

THE ROLE OF MACROZOOBENTHOS IN AQUATIC ECOSYSTEMS

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Abstract. This article examines the ecological role of macrozoobenthos in aquatic ecosystems, focusing on its functions in the food chain, organic matter decomposition, sediment bioturbation, and its use as a bioindicator of water quality. Drawing on case studies from the Namu Sira-Sira River, the Citarum River, and Lake Asam Suoh, the article demonstrates how shifts in macrozoobenthos species composition reflect chemical and physical changes in aquatic environments more sensitively than standard water-quality measurements alone. The findings underscore the importance of macrozoobenthos monitoring for water resource management and ecological assessment.

Keywords: macrozoobenthos, aquatic ecosystem, bioindicator, water quality, EPT index, biodiversity, bioturbation, organic matter decomposition

The assemblage of visible (typically larger than 2 mm) invertebrate animals living at the bottom of water bodies — in silt and sandy substrates, as well as among the roots of aquatic plants — is known as macrozoobenthos. This group includes mollusks (Gastropoda, Bivalvia), crustaceans, annelid worms, and the aquatic larvae of insects — mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), collectively referred to as the EPT taxa. It is precisely this diversity that turns macrozoobenthos into a group of organisms performing several vital ecosystem functions simultaneously, which is why it is more accurate

to regard it not merely as "bottom-dwelling animals" but as an active participant in the aquatic ecosystem.

First and foremost, macrozoobenthos serves as a crucial link in the food chain: by consuming fallen leaves, plant remains, and organic detritus that settle into the water, these organisms break them down and convert energy into a form that can be assimilated by higher trophic-level organisms — fish and waterfowl. This process not only transfers energy along the food chain but also directly contributes to the water's natural self-purification by preventing the excessive accumulation of organic matter on the bottom — meaning the feeding and purification functions are, in effect, inseparable, mutually reinforcing processes rather than distinct ones.

It is precisely because of this sensitivity that macrozoobenthos has become a reliable bioindicator of water quality in hydrobiological monitoring. For instance, a study conducted on the Namu Sira-Sira River in Indonesia (Balqish et al., 2024) assessed water quality in the upstream, midstream, and downstream sections of the river based on the EPT index and the Family Biotic Index (FBI), identifying 23 species across 18 families from 7 orders, with the Shannon diversity index ranging from 1.42 to 1.60 — indicating a moderate level of diversity. A similar approach was applied to the upper reaches of the Citarum River (Muntalif, 2020): the study found that bivalve mollusks of the genus *Corbicula* dominated in lightly polluted sections with clay-rich sediment and high dissolved oxygen, while pollution-tolerant genera such as *Chironomus*, *Tubifex*, and *Enallagma* proliferated in areas with moderate pollution, high nitrate levels, and abundant organic matter. This example demonstrates that shifts in the macrozoobenthos species composition reflect chemical changes in water more quickly and accurately than numerical water-quality data alone, since each species is adapted to a specific level of oxygen availability and pollution.

Furthermore, a study conducted on Lake Asam Suoh in Lampung (Santoso et al., 2021) reveals another important aspect: even when chemical indicators of water (BOD, COD, dissolved oxygen) remain within normal ranges,

macrozoobenthos diversity can decline sharply if pH and temperature conditions are unfavorable. This shows that macrozoobenthos responds not only to pollution but also to the overall physicochemical balance of the water, which is why it should be viewed not as a single indicator but as a comprehensive "mirror" reflecting the state of the ecosystem as a whole.

Another, often overlooked, function of macrozoobenthos is bioturbation — the process by which these organisms dig through and mix the bottom sediment layers, helping oxygen penetrate deeper into the silt. This process, in turn, enhances microbial activity within the sediment, further strengthening the decomposition and self-purification functions described above — demonstrating that all these ecosystem functions are linked like a chain, so that disruption of one inevitably affects the others.

Conclusion

Macrozoobenthos thus simultaneously serves as a food source, a decomposer of organic matter, an improver of sediment structure, and a natural indicator of water quality within aquatic ecosystems. The examples cited above — from the Namu Sira-Sira River, the Citarum River, and Lake Asam Suoh — confirm that the species composition and abundance of macrozoobenthos can be used to assess the ecological condition of a water body accurately and cost-effectively. For this reason, studying and conserving macrozoobenthos is increasingly becoming an integral part of water resource management and ecological monitoring systems.

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