ECOLOGICAL DYNAMICS OF CRUSTACEAN ZOOPLANKTON AND THEIR CONTRIBUTION TO THE FOOD WEB OF TUDAKUL RESERVOIR

Toshov Hayot Mukhammadovich
Bukhara State University,
Doctor of Philosophy (PhD) in Biological Sciences, Associate Professor
E-mail: toshovhayotjon89@gmail.com

Komilova Aziza Asror qizi
Bukhara statate medical institute, assistant
E-mail: komilovaaziza12@gmail.com
https://doi.org/10.5281/zenodo.23268741

Abstract Crustacean zooplankton represents an important component of freshwater ecosystems and plays a significant role in the transfer of energy from primary producers to higher trophic levels. The present study considers the ecological characteristics of crustacean zooplankton inhabiting the Tudakul Reservoir, with particular attention to representatives of the classes Cladocera and Copepoda. The ecological importance of these organisms was assessed in relation to seasonal changes, environmental conditions, trophic interactions, and their contribution to the natural food resources of fish. Published data indicate that zooplankton communities of Uzbek reservoirs are composed of rotifers, cladocerans, and copepods, while Tudakul Reservoir has previously been reported to contain representatives of all three major groups. Crustacean zooplankton, particularly cladocerans and copepods, contributes substantially to the transfer of organic matter and energy within aquatic food webs. These organisms consume phytoplankton and particulate organic matter and, in turn, serve as food for fish and other aquatic consumers.

The ecological significance of crustacean zooplankton in Tudakul Reservoir is therefore associated not only with its taxonomic diversity but also with its role in maintaining trophic interactions, supporting fish productivity, and responding to environmental changes. Monitoring the abundance and composition of Cladocera and Copepoda may provide useful information for evaluating the ecological condition and biological productivity of the reservoir.

Keywords: Tudakul Reservoir, Crustacea, Cladocera, Copepoda, zooplankton, food web, fish nutrition, ecological dynamics, freshwater ecosystem.

INTRODUCTION

Freshwater reservoirs are complex aquatic ecosystems in which organisms from different trophic levels interact continuously. Zooplankton occupies an important position in these systems because it connects primary producers with higher consumers, particularly fish. Among freshwater zooplankton, crustacean groups such as Cladocera and Copepoda are especially important because of their feeding activity, relatively rapid reproduction, and sensitivity to environmental conditions. Cladocerans and copepods are major components of

freshwater metazooplankton. They participate in nutrient recycling and energy transfer and can influence phytoplankton biomass through grazing. Their ecological functions extend beyond their role as consumers because changes in their abundance and community composition may reflect variations in water quality, trophic state, predation pressure, and environmental conditions. The importance of crustacean zooplankton is particularly evident in fish-producing water bodies. Many fish larvae and juveniles consume zooplankton during early developmental stages, while larger fish may also use cladocerans and copepods as part of their natural diet. Thus, zooplankton abundance can influence the availability of natural food resources and consequently contribute to fish productivity.

Uzbekistan possesses a considerable number of artificial reservoirs used for irrigation, water supply, energy production, and fisheries. Previous investigations have demonstrated considerable zooplankton diversity in Uzbek reservoirs, including representatives of Rotifera, Cladocera, and Copepoda. A regional study reported 106 zooplankton species from reservoirs of Uzbekistan, including 35 cladoceran and 22 copepod species. Tudakul Reservoir was among the studied reservoirs. Previous research specifically concerning Tudakul Reservoir has reported 15 zooplankton species, including 10 rotifers, 3 cladocerans, and 2 copepods. Among the crustaceans, Diaphanosoma mongolianum and Thermocyclops vermifer were identified as important components of the zooplankton community.

Therefore, investigation of crustacean zooplankton is relevant for understanding the biological productivity and trophic structure of Tudakul Reservoir.

The **aim of this study** was to characterize the ecological role of crustacean zooplankton in Tudakul Reservoir and to evaluate the significance of Cladocera and Copepoda in the reservoir food web and natural fish food resources.

MATERIALS AND METHODS

The study was based on published hydrobiological information concerning Tudakul Reservoir and freshwater zooplankton communities of Uzbekistan. Particular attention was given to crustacean zooplankton belonging to the groups Cladocera and Copepoda.

The ecological analysis included the following characteristics:

1. taxonomic composition of crustacean zooplankton;
2. ecological characteristics of Cladocera and Copepoda;
3. seasonal variation in zooplankton development;
4. trophic relationships between crustacean zooplankton and phytoplankton;
5. importance of crustaceans as food organisms for fish;
6. potential use of zooplankton characteristics for ecological assessment.

In freshwater ecosystems, crustacean zooplankton communities are strongly influenced by temperature, food availability, predation, nutrient conditions, and other environmental factors. Body size, reproductive characteristics, feeding strategies, and behavioral traits can determine the ecological response of cladocerans and copepods to these factors. For taxonomic interpretation, standard freshwater zooplankton identification approaches were considered. The ecological interpretation was based on published literature concerning freshwater zooplankton, trophic interactions, and the role of microcrustaceans in aquatic ecosystems. It should be noted that the present manuscript is designed as a literature-based

ecological analysis. Exact new abundance values, biomass measurements, or statistical parameters were not introduced where original field measurements were unavailable.

RESULTS AND DISCUSSION

Crustacean zooplankton composition

Crustacean zooplankton of freshwater ecosystems is primarily represented by Cladocera and Copepoda. These groups differ in morphology, feeding strategies, reproduction, and ecological responses. Previous investigations of Tudakul Reservoir identified representatives of both groups. In the reported zooplankton community, Cladocera was represented by three species and Copepoda by two species. Among the crustaceans, Diaphanosoma mongolianum and Thermocyclops vermifer were highlighted as important components. (ResearchGate) The presence of both cladocerans and copepods is ecologically significant because these groups occupy somewhat different functional positions within the plankton community. Cladocerans are frequently important consumers of phytoplankton and suspended particles, whereas copepods may combine herbivorous, omnivorous, and predatory feeding strategies. Consequently, the coexistence of these groups increases the functional complexity of the zooplankton community.

Seasonal ecological dynamics

Seasonality is one of the major factors influencing freshwater zooplankton communities. Changes in water temperature, phytoplankton development, nutrient availability, and fish predation can cause substantial changes in zooplankton composition and abundance. Studies of Uzbek reservoirs have demonstrated seasonal succession in zooplankton communities. In early spring, small rotifer forms may become prominent, while crustaceans, particularly cladocerans, may become more important during subsequent periods. For Tudakul Reservoir, seasonal changes can therefore be expected to influence the relative contribution of Cladocera and Copepoda to total zooplankton biomass. The development of crustacean populations is closely associated with phytoplankton availability. When suitable food resources increase, populations of herbivorous zooplankton may respond through rapid reproduction. At the same time, increasing fish predation can reduce larger zooplankton individuals and alter community structure.

Thus, seasonal zooplankton dynamics should be interpreted as the result of interactions between bottom-up factors, such as food availability, and top-down factors, such as fish predation.

Role of crustaceans in the aquatic food web

One of the most important ecological functions of crustacean zooplankton is its position between primary producers and higher consumers. Phytoplankton converts inorganic nutrients and solar energy into organic matter. Cladocerans and copepods consume part of this production and convert it into animal biomass. Fish and other predators subsequently utilize this zooplankton biomass.

Therefore, the simplified trophic pathway can be represented as:

Phytoplankton → Cladocera/Copepoda → Fish

This pathway is particularly important in productive reservoirs where fish production depends partly on naturally occurring food resources. Freshwater metazooplankton is recognized as an important trophic link between primary producers and fish communities. Copepods and cladocerans can constitute an important food resource for fish larvae and juveniles, while larger zooplankton may also contribute to the diet of adult fish depending on fish species and food availability.

Nutritional significance for fish

The nutritional value of zooplankton is associated with its relatively high content of proteins, lipids, essential fatty acids, and other biologically important compounds.

Fish larvae generally require small and easily digestible organisms during early development. As larvae grow, their prey size and feeding spectrum may change, with larger cladocerans and copepods becoming increasingly suitable prey. Zooplankton is therefore particularly important during the early stages of fish development.

The availability of natural crustacean zooplankton in Tudakul Reservoir may consequently contribute to the feeding conditions of fish populations.

This relationship is important from a fisheries perspective. Maintenance of favorable environmental conditions for zooplankton development can indirectly support fish productivity by strengthening the natural food base.

Ecological importance of Cladocera

Cladocerans are generally characterized by rapid reproduction and high sensitivity to environmental changes. Some species are efficient filter feeders capable of consuming considerable quantities of phytoplankton. Their grazing activity may influence phytoplankton abundance and therefore affect water transparency and nutrient cycling. In freshwater food webs, large cladocerans can play an especially important role in controlling phytoplankton biomass.

At the same time, cladocerans themselves constitute an important food resource for fish. This creates a direct ecological connection between primary production and fish production.

CONCLUSION

Crustacean zooplankton is an important biological component of the Tudakul Reservoir ecosystem. Representatives of Cladocera and Copepoda participate in energy transfer, nutrient cycling, regulation of phytoplankton communities, and formation of natural food resources for fish. Published investigations have confirmed the presence of both crustacean groups in Tudakul Reservoir, including Diaphanosoma mongolianum and Thermocyclops vermifer. Their ecological importance is determined not only by taxonomic presence but also by their functional role within the aquatic food web. The development of crustacean zooplankton is closely associated with seasonal environmental changes, food availability, and biological interactions. Therefore, seasonal monitoring of Cladocera and Copepoda may contribute to a better understanding of the ecological dynamics of the reservoir.

From a fisheries perspective, crustacean zooplankton represents an important natural food resource, particularly for fish larvae and juveniles. Maintaining favorable ecological conditions for zooplankton development may therefore contribute to the sustainability of the natural food base and fish productivity.

Further research should focus on quantitative seasonal sampling, species-level identification, biomass determination, analysis of environmental parameters, and evaluation of zooplankton–fish feeding relationships in different zones of Tudakul Reservoir.

REFERENCES

1. Błędzki, L.A., & Rybak, J.I. (2016). Freshwater Crustacean Zooplankton of Europe: Cladocera & Copepoda. Springer.
2. Declerck, S.A.J., & de Senerpont Domis, L.N. (2023). Contribution of freshwater metazooplankton to aquatic ecosystem services: an overview. Hydrobiologia, 850, 2795–2810.
3. Sommer, U., & Sommer, F. (2006). Cladocerans versus copepods: the cause of contrasting top-down controls on freshwater and marine phytoplankton. Oecologia, 147, 183–194.
4. Khan, M.A. et al. (2025). Zooplankton in aquaculture: a perspective on nutrition and cost-effectiveness. Aquaculture Research.
5. Sommer, U., & Stibor, H. (2002). Copepoda–Cladocera–Tunicata: the role of three major mesozooplankton groups in pelagic food webs. Ecological Research, 17, 161–174.
6. Kuzmetov, A.R., & Abdinazarov, X.X. (2016). Ecological-faunistic characteristic of reservoirs' zooplankton in Uzbekistan. European Journal of Technical and Natural Sciences, 1–2, 3–7.
7. Brendonck, L. et al. (2022). Zooplankton. In Fundamentals of Tropical Freshwater Wetlands: From Ecology to Conservation Management, pp. 221–271. Elsevier.
8. Thorp, J.H., & Covich, A.P. (eds.). Ecology and Classification of North American Freshwater Invertebrates. Academic Press, 2007.
9. Wetzel, R.G. Limnology: Lake and River Ecosystems. Academic Press, 2008.