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SPECIES COMPOSITION AND ECOLOGICAL CHARACTERISTICS OF THE ALGAL FLORA OF WATER BODIES IN UZBEKISTAN: A REVIEW

Yusufjonova Munisa Abdumannob qizi
Namangan State Pedagogical Institute
Lecturer, Department of Natural Sciences.
munisayusufjanova@gmail.com
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Abstract: Algae represent an important component of aquatic ecosystems, contributing to primary production, nutrient cycling, and the maintenance of aquatic food webs. Their taxonomic diversity and ecological distribution are influenced by environmental conditions, including water temperature, light availability, nutrient concentrations, pH, mineralization, and hydrological characteristics. Uzbekistan contains diverse aquatic habitats, including rivers, canals, reservoirs, lakes, and artificial water bodies, each of which may support distinct algal communities. This review examines published research on the species composition and ecological characteristics of the algal flora of Uzbekistan's aquatic ecosystems, with particular attention to regional studies from the Fergana Valley and the Western Zarafshan Range. Available studies demonstrate substantial variation in reported taxonomic composition among individual water bodies and research periods. Diatoms and other algal groups have been documented in regional investigations, while studies of seasonal development and indicator-saprobic algae highlight the potential value of algal communities for ecological assessment. However, differences in sampling strategies, taxonomic identification, geographical coverage, and reporting practices limit direct comparisons among studies. The review emphasizes the need for standardized sampling, updated taxonomic verification, integration of morphological and molecular methods, and long-term monitoring of aquatic biodiversity. A more coordinated research framework would improve understanding of algal diversity and support the ecological assessment and sustainable management of Uzbekistan's water resources.

Keywords: algal flora; aquatic biodiversity; species composition; freshwater algae; phytoplankton; ecological characteristics; bioindication; Uzbekistan; taxonomic diversity; water quality.

Introduction Algae are a diverse group of photosynthetic organisms that play fundamental roles in aquatic ecosystems. They contribute to primary production, participate in carbon and nutrient cycling, and provide food resources for numerous aquatic organisms. Through their interactions with environmental conditions, algal communities also contribute to the ecological functioning of rivers, lakes, reservoirs, and artificial water bodies.

The composition and distribution of algal communities depend on a combination of physical, chemical, and biological factors. Water temperature, light intensity, nutrient availability, pH, salinity, mineralization, water flow, and substrate characteristics may influence the occurrence, abundance, and seasonal development of

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different taxa. Consequently, algal diversity can provide valuable information about environmental variability and changes in aquatic ecosystem conditions.

Uzbekistan is characterized by contrasting climatic and hydrological conditions. Its aquatic habitats include mountain streams, lowland rivers, irrigation canals, reservoirs, lakes, and water bodies associated with agricultural and urban activities. These environments differ in water exchange, mineral content, nutrient inputs, and seasonal hydrological regimes. Such differences create a range of ecological conditions that may support distinct algal assemblages [3].

Regional studies have investigated the algal flora of several Uzbek water bodies. Research on the South Fergana Canal has documented taxonomic composition and seasonal development, while investigations of the North Fergana Canal have examined the composition of algal taxa during the winter period. Studies of the Western Zarafshan Range have also described the taxonomic and ecological characteristics of algae in different reservoirs. In addition, research on Uzbek water bodies has reviewed earlier investigations of algal flora and its distribution under varying environmental conditions (Ikramov, 2023; To‘lqinov, 2023; Yuldashova, 2022).

Despite these contributions, regional information remains distributed across publications addressing individual water bodies, particular seasons, or specific ecological questions. This makes it difficult to compare algal communities across regions and to determine how much of the observed variation reflects environmental differences, sampling procedures, or taxonomic practices.

A review of the existing literature is therefore important for consolidating current knowledge, identifying consistent ecological patterns, and establishing priorities for future research. Particular attention should be given to the representation of major algal groups, differences among aquatic habitats, seasonal dynamics, and the application of algae in ecological monitoring.

The aim of this review is to summarize published information on the species composition and ecological characteristics of the algal flora of water bodies in Uzbekistan, evaluate the principal findings of regional investigations, and identify methodological and geographical gaps that should be addressed in future studies.

Literature search strategy. Relevant publications can be identified through Google Scholar, Crossref, scientific journal websites, and biodiversity data repositories such as the Global Biodiversity Information Facility (GBIF). Searches should include English, Uzbek, and Russian terminology because regional algological research may be published in different languages.

The principal search terms include “algal flora of Uzbekistan,” “freshwater algae Uzbekistan,” “species composition of algae,” “ecological characteristics of algal flora,” “phytoplankton biodiversity,” “South Fergana Canal algae,” and “algal flora of the Western Zarafshan Range.” Equivalent Uzbek and Russian terms should also be used to improve the coverage of regional publications.

Overview of research on the algal flora of Uzbekistan. Published research indicates that algal communities have been investigated in several aquatic environments across Uzbekistan. These include irrigation canals, reservoirs, river systems, and lake ecosystems. The studies differ in their geographical coverage, sampling periods, taxonomic scope, and ecological objectives.

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Research in the Fergana Valley provides useful examples of taxonomic and seasonal investigations. To‘lqinov (2023) examined the seasonal development of algal flora in the South Fergana Canal during 2019–2020. The study reported 181 species and infraspecific taxa belonging to six major divisions. Bacillariophyta represented the largest reported group, followed by Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta, and Pyrrophyta [7].

A separate study of the North Fergana Canal examined the algal flora during the winter period of 2019–2021. Yuldashova (2022) reported 74 species and infraspecific taxa, with diatoms accounting for the largest proportion of the recorded taxa. This finding illustrates the importance of considering sampling season when interpreting the taxonomic composition of algal communities.

Studies from other regions provide additional evidence of variation among aquatic habitats. Dustov and Tashpulatov (2023) investigated reservoirs in the Western Zarafshan Range and reported 217 algal species distributed across five divisions. Their research also considered the ecological characteristics of the recorded flora [5].

These figures demonstrate the contribution of individual regional studies to knowledge of Uzbekistan’s algal biodiversity. However, they should not be added together to estimate the total algal diversity of the country because the studies concern different sites and may differ in their taxonomic and sampling approaches.

Taxonomic composition of algal communities

The reviewed regional studies document several major groups of algae and photosynthetic microorganisms, including diatoms, green algae, cyanobacteria, euglenoids, and other historically recognized algal groups.

Diatoms, traditionally classified within Bacillariophyta, were particularly prominent in the reported floristic inventories of the South and North Fergana canals. Their ecological importance is associated with their broad distribution in aquatic habitats and the diversity of forms adapted to different environmental conditions.

Green algae, commonly associated with Chlorophyta in traditional classifications, are also components of freshwater communities. Their distribution and abundance may vary with light availability, nutrient concentrations, temperature, and habitat structure.

Cyanobacteria are photosynthetic bacteria rather than eukaryotic algae, although they have historically been included in many algological inventories. They are ecologically important because some taxa can form extensive blooms under favorable conditions, and certain species produce toxins. Their presence alone, however, does not establish that a water body is experiencing a harmful bloom.

Euglenoids and other groups may also contribute to algal assemblages, particularly in habitats with distinctive nutrient conditions or organic enrichment. Their occurrence should be interpreted in relation to the characteristics of each study site rather than assumed to indicate a uniform ecological condition.

The taxonomic composition reported for a water body therefore reflects both its environmental conditions and the methods used to collect, identify, and classify organisms.

Ecological characteristics and environmental influences

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Environmental conditions are important determinants of algal distribution and community structure. The regional literature provides a basis for examining several major ecological factors.

1. Temperature and seasonal variation.
2. Nutrient availability.
3. Mineralization and salinity.
4. Water flow and habitat structure.
5. Organic pollution and bioindication.

Research methods used in algal studies

Traditional algological investigations rely heavily on field sampling, microscopic examination, morphological identification, and taxonomic classification. These approaches remain valuable for documenting algal diversity and describing community composition.

Ecological investigations can be strengthened by recording environmental variables such as water temperature, pH, electrical conductivity, dissolved oxygen, nutrient concentrations, and water transparency. The selection of variables should reflect the research objectives and the characteristics of the study site.

Molecular approaches, including DNA barcoding and sequencing of suitable genetic markers, can complement morphological identification. They may be especially useful when organisms have similar morphological characteristics or when specimens are difficult to identify reliably. However, molecular identification depends on suitable reference sequences, appropriate markers, and careful interpretation of taxonomic results.

Biodiversity repositories can provide supplementary occurrence records and help researchers identify geographical gaps. Such records should be evaluated for taxonomic reliability, geographical precision, duplication, and sampling bias before being used in quantitative comparisons.

Conclusion. Published investigations demonstrate that the algal flora of Uzbekistan's water bodies has been studied in several regional aquatic ecosystems, including canals and reservoirs in the Fergana Valley and the Western Zarafshan Range. These studies provide valuable taxonomic inventories and information about seasonal development and ecological characteristics.

Diatoms were prominent in the reported taxonomic inventories of the South and North Fergana canals. However, regional differences in reported taxon numbers should be interpreted cautiously because sampling periods, study locations, and methodological approaches are not necessarily equivalent.

A more comprehensive understanding of Uzbekistan's algal biodiversity requires coordinated research based on standardized sampling, consistent taxonomic verification, and the integration of ecological measurements. Molecular identification and accessible biodiversity databases can further strengthen regional assessments when used with appropriate quality controls.

In conclusion, consolidating existing algological knowledge and improving the comparability of future investigations are important steps toward a more reliable understanding of aquatic biodiversity and the ecological functioning of Uzbekistan's water bodies. The present review provides a framework for organizing the available evidence and identifying priorities for further research.

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