day, the temperature went only up to 19°C. The midges were encountered at a temperature of 16°C. The maximum activity was observed at 16–19°C, that is, this temperature level did not have a negative impact on the midges' activity.

The total flight period of sandflies is about a month from the end of July to the end of August. The maximum number of sandflies (up to 130 individuals per registration in 5 minutes) above the Arctic circle in Yar-Sale is seen at the end of August. The peak number of the only registered C. *punctatus* species here was at this time. The total flight period is about a month from the end of July to the end of August.

The major component of gnat that cause the greatest disturbance for reindeer in the tundra zone are mosquitoes, and in some periods – midges.

Tundra-forest zone

The number of horseflies in the tundra-forest is usually small. In some years, they may be rare, but sometimes they cause significant disturbance to people and especially reindeer. Within 30 minutes, a deer in the herd is attacked by 35, and by 700 or more horseflies during the day. The total duration of flight period is 30-40 days: from the middle of last 10 days of June – the middle of the second half of July to the middle of the first – second half of August. The period of mass activity ranges from 5 to 20 days. The period of maximum number is sometimes in mid-July, sometimes – in late July – early August.

Mosquitoes begin to fly in the second half of June. Mass flight is seen from the end of last 10 days of June to the end of July. During this period, the number of mosquitoes on a deer can reach 2110 individuals per five-minute registration. Then the number of mosquitoes decreases, some individuals fly until the end of August.

In 2018, in the tundra-forest of Priuralsky District, the number of mosquitoes during the mass flight amounted to 197 individuals according to average data per registration. The air temperature during this period was 20°C, humidity 42%, wind speed 8 m/s.

Midges are active from the end of June to September. Their mass flight is seen from mid-July to mid-first 10 days of September with a peak number in mid-August. On average, the deer is attacked by 1525, up to a maximum of 3496 individuals in 5 minutes per season.

In July 2018, in the tundra-forest of Priuralsky District, the number of midges was 17 individuals according to average data per registration.

The flight period of sandflies is subject to significant changes and is noted depending on the season from early July to mid-September or from mid-July to mid-August, that is, lasts from one to 2.5 months, often stopped due to weather conditions. The maximum number (up to 97 individuals on a deer per 5-minute registration) is observed at the end of August –early September.

Northern taiga and forest zone subzone

In this subzone, horseflies begin to fly in the second – third decade of June and stop to fly in the first or last 10 days of August. The total duration of flight period is more than 50 days, of which the period of mass flight is 30 days – from the middle of last 10 days of June to the middle of last 10 days of July. In 15 minutes, the maximum number reaches 60-70 individuals, and about 2.5 thousand individuals in a day.

Mosquitoes fly from June to the first 10 days of September. The period of mass flight is observed from the second half of June to the end of July. During the largest number, up to 500 individuals are caught by butterfly net per 3-minute registration.

Midges begin to fly from the second half of June and until the end of September. The mass flight is in the last 10 days of June - the second half of July. A person is attacked by 1348 individuals per 5-minute registration.

Sandflies fly from late June – early July to late August – mid-September, that is 2-2.5 months. There are 2 peaks in seasonal dynamics: the first peak in July, the second – in August with a maximum number of 249 and 536 individuals on a person per five- minute registration, respectively, due to the species change. There was a maximum number in the middle of August (3752 individuals in registration).

As to the attacking blood-sucking Diptera, the most harm to animals is caused by horseflies. Deer massively suffer from necrobacteriosis during the period of their high number.

The number and flight time of gadflies' adults

A study of O. tarandi distribution in the subarctic tundra conditions of Tazovsky District was made. The work was carried out in 2018 at the premises of reindeer team and slaughter units of Tazovsky District. Adults of Oedemagena tarandi were caught using a butterfly net near herds of grazing deer. To clarify the flying extent of the Oedemagena tarandi adults, from the main herd of deer, the censuses were performed directly in the herd, as well as at a distance of 1, 3, 5, 7 km from it. The prevalence of reindeer is, on average, 66,7 ± 1,6% with infection intensity of 9,4 ± 1,2 larvae. When comparing the track routes of reindeer team, it was found that the routes, the grazing area of which is situated to the north, or runs in the immediate vicinity of the Taz or Ob Bay, where climatic conditions are unfavorable for the mosquitoes' flight, are more protected from Oedemagena tarandi. The infestation of deer with O. tarandi larvae, the grazing line of which lies to the north of prevalence, was 62.1%, infection intensity of 7,2 ± 0,2 larvae, and deer grazing relatively close to the Taz Bay, the prevalence was 68,3%, infection intensity - 10,3 ±1 ,5 larvae. The ratio of infestation of young and adult animals was 7.3:5.2. The distribution of O. tarandi clearly shows a tendency to decrease both the number of adults in nature and the degree of infestation of deer with larvae with expansion to the North-West, especially in the immediate vicinity of the Taz or Ob Bay. The high rate of prevalence is due to the refusing the early chemotherapy of young slaughter reindeer.

In Priuralsky and Yamalsky Districts, the infestation of deer with Oedemagenosis agents is, on average, slightly lower – 34.6 and 28.8% in terms of prevalence, with the infection intensity of 9.4 ± 1.6 and 8.6 ± 1.2 larvae, respectively, which, in our view, is due to the mass performance of early chemotherapy. However, the infestation of deer, not subjected to therapy measures, remains high – up to 100%, with the infection intensity of 18.5 ± 1.7 larvae.

An analysis of indicators of extensinvasion of deer, not subjected to therapy measures, by age-sex group indicated that the infestation of calves (96%) was significantly higher than animals in other age-sex groups (she-deer – 90%, bucks - 89.7%, bulls - 82%.

In addition, skinny animals were infested in all cases by 100% with high infection intensity - 29.8 ± 1.5 larvae of O. tarandi. In terms of intensity, deer in high and middle condition were infected by the larvae of O. tarandi much less - 12,1 ± 0,4.
We know that the infestation of deer with Oedemagenosis and cephenomyosis agents decreases relatively slowly, despite the use of highly effective imagocides and larvicides. If therapy and prevention of gadfly diseases is discontinued, the recovery of abundance of parasites and infestation of deer to the initial level is fast enough. At this stage, anthropogenic suppression is a critical influencing factor on O. tarandi and C. Trompe.
In addition, variable climate conditions, in particular, marked in 2018, may have a negative impact on the planned activities against gnat and adults of gadflies, which, according to veterinary reports, were carried out only on a small number of livestock (n-23856) in Yamalsky District. In Priuralsky District, no treatment against gnats and adults of gadflies was carried out.
Variable climate conditions can also affect the biological features of the parasite. For example, in 2018, the larvae pupation occurred also in August, which had not been recorded in the literature. During the phenological observations, a delay in the beginning of the flight season until the second half of July was established, a direct dependence of the appearance time of gadflies' adults in nature, the circadian and seasonal dynamics of their activity and abundance on the magnitude of solar activity and air temperature was evidenced. For example, the first insects were encountered near deer from 6.30 -7 o'clock and the last one at 21 o'clock, and from the second half of August from 9.30 -11 o'clock (peak activity at 13-14 o'clock and at 16-18 o'clock, respectively), which is consistent with the literature data. The highest activity and abundance of gadflies was seen at illuminance of 45-90 thousand lux and at a temperature of 18-28°C. During the days of high activity and abundance, the control deer was attacked by more than 10 female gadflies per 30-minute registration.
Worth noting is the early (last 10 days of November - first 10 days of December) fistulation on the skins and a considerable size of larvae of age II, which, in our opinion, may also be related to changes in climate.

Discussion

Horseflies (family *Tabanidae*)

According to the literature data, there are almost no horseflies in the Arctic and typical tundra (Sazonova, 1949; Olschvang, 1980; Mirzaeva et al., 1984). As a result of study carried out during the summer season of 2016, the horseflies' larvae of the first age were found on Bely Island for the first time, it was not possible to establish their species (Khlyzova et al., 2018). According to the literature data, there are 6 species of horseflies in the shrub tundra: Chrysops nigripes, Hybomitra sexfasciata, H. aequetincta, H. lurida, H. nitidifrons confiformis, H. montana montana (Schepetkin, 1974; Pavlov, Schepetkin, 1975).
As a result of study carried out during the summer season of 2018, Hybomitra aequetincta, H. arpadi, H. lundbecki, H. nitidifrons nitidifrons, H. nitidifrons confiformis, Hybomitra astur horseflies, 3 species and 1 subspecies were first registered for the tundra zone of Yamalo-Nenets Autonomous Region. Currently, the fauna of horseflies includes 9 species. In the study season, the dominant species were H. aequetincta and H. arpadi with a dominance index of 27.3%.
According to the literature data, 17 species of horseflies live in the tundra-forest zone of Yamalo-Nenets Autonomous Region: Chrysops divaricatus, Ch. nigripes, Ch. relictus, Hybomitra lapponica, H. sexfasciata, H. astuta, H. arpadi, H. tarandina, H. aequetincta, H. lurida, H. nitidifrons confiformis, H. ciureai, H. bimaculata, H. nigricornis, H. lundbecki lundbecki, H. m. montana, Haematopota pluvialis pluvialis (Olsufyev, 1935, 1937, 1977; Popov, Zuevsky, 1965; Violovich, 1966, 1967, 1968; Cherpanov et al., 1970; Beltyukova, Mitrofanova, 1971; Schepetkin, 1974; Pavlov, Schepetkin, 1975; Olschvang, 1977, 1980; Gagarin, 1982; Sedykh, 1986).
According to the literature data, there are 25 species of horseflies in the northern taiga: Chrysops sepulcralis, Ch. nigripes, Ch. divaricatus, Ch. caecutiens, Ch. relictus, Tabanus maculicornis, T. autumnalis autumnalis, Atylotus fulvus, A. sublunaticornis, Hybomitra sexfasciata, H. lapponica, H. astuta, H. arpadi, H. tarandina, H. aequetincta, H. lurida, H. nitidifrons confiformis, H. ciureai, H. muehlfeldi, H. bimaculata, H. nigricornis, H. l. Lundbecki, H. m. montana, Haematopota subcylindrica, H. p. pluvialis (Popov, 1932; Olsufyev, 1935, 1937, 1977; Sezonova, 1949; Popov, 1959, 1962; Zuevsky, 1965; Violovich, 1966, 1968; Polyakov, 1985; Olsufyev, Polyakov, 1985; Sergeeva, 1986).

Thus, the fauna of the region includes 26 species and 2 subspecies, of which Hybomitra nitidifrons nitidifrons and Hybomitra astur are specified first by us for the region for the first time, and 16 species and 1 subspecies are known as potential carriers of dangerous human and animal pathogens.

Mosquitoes (family *Culicidae*)

There are no literature data on blood-sucking mosquitoes in the Arctic tundra of Yamalo-Nenets Region. Larvae and adults of Ochlerotatus mosquitoes were found on the territory of Bely arctic island for the first time in 2014 and 2016 (Gavrichkin et al., 2016; Khlyzova et al., 2018).
In the typical tundras subzone (Cape Povorotny), E.F. Kiseleva (1927) identified 6 species of mosquitoes (complex of Anopheles maculipennis, Ochlerotatus dorsalis, O. excrucians, O. cyprius, Aedes cinereus and Culex pipiens). L.P. Kukharchuk (1981) added 9 more species to the list: Ochlerotatus nigripes, O. cantans, O. communis, O. punctor, O. hexodontus, O. intrudens, O. pullatus, O. impiger, O. cataphylla.
N.V. Nikolaeva (1978) studied preimaginal stages of mosquitos' development in the water bodies of the shrub tundra of Yamal, she found no new species for the tundra zone.
As a result of study made in 2018, 12 species of blood-sucking mosquitoes was registered in the tundra, while 4 more species were added to the faunal list of mosquitoes of the tundra zone: Ochlerotatus pionips, O. implicatus, O. nigrinus and O. diantaeus. O. communis (Dominance Index 29%) was more prevalent among 12 registered species in terms of number, and in Tazovsky District - O. hexodontus (Dominance Index 29.4%).

The fauna of blood-sucking mosquitoes in the tundra-forest zone of the region was studied by V.A. Schepetkin (1972, 1974), P.E. Polyakova and V.D. Patrusheva (1974), N.V. Nikolaeva (1980, 2012), N.V. Nikolaeva and A.V. Gilev (2006). The work of these studiers established that mosquitoes of Anopheles maculipennis, Culiseta alaskaensis, Ochlerotatus excrucians, O. communis, O. punctor, O. hexodontus, O. intrudens, O. pullatus, O. impiger, O. cataphylla, O. nigripes, O. euedes, O. churchillensis, O. punctodes, O. implicatus, Aedes cinereus and Culex pipiens complex live on the territory of this natural and climatic zone.

When carrying out the study in 2018, 13 species of blood-sucking mosquitoes were registered in the forest tundra of Yamalo-Nenets Autonomous Region, the following 4 species: Ochlerotatus cantans, O. pionips, O. behningi and O. diantaeus were specified for this natural and climatic zone of the region for the first time. At the time of studies, O. communis was prevalent among the identified species in terms of number (Dominance Index 34%).

According to P.E. Polyakova (1968), there are 17 species of mosquitoes in the northern taiga subzone of the forest zone: Anopheles maculipennis, Culiseta alaskaensis, Cs. bergrothi, Cs. morsitans, Coquillettidia richiardii, Ochlerotatus cantans, O. riparius, O. excrucians, O. flavescens, O. communis, O. punctor, O. hexodontus, O. diantaeus, O. intrudens, O. pullatus, O. cataphylla and Aedes cinereus complex.

Thus, the fauna of mosquitoes of Yamalo-Nenets Region includes currently 29 species. As a result of study carried out in 2018, 2 species - O. nigrinus and O. behningi - were added to the faunal list of blood-sucking mosquitoes in the region.

Midges (family *Simuliidae*)

The fauna of midges in the tundra zone of Yamalo-Nenets Autonomous Region was studied by V.D. Petrusheva et al. (1972, 1974, 1976а, 1976б, 1976в, 1982), V.A. Schepetkin (1974), L.V. Boldarueva (1982).

The work of these researchers found habitation of 22 species of blood-sucking midges in the western part of the zone in the Polar Urals: Schoenbaueria tshernovskii, Sch. sp. aff. rangiferina, Sch. subpusilla, Sch. brachyarthra, Simulium truncatum, Sim. longipalpe, Sim sp. aff. venustum, Cnephia pallipes, Metacnephia tredecimata, M. trigoniformis, M. pectinata, M. korsacovi, M. edwardsiana, M. tabescentifrons, Archesimulium vulgare, Arch. Tuberosum, Byssodon maculatus, Cnetha verna, C. silvestris, C. bicornis, C. pugetensis, Gnus corbis.

23 species of midges have been registered in the plain part of the tundra zone - Cnephia pallipes, Simulium truncatum, Sim. longipalpe, Sim. rostratum, Sim. sp. aff. venustum, Sim. tuberosum, Sim. tumulosum, Schoenbaueria sp. aff. rangiferina, Sch. tshernovskii, Sch. aculates, Sch. pusilla, Sch. subpusilla, Sch. brachyarthra, Cnetha verna, Cn. bicornis, Cn. silvestris, Cn. arcticum, Archesimulium vulgare, Metacnephia pectinata, M. tabescentifrons, Prosimulium kolymensis, Stegopterna trigoni.

In 2018, when carrying out the study in the tundra of Yamalo-Nenets Autonomous Region, a flight of 5 species of blood-sucking midges was registered, of which 2 - Simulium paramorsitans and Odagmia ornata - are specified for this natural and climatic zone of the region for the first time. Simulium paramorsitans was prevalent among the identified species in terms of the number, in Yamalsky District, the dominance index of this species was 80.7%, and in Tazovsky District - 90.5%.

Thus, the fauna of blood-sucking midges of the tundra zone currently includes 32 species. The species composition in the tundra-forest zone was studied by I.A. Rubtsov (1956), V.D. Patrusheva and P.E. Polyakova (1965), V.D. Patrusheva (1966, 1967, 1982), S.A. Novitskaya (1970), V.A. Schepetkin (1974), L.V. Petrozhitskaya (1987). The work of these researchers found the habitation of 23 species of blood-sucking midges: Byssodon maculatus, Schoenbaueria pusilla, Sch. subpusilla, Sch. rangiferina, Sch. gigantea, Sch. brachyarthra, Gnus corbis, Odagmia ornata, Simulium longipalpe, Sim. rostratum, Sim. murmanum, Sim. venustum, Sim. truncatum, Sim. posticatum, Archesimulium vulgare, Prosimulium hirtipes, Boophthora erythrocephala, Cnephia pallipes, Eusimulium aureum, Cnetha verna, C. silvestris, C. bicornis, Parabyssodon transiens.

As a result of study carried out in 2018, the flight of 4 species of blood-sucking midges was registered in the tundra-forest zone, of which 1 - Simulium paramorsitans - is specified for this natural and climatic zone of the region for the first time. Simulium paramorsitans was prevalent among the identified species in terms of the number (Dominance Index 58.8%).

Currently, the fauna of blood-sucking midges of the tundra-forest zone of Yamalo-Nenets Autonomous Region includes 24 species. In 2018, 1 species - Simulium paramorsitans - was added to the list of midges' species of the region.

Petrusheva V.D. (1966, 1982) studied the midges in the northern taiga subzone of the forest zone, she found the habitation of 8 species: Byssodon maculatus, Cnetha verna, C. silvestris, C. pugetensis, Simulium rostratum, Sim. longipalpe, Sim. palustre, Schoenbaueria pusilla.

Sandflies (family *Ceratopogonidae*)

Literature data on blood-sucking sandflies in Yamalo-Nenets Autonomous Region are limited. In 2018, the studies of the fauna of blood-sucking Diptera in the tundra zone of the region registered a flight of Culicoides *punctatus* sandflies. This species was specified for both the tundra zone and the region for the first time.

The fauna of sandflies of the tundra-forest zone was studied by A.G. Mirzaeva (1989). Her studies identified 12 species*: Culicoides riethi, C. helveticus, C. manchuriensis, C. stigma, C. circumscriptus, C. salinarius, C. sibiricus, C. pulicaris, C. grisescens, C. obsoletus, C. fascipennis, C. pallidicornis. C. grisescens,*

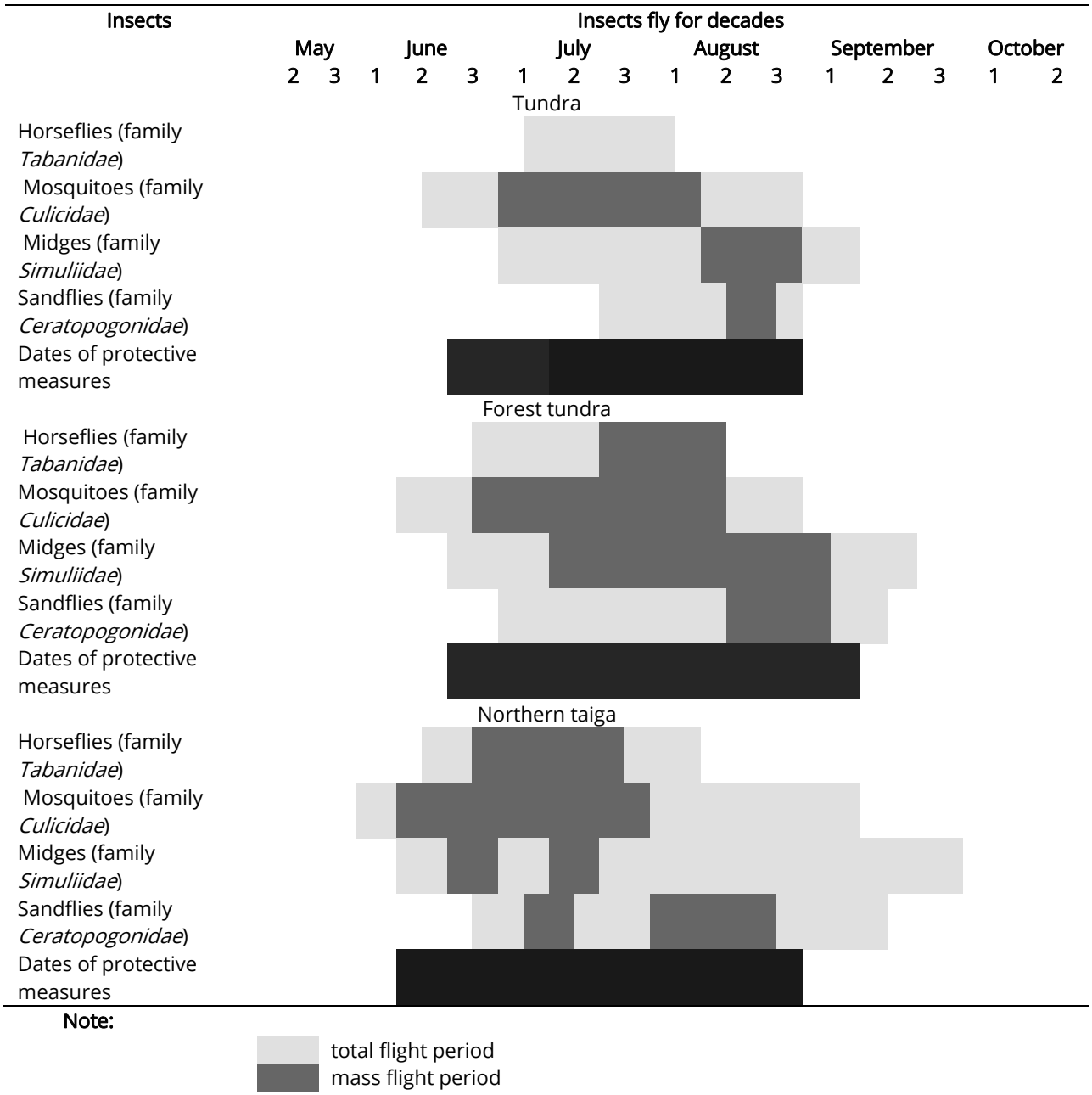
According to the literature data, there are sandflies of 20 species in the northern taiga subzone of the forest zone: *Culicoides obsoletus, C. chiopterus, C. gornostaeva, C. pulicaris, C. punctatus, C. reconditus, C. fascipennis, C. subfascipennis, C. pallidicornis, C. sensillatus, C. albicans, C. circumscriptus, C. salinarius, C. sphagnumensis, C. manchuriensis, C. sibiricus, C. nubeculosus, C. stigma, C. helveticus.*

The fauna of the blood-sucking sandflies in Yamalo-Nenets Autonomous Region includes currently 33 species.

When studying the O. tarandi distribution in the subarctic tundra of Tazovsky District, in 2018, the extensinvasion of reindeer averages 66,7 ± 1,6% with infection intensity of 9,4 ± 1,2 larvae. When comparing the track routes of reindeer team, it was found that the routes, the grazing area of which is situated to the north, or runs in the immediate vicinity of the Taz or Ob Bay, where climatic conditions are unfavorable for the mosquitoes' flight, are more protected from Oedemagena tarandi. In Priuralsky and

Yamalsky Districts, the infestation of deer with Oedemagenosis agents is, on average, slightly lower – 34.6 and 28.8% in terms of prevalence, with the infection intensity of 9.4 ± 1.6 and 8.6 ± 1.2 larvae, respectively, which, in our view, is due to the mass performance of early chemotherapy. However, the infestation of deer, not subjected to therapy measures, remains high – up to 100%, with the infection intensity of 18.5 ± 1.7 larvae. In 2018, the larvae pupation occurred also in August, which had not been recorded in the literature. For example, the first insects were encountered near deer from 6.30 -7 o'clock and the last one at 21 o'clock, and from the second half of August from 9.30-11 o'clock (peak activity at 13-14 o'clock and at 16-18 o'clock, respectively), which is consistent with the literature data. The highest activity and abundance of gadflies was seen at illuminance of 45-90 thousand lux and at a temperature of 18-28°C. During the days of high activity and abundance, the control deer was attacked by more than 10 female gadflies per 30-minute registration. Worth noting is the early (last 10 days of November - first 10 days of December) fistulation on the skins and a considerable size of larvae of age II, which, in our opinion, may also be related to changes in climate.

Table 2. The dates of the flight of the midges and the implementation of measures to protect the reindeer from their attack on the territory of the Yamalo-Nenets Autonomous District.



Conclusions

Thus, the fauna of bloodsucking dipterans of the Yamalo-Nenets Autonomous District is represented by 116 species. Hybomitra aequetincta, H. arpadi, H. lundbecki, H. nitidifrons nitidifrons, H. nitidifrons confiformis, Hybomitra astur. The faunal list of mosquitoes of the region is replenished with 2 species - O. nigrinus and O. behningi, black flies, including 1 - Simulium

paramorsitans, biting midges, incl. 1 species - Culicoides *punctatus*. This species was first indicated both for the tundra zone and for the region. The dominant species of horseflies were H. aequetincta and H. arpadi with an EID of 27.3%. Among the 12 registered species of mosquitoes, O. communis (ID 29%) prevailed in the Yamal District (ID 29%), and O. hexodontus in the Tazovsky District. (EID 29.4%). Among the identified species of midges, Simulium paramorsitans dominated in numbers, in the Yamal region with an ID of 80.7%, and in the Tazovsky region - 90.5%. When studying the distribution of dedemagena tarandi under the conditions of the subarctic tundra of the Tazovsky region in 2018, the reindeer 'extensinvasiveness averaged 66.7 ± 1.6% with an invasion intensity of 9.4 ± 1.2 larvae. In the Priuralsky and Yamalsky districts, on average, the deer incidence of pathogens of edema nausea is slightly lower - 34.6 and 28.8% by extension, with an invasion intensity of 9.4 ± 1.6 and 8.6 ± 1.2 larvae, respectively, in our opinion, due to the massive conduct of early chemotherapy. However, the invasion of deer that did not undergo therapeutic measures remains high - up to 100%, with AI - 18.5 ± 1.7 larvae. The release of larvae to pupation in 2018 was observed in August, which was not recorded in the literature. Thus, the first insects appeared near deer from 6.30-7 hours, and the last at 21 hours. From the second half of August, insect activity was noted from 9.30-11 am (the peak of activity was at 13-14 o'clock and at 16-18 h, respectively). Today the topic is relevant and requires further research.

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