

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy (PhD) in 8D05101
Biology

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“FAUNA, BIOLOGY AND ECOLOGY OF SIMULIIDAE OF THE IRTYSH RIVER IN THE PAVLODAR REGION”

General characteristics of the study: The dissertation investigates the fauna, biology, and ecology of blackflies (*Simuliidae*) inhabiting the Irtysh River within the Pavlodar region. Particular attention is paid to the population dynamics of blackflies during the flood period, as well as to the influence of abiotic factors (pH, dissolved oxygen concentration, current velocity, hydrological and thermal regimes) on the development of preimaginal stages.

Relevance of the study:

Blackflies (Diptera: *Simuliidae*) represent one of the most ecologically significant groups of amphibiotic insects widely distributed in freshwater ecosystems of temperate and subarctic regions. Their life cycle is closely associated with lotic environments, where preimaginal stages (larvae and pupae) develop on solid substrates under conditions of continuous flow. Consequently, blackflies play a crucial role in river ecosystem functioning, participating in organic matter processing, filtration of suspended particles, and the formation of trophic networks (Crosskey, 1990; Adler & McCreadie, 2019).

The ecological importance of blackflies is determined by their role in the structure of aquatic communities and their high sensitivity to environmental changes. Larvae of *Simuliidae* are typical rheophilic organisms and respond to variations in flow velocity, water temperature, dissolved oxygen content, and other abiotic factors. Therefore, blackflies are widely regarded as effective bioindicators of freshwater ecosystem condition (Malmqvist & Rundle, 2002; Naiman & Décamps, 1997). Changes in their abundance and community structure may reflect hydrological alterations, anthropogenic impacts, and habitat degradation.

In addition to their ecological significance, blackflies have considerable veterinary and medical importance. Many species are hematophagous and capable of mass attacks on humans and livestock, causing simuliotoxicosis, which is associated with allergic reactions, intoxication, and decreased productivity of animals (Adler & McCreadie, 2019; Balashov, 2009). Furthermore, blackflies act as vectors of various parasitic diseases. Of particular importance is their role in the transmission of filarial infections, including onchocerciasis, which represents a serious public health concern in several regions worldwide (Crosskey, 1990; Usova, 1961). In veterinary practice, blackflies are also considered potential vectors of pathogens affecting cattle and other farm animals.

Under conditions of changing river hydrological regimes, driven by both climatic factors and anthropogenic influences (flow regulation, reservoir

construction, transformation of floodplain ecosystems), blackfly community structure may undergo significant changes. These transformations affect both species composition and abundance, including dominant species complexes (Huang et al., 2012; Zheng et al., 2018). Therefore, comprehensive studies of blackfly fauna and ecology at the regional level are increasingly necessary, particularly in large river basins characterized by pronounced spatial heterogeneity.

The Pavlodar Irtysh region, located in the middle reaches of the Irtysh River, represents an important area for such investigations. The river is characterized by a regulated hydrological regime, considerable length, and a diversity of habitats that provide conditions for the development of various assemblages of aquatic organisms. However, despite its importance, data on the blackfly fauna of this region remain limited and fragmented, and up-to-date information on community structure and dynamics is largely lacking.

Previous studies conducted in Kazakhstan and adjacent regions have generally been local in scope and primarily focused on the abundance of hematophagous Diptera or on individual aspects of their biology (Rubtsov, 1956; Konurbaev, 1984; Isimbekov, 2000; Makatov, 2004). Comprehensive studies integrating species composition, community structure, and the influence of abiotic factors under altered hydrological conditions remain insufficient.

Thus, the relevance of the present study is determined by the need for a comprehensive investigation of the fauna, biology, and ecological characteristics of blackflies in the middle reaches of the Irtysh River within the Pavlodar region. Such research allows not only refinement of the current species composition of *Simuliidae*, but also identification of spatial distribution patterns, community formation processes, and responses to environmental factors. The results are of significant importance for hydrobiological and entomological research and can be applied in environmental monitoring and assessment of freshwater ecosystem condition.

Aim of the study: The aim of the study is to investigate the fauna, biology, and ecological characteristics of blackflies in the Irtysh River (Pavlodar region), to identify patterns of their spatial distribution, community structure, and changes in species composition under modern regulated hydrological conditions.

Objectives of the study:

1. To determine the species composition of blackflies in the Irtysh River (Pavlodar region) and уточнить their taxonomic status based on morphological characteristics of larvae, pupae, and adults.
2. To characterize the spatial distribution of blackflies across different sections of the river, taking into account habitat heterogeneity.
3. To analyse community structure using quantitative indicators and modern analytical approaches.
4. To investigate the formation of dominant species complexes in different biotopes and assess their stability.
5. To conduct a comparative analysis of the current species composition with historical data to identify changes in faunal structure over the past two decades.

6. To evaluate the role of biotopic and hydrological factors in shaping blackfly fauna and community structure.

7. To summarize the obtained results and determine their significance for monitoring and assessment of river ecosystems in the Pavlodar Irtysh region.

Object of the study: The object of the study comprises blackflies (Diptera: *Simuliidae*) inhabiting aquatic ecosystems of the middle reaches of the Irtysh River within the Pavlodar region. The primary focus is on preimaginal stages (larvae and pupae) forming communities in various sections of the river channel and its tributaries.

Research methods: The study employed field survey methods, sampling of different developmental stages, quantitative assessment of blackfly abundance, morphological identification, preparation of permanent and temporary slides, molecular genetic analysis, hydrological and hydrochemical methods, and statistical data analysis.

Scientific novelty

As a result of the conducted research, for the first time:

1. A comprehensive faunistic and ecological study of blackflies was carried out across several districts of the Pavlodar region (2023–2025).

2. The species composition was уточнён and expanded; *Simulium reptans* was впервые recorded for Kazakhstan, and *S. murmanum* was identified in mountain tributaries.

3. A quantitative analysis of community structure was performed using biodiversity indices (Shannon, Pielou) and graphical methods (rank-abundance curves, Pareto analysis).

4. Pronounced spatial differences in community structure were revealed, demonstrating that high abundance does not necessarily correspond to high community stability.

5. Relationships between habitat characteristics (substrate type, microhabitat heterogeneity, riparian vegetation) and dominance patterns were established.

6. Comparison with previous studies revealed changes in faunal and structural organization over the past ~20 years.

Theoretical and practical significance: The results have practical importance and can be used in scientific research, environmental protection, applied pest control, and monitoring of freshwater ecosystems. Data on species composition and community structure may be applied in ecological monitoring and assessment of river ecosystem conditions. The results are also relevant for sanitary and epidemiological services in evaluating risks associated with mass development of hematophagous blackflies.

Main provisions for defense:

1. Blackfly fauna in the Pavlodar Irtysh region exhibits pronounced spatial heterogeneity shaped by local habitat conditions.

2. The species composition includes both widely distributed, ecologically plastic species and rare, locally distributed taxa.

3. Community structure varies significantly along the river continuum depending on habitat characteristics.

4. The most stable communities are formed at relatively low abundance levels.

5. Modern community structure differs from data of the early 2000s, indicating dynamic faunal changes.

Personal contribution: The author independently conducted literature analysis, formulated research objectives, performed laboratory and statistical analyses, and prepared the dissertation manuscript.

Approbation and publications: The results were presented at international and national conferences, including the XII All-Russian Dipterological Symposium (St. Petersburg, 2024). The findings have been published in peer-reviewed journals, including SCOPUS-indexed publications.

Structure and scope: The dissertation consists of an introduction, seven chapters, conclusions, and references. The total volume is 129 pages, including 11 tables and 64 figures. The reference list includes 56 domestic and 46 international sources