Research Article

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ECOLOGY OF PREIMAGINAL STAGES OF BLOOD-SUCKING BLACK FLIES IN CENTRAL NON-CHERNOZYOM ZONE OF THE RUSSIAN FEDERATION

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ABSTRACT

Species composition of black flies pre-imago stages was investigated in different types of inland waters (large, middle and small rivers, brooks and reclamation channels of Moscow, Ryazan and Tver regions). There were found 9 species of Simuliidae in large rivers, 12 - in middle rivers, 14 - in small, 10 - in reclamation channels. Larvae and pupae inhabit coastal area on hydrophytes, rocks, water objects, etc. Dominant, subdominant and scanty black flies species were discovered. Maximum of population density was registered in the late May - early June and was up to 700 flies per 1 dm^2 in average.

Key words: Black flies, larvae, pupae, rivers, reclamation channels, Simuliidae, biotopes, populations, dominant species.

INTRODUCTION

Blood-sucking black flies (*Diptera*, *Simuliidae*) are widespread in Russia and cause great economic losses to livestock.

During the mass flight of black flies milk loss per one cow reaches 25%, the increase in body weight in calves reduces to 20%. As a result of contact with a large amount of toxins within the saliva of black flies during bloodsucking simulidotoxicosis occurs. Annual losses of simulidotoxicosis in Canada are calculated by hundreds of thousands of dollars. It is estimated that blood-sucking black flies are biological and mechanical carriers of dangerous infection agents: anthrax, tularemia, onchocercosis and anaplasmosis of cattle.

In the past 30 years the many works were devoted to the study of blood-sucking black fly ecology in the Republic of Belarus, zone of forest-steppe Zauralye, southwest Altai, Pavlodorskoye Priirtyshye [1-16]. Works, devoted to that problem in Central non-Chernozyom zone of the Russian Federation, have not been found.

The purpose of our research is to study the species composition and ecological features of blood-sucking black flies in Central non-Chernozyom zone of the Russian Federation, their quantitative ratio in the inland waters of different type**.**

MATERIALS AND METHODS

Studies on the development places of preimaginal stages of black flies were carried out in 2011-2013 in flowing waters (large, middle and small rivers, brooks and reclamation channels) of Moscow, Ryazan and Tver regions.

Larvae and pupae have been observed for the whole season. A systematic survey of breeding places was carried out 1 time in 10 days. Water temperature, flow velocity, water level, and considering the width and depth of the watercourse, the degree of vegetation overgrowing have been estimated in the places of larvae accumulation for the whole season.

Larvae and pupae are most readily to inhabit the coastal area on hydrophytes (leaves of sedges, etc.), the rocks and other water objects. We determined the density of their settling on the studied substrate with an area of 1 dm^2. Natural sites of reservoirs were examined through sampling with the help of "cat". For collecting primary material in small and middle rivers a pole with nails hammered from the different parties in the form of a hedgehog was used, also we caught larvae and pupae with the help of whisk-catcher [10].

All colected material was placed in test tubes and glass jars filled with 70° ethanol.

Species affiliation was determined using microscope MBS-10 and identifiers [5, 11, 16], as well as reference specimens. For qualitative and quantitative assessment of the species composition of black flies, their distribution and ratio of species, the index of dominance (ID) was used.

Mass or dominant (ID 50-100 %), subdominant (ID 15-49,9 %), scanty (ID 5-14,9%) and rare (ID до 5 %) species were estimated.

RESULTS

During the period of research there were collected and identified 39893 larvae and pupae of black flies.

Life of preimaginal stages of pathogen species of black flies in Central non-Chernozyom zone of the Russian Federation is connected with flowing water. Specimen composition and quantity of bloodsuckers are determined primarily by hydrothermal habitat conditions. On the basis of physical, geographical, hydrological and faunistic characteristics in the study area 4 types of flowing waters were marked out (Table 1).

Large rivers have few hundred kilometers length, over 100 m width, up to 6 m depth. (Volga, Oka, Moscow).

They flow in open areas and have broad floodplain. The river bottom is sandy or, less often, muddy. The flow is leisurely - 0,3-0,6 m/sec. The water temperature in the summer is about 15°-22,5°C. The riverbed in many places is overgrown with macrophyte vegetation. Larvae and pupae inhabit plant leaves (sedge, pondweed, arrowhead, on the fallen trees and so on),

mainly in upper levels of water, less often on the depth up to 0,5-0,7m.

Maximum of population density was registered in the late May - early June and was up to 700 flies per 1 dm^2 in average.

The date of the first larvae appearance was not estimated because the study has begun in the late May. According to the literature data black flies overwinter in ponds in the egg stage, hatched larvae can be found in ponds from the third decade of April until the end of August [6].

In the second decade of June at the water temperature of 22°C population density of the larvae on the branch of a willow reached 195, and population density of pupae was up to 30 specimen/dm^2. In late June the number of pupae was the biggest and reached 550, with a density of larvae up to 50 specimen/dm^2.

In the fourth week of August at a water temperature of 15°-17°C sporadic larvae have been seen on plants. That time the number of pupae was up to 40 specimen/dm^2, however many midges have already flown out of them.

In these biotopes 9 species of blood-sucking black flies were found: *Byssodon maculata, Schoenbaueria pusilla, Schoenbaueria nigra, Boophthora erythrocephala, Odagmia pratora, Simulium promarsistans, Argentisimulium noelleri, Boophthora sericata.*

Boophthora erythrocephala, Schoenbaueria pusilla, Odagmia ornata were dominant. All the rest were scanty and rare.

Middle rivers have 100-200 km length, 15-35 m width and up to 3m depth (Pakhra, Yauza, channel named after Moscow, Medveditsa). They flow as in open and forested areas.

The river bottom is sandy or muddy. Flow rate varies depending on the terrain. On the rift it reaches 0,7-0,9 m/sec, on the flat areas - 0,3-0,6 m/sec. The water temperature in the summer is about 17-24 °C. The riverbed in some places is overgrown with plants. A substrate for the attachment of larvae and pupae is water vegetation, as well as going into the water branches and trunks of coastal shrubs. Maximum of population density was registered in May - June - 680-750 specimen/dm^2.

There were 12 Simuliidae species found. The following ones were dominant: *Simulium morsistans, Boophthora erythrocephala, Schoenbaueria pusilla*, all the rest were scanty and rare.

Small rivers have up to 100 km length, 5-15 m width, up to 2 m depth, and brooks have 10 km length, 0,5-1,5 m width and up to 0,5 m depth (Serebryanka, Yakhroma, Voloshnya, Volgusha, Malaya Sestra).

Their floodplain is not wide, the bottom is of sand and rocks, muddy in the rift.

The speed of flow is about 0,3 - 0,6 m/ sec, during spring flood it increases up to 1,0 m/sec. The water temperature in the summer is about 13° - 25 °C. Different temperature fluctuations can be observed (± 5°C). In some places there is a strong siltation and turbidity after rains.

Rooted vegetation is observed around the whole riverbed.

A substrate for the attachment of larvae and pupae are, apart from water vegetation, grasses descending into the water, branches of shrubs, sunken objects, rocks, and so on. Maximum of population density was registered in late May - first part of June - 700-800 specimen/dm^2.

In these biotopes 14 species of blood-sucking black flies were found.

Reclamation channels have 1-3 m width and 0,5 - 1,5 m depth. The speed of flow is about 0,25 - 0,7 m/sec, but it can increase to 1,5 m/sec on the hydraulic sluices. The water temperature in the summer is about 12° - 25°C and has typical sharp daily amplitudes (5-7°C), channels riverbed is straight.

The bottom is sandy, peaty, muddy, or made of rocks, may be overgrown with plants. The shore of the main channels is partially covered with concrete slabs.

The central channels have weak flow, small channels have flowing only during floods and summer rains.

DISCUSSION

Ecology of blood-suckling black flies, including preimaginal stages, in different regions of Russia and CIS countries is presented in the works of Kaplich V.M., Skulovets M.V., Vasilevich F.I., Isimbekov Zh.I., Pavlova R.P., Fedorova O.A. and others.

Table 1. Preimaginal stages of blood-sucking midges in inland waters of the central and non-Chernozem zones of Russia (2010-2013)

Species	Type of inland water								Total	
	Large rivers		Middle rivers		Small rivers, brooks		Reclamation channels		Ex	ID
	Ex	ID	Ex	ID	Ex	ID	Ex	ID		
Byssodon maculate Meigen, 1804	315	3,2	-	-	-	-	-	-	315	0,7
Schoenbaueria pusilla Fries, 1824	2350	24	1210	12,1	1385	14,5	1650	16,9	6595	16,5
Schoenbaueria nigra Meigen, 1804	-	-	730	7,3	62	0,6	552	5,7	1344	3,3
Boophthora erythrocephala De Greer, 1776	4012	41,2	1587	15,9	889	9,2	2751	28,2	9239	23,1
Odagmia ornata Meigen, 1818	1926	19,7	1119	11,2	764	7,9	1105	11,3	4914	12,3
Odagmia pratora Friederichs,1921	312	3,2	201	2,01	342	3,6	728	7,5	1583	3,9
Simulium paramorsistans Rubtsov, 1956	-	-	160	1,6	595	6,2	1251	12,8	2006	5,0
Simulium morsistans Edwards, 1915	-	-	2102	21,08	1248	13,00	1400	14,3	4750	11,9
Simulium posticatum Meigen, 1838	-	-	-	-	1345	14,06	-	-	1345	3,4
Simulium promorsistans Rubtsov, 1956	80	0,8	-	-	465	4,8	-	-	545	1,36
Wilhelmia eguina, L. 1746	-	-	905	9,07	790	8,1	-	-	1695	4,2
Wilhelmia salopienisis Edward, 1927	-	-	810	8,1	518	5,4	-	-	1328	3,3
Simulium reptans L., 1758	-	-	149	1,5	-	-	-	-	149	0,4
Argentisimulium noelleri Friederichs, 1920	119	1,2	205	2,05	548	5,7	135	1,26	1007	2,5
Argentisimulium dolini Usova et Sukhomlin, 1989	-	-	-	-	95	0,99	170	1,6	265	0,7
Boophthora serica ta Meigen, 1818	615	6,3	790	7,9	518	5,4	890	8,4	2813	7,05
Total	9729	-	9968	-	9564	-	10632	-	39893	-

The authors noted, that places of black fly breeding in the forest-steppe zone are the large, medium, small rivers, brooks and reclamation channels. Larvae in watercourses can be found from late April to late August. We have ascertained that in the lowland parts of the Central non-Chernozem zone of Russia pupation and adult emergence can be recorded from May to September, this fact is consistent with the results of the above authors.

Black flies species composition varies depending on the size of inland water. There were discovered 9 species of larvae and pupae of the blood-sucking black flies in large rivers, 12 - in middle rivers, 14 - in small rivers and brooks, 10 - in reclamation channels.

It is important to note, that the greatest adaptation to the existence conditions is characteristic for species of the genus *Boophtora,* which has high population and can be found in all the types of inland water. Species *Odagmia, Schoubouteria* and *Simulium* were also found by us in different flowing waters, but their populations are not the same everywhere.

CONCLUSION

We identified 16 species of blood-sucking black flies belonging to 1 subfamily, 5 tribes and 7 genera in the Central non-Chernozem zone of the Russian Federation.

Massive and numerous, harassing animals on pastures, are the following species: *Shoenbaweria pusilla, Boophthora erythiocephola, Odagmia orhata, Simulium morsistaus.*

Based on the study of the preimaginal stages and the seasonal dynamics of the blood-sucking black fly population in Moscow, Ryazan and Tver regions, as well as based on analysis of the results of studies conducted earlier by other authors in the forest-steppe zone, we came to the following conclusion. The places of midges breeding are large (Volga, Oka, Moscow), middle (Pakhra, Yauza, Medveditsa), small (Voloshnya, Serebryanka, Yakhroma, Volgusha, Malaya Sestra) rivers and also brooks and reclamation channels.

Larvae and pupae can be found in the inland waters from May till August.

Our studies allow us to validate biologically the viability and timing of animal and human protecting measures from blood-sucking midges in the region.

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