

The Role of Leeches in Assessing Biodiversity and Water Quality in Irrigated Ecosystems

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ABSTRACT

This study reviews the role of leeches (Hirudinea) in aquatic ecosystems and examines their distribution patterns in collector-drainage networks in relation to biodiversity conservation and water quality assessment in agricultural landscapes. Global agricultural intensification has significantly reduced natural wetlands while promoting the development of artificial aquatic habitats, including irrigation canals, reservoirs, and drainage systems. Although these artificial environments cannot fully replace natural wetlands, they provide alternative habitats for various aquatic organisms, including leeches. The research analyzes the main environmental factors influencing leech distribution, such as hydrological conditions, water physicochemical characteristics, mineralization levels, and anthropogenic impacts. Particular attention is given to the relationship between water mineralization and the species composition, abundance, and spatial distribution of leech populations. The findings indicate that increasing salinity levels significantly affect the occurrence and reproductive capacity of freshwater leech species. The study evaluates the ecological and economic impacts of leeches on livestock production and land reclamation systems in the Mughan Plain. The results show that uncontrolled leech populations may harm animal health and reduce the efficiency of drainage infrastructure. The study demonstrates that integrated management strategies combining hydraulic engineering solutions, preventive measures, and continuous ecological monitoring are more effective than individual control methods for sustainable leech management.

Keywords: Leeches (*Hirudinea*), Biodiversity, Water Mineralization, Mugan Plain

1. INTRODUCTION

Conserving biodiversity in agricultural landscapes is essential for maintaining ecosystem functions and ensuring long-term sustainability. However, agricultural intensification has led to the widespread degradation and loss of natural wetlands worldwide, reducing habitat availability for aquatic organisms (Feld & Hering, 2011). Mammadova (2012) found that climate conditions directly influence leech habitats. At the same time, the expansion of irrigation infrastructure has created artificial aquatic environments, including irrigation canals, reservoirs, collector-drainage networks, and rice paddies. Although these systems cannot completely replace natural wetlands, they can partially support biodiversity and provide important ecological functions, such as nutrient retention, water purification, and habitat connectivity (Mitsch & Gosselink, 2015).

Leeches (*Hirudinea*) are important components of freshwater ecosystems

(Mammadova et al., 2025) and occupy diverse ecological niches as predators, parasites, scavengers, and prey organisms (Sawyer, 1986). Because they are sensitive to environmental changes, leeches are recognized as valuable bioindicators of aquatic ecosystem health and water quality (Sket & Trontelj, 2008). Their occurrence and abundance are strongly associated with habitat characteristics, including water flow, substrate type, vegetation cover, and physicochemical conditions.

Irrigation systems and collector-drainage networks create suitable habitats for leeches because these environments generally have low water velocity, abundant organic matter, and stable hydrological conditions. These habitats are particularly important for cocoon deposition and juvenile development. Moreover, amphibians, fish, mollusks, and aquatic insect larvae serve as major food sources for many leech species (Sawyer, 1986).

Previous studies have identified several environmental factors affecting leech

distribution, including nutrient availability, substrate characteristics, water depth, hydrological regime, pH, temperature, dissolved oxygen concentration, turbidity, and salinity (Sawyer, 1986; Trontelj et al., 2004). Among these variables, water mineralization is considered one of the most influential factors in collector-drainage systems located in arid and semi-arid regions.

The Kura-Araz lowland, particularly the Mughan Plain, contains one of Azerbaijan's largest irrigation and drainage networks. These systems transport saline drainage waters originating from reclaimed agricultural lands, creating specific ecological conditions that affect the distribution and diversity of aquatic organisms, including leeches (Mammadov, 2020). Despite their ecological and economic importance, the role of leeches as indicators of biodiversity and water quality in irrigated ecosystems remains insufficiently studied.

Therefore, this study aims to evaluate the role of leeches in assessing biodiversity and water quality in irrigated ecosystems, with a particular focus on collector-drainage networks in the Mughan Plain.

2. RESEARCH METHOD

As the degree of mineralization (salinity) of water in collector-drainage networks increases, many species of freshwater leeches move away from it. However, some hardy species can also survive in highly mineralized drainage waters. Because the Kura-Araz lowland, especially the Mughan Plain, has a complex collector-drainage network, leech populations here and their influence on agriculture are unique. The main Mil-Mughan collector and other drainage systems in the Mughan Plain carry salts washed out of the soil, so the water's mineralization rate is high. Although leeches are usually considered freshwater creatures, some species in the Kura-Araz lowland (for example, *Hirudo medicinalis* – medical Leech) have adapted to moderate mineralization. However, when the salinity of the water exceeds the limit of 10-12 g/l, the activity and reproduction capacity of leeches sharply decrease. Pesticide and fertilizer residues discharged into collectors can have a toxic effect on leeches, but an excess of nitrogenous compounds increases algae, which indirectly enriches the leeches' food chain (snails, larvae) (Mammadov, 2020; Trontelj et

al., 2004)

Leeches in this region are important from both an animal husbandry and a technical water supply perspective. Research shows that slight water warming under sunlight increases leech activity, especially when animals drink, and their activity increases. When animals (especially large and small cattle) drink from irrigation channels on the Mugan Plain, leeches can cling to the mouth, nose, or throat of the animal. Infected animals show clinical signs such as coughing, nosebleeds, mouth bleeding, weight loss, and anemia. This leads to respiratory distress and anemia, secondary infections, and decreased dairy and meat productivity (Koubaa, 2014). The results show that leech infestation is a serious problem for animal husbandry in the studied territories. Therefore, economically beneficial and environmentally friendly control methods are necessary.

3. RESULT AND DISCUSSION

The massive growth of leeches (*Hirudinea*) in collector and drainage networks reduces the efficiency of reclamation infrastructure and causes economic damage to animal husbandry. Eliminating this problem requires an integrated approach, based mainly on hydraulic and reclamation measures, preventive measures, and ongoing monitoring. First, measures aimed at changing the surrounding environment are particularly important. Regularly cleaning channels of sludge eliminates leeches' shelters and wintering grounds, and disposing of reeds and other water plants along the coast limits their breeding. At the same time, regulating the flow of water, that is, preventing stagnation and increasing the water velocity, is considered the most effective technical method to prevent the spread of leeches.

From a prophylactic perspective, installing automatic filters at intake structures and pumping stations prevents leeches from entering irrigation systems. In addition, on livestock farms, limiting the direct use of reservoir water by animals and providing them with filtered water helps reduce parasitic risks (Aliyev, 2018)

At the same time, monitoring leech population dynamics serves as an important indicator of water quality and ecological conditions. If necessary, certain substances may

be applied in limited, controlled areas to regulate water chemistry.

4. CONCLUSION

In general, effective leech control in the Mughan Plain relies not only on chemical methods but also on integrated reclamation and preventive measures that improve drainage

system functionality and limit the spread of biological pests. Leeches serve as valuable indicators of ecological conditions in aquatic systems. Their population dynamics reflect changes in water quality, especially salinity and nutrient levels. Integrated management approaches are essential for sustainable ecosystem functioning.

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