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Role of Freshwater Mussels *Lamellidens marginalis* (Lamarck, 1819) in Pond Water Quality Maintence

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Freshwater mussels are recognized as ecosystem engineers because they perform water filtration through filter feeding. This study aimed to quantify the changes that occurred in pond water after filtration by freshwater mussels *Lamellidens marginalis*. Specimens of *L. marginalis* were gathered from a small pond near Palghar in January. Mussels are hand-picked and stored in buckets of water. Twenty-five individuals of this species were used to assess the changes in various water parameters, including Biological oxygen demand (BOD), turbidity, hardness, and pH. Before the estimation, the mussels were acclimatized to laboratory conditions for approximately 7 days to ensure they adapted to the pond water parameters before filtration evaluation. The water parameters were examined before filtration while acclimatization was occurring. After the

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acclimatization period, the mussels were housed in a fish tank with about 4 liters of pond water for 2 days. The water parameters were then examined again, which revealed a difference. The BOD was nearly half of its initial value, dropping from 2.4mg/l to 1.2mg/l, and the turbidity fell by 8 NTU. However, the hardness of the water was 16mg/l lower than the starting value, and the pH was dropped from 7.46 to 7.16. This suggests that mussels play a significant part in freshwater filtration to preserve good water quality.

Keywords: Freshwater mussels; Lamellidens marginalis; water filtration; water parameters; water quality.

1. INTRODUCTION

Environmental changes are universal elements of the natural environment and dangerous markers of population dynamics. At the moment, the world's environment is being destroyed on a daily basis, and we, as humans, are to blame for the deterioration of our climate and biodiversity. Water is the most vital natural resource, and contamination occurs regularly. To avoid this contamination, the natural recycling mechanisms within the ecosystem should be followed. The biological process is ideal for maintaining ecological balance. A number of aquatic organisms, including microscopic rotifers, caddis fly larvae, paddlefish, and freshwater mussels, rely on filter feeding to obtain energy [1]. In freshwater environments, burrowing bivalves primarily remove particles from the water column, excrete nutrients, and biodeposit feces and pseudofeces [2]. An important animal group in wetland habitats are freshwater mollusks. Scientific research is needed on the distribution and abundance of species [3]. Freshwater bivalves are ecosystem engineers that feed by filtering suspended particles, including phytoplankton, 45 zooplankton, bacteria and fine organic detritus [4]. *L. marginalis* is the commonly found species. It exhibited filtration rates of 934.7± 0.07 cells min^{-1} $mussel^{-1}$ and 13.79 ± 0.04 cells g^{-1} min^{-1} [5-7]. This following studies are done to check the water quality of the pond before and after filtration by *L. marginalis.* Several approaches are used to measure water quality. Turbidity, or the clarity of water due to suspended particulates, is a common method for assessing water quality [8]. Other water quality indicators include pH, BOD, and hardness.

2. MATERIALS AND METHODS

Specimens of *L. marginalis*, which has the IUCN category of least concern, were collected from a small pond near Palghar in the month of January. Mussels are harvested manually and stored in buckets of water. The mussels were acclimatized to laboratory settings for around 7 days before being evaluated for filtration. The clearance method is used to check the filtration by freshwater mussels. The water parameters were tested prior to filtration while acclimatization was underway. After acclimation, 25 mussels were housed in a fish tank with approximately 4 liters of pond water for two days according to standard stocking density. The water parameters were then analyzed again. BOD, turbidity, pH, and hardness were measured in the laboratory. To determine BOD Winkler's method is used [9]. The turbidity was estimated using a nephelometer, and the pH was determined using a pH meter after calibration. To test the hardness of the water mixture, 50 ml of pond water and 2 ml of ammonia were titrated against 0.01M EDTA using an Erichrome black T indicator to check the color change from wine red to blue following titration. Burette reading was recorded [10].

3. RESULTS AND DISCUSSION

The results of the relative impact of mussels on water quality parameters, i.e., BOD, Turbidity, pH and Hardness –

In the Fig. 1. Before filtering by *L. marginalis* the amount of BOD was 2.4mg/l, and after filtration, it was 1.2mg/l. According to Fig. 2, the turbidity of the water fell from 28 NTU before filtration to 20 NTU after. According to Fig. 3, the pH of the water before filtration was 7.46 and decreased to 7.16 after filtering. Fig. 4 shows that the hardness of the water before filtration was 28 mg/l, and after filtration, it reduced to 12 mg/l.

The BOD level has fallen. This shows that *L. marginalis* made use of oxygen. The turbidity of the water decreased, indicating the usefulness of *L. Marginalis* in water filtration. The pH of the water suggests that *L. Marginalis* contributes to pH neutralization. The hardness of the water was lowered following filtration.

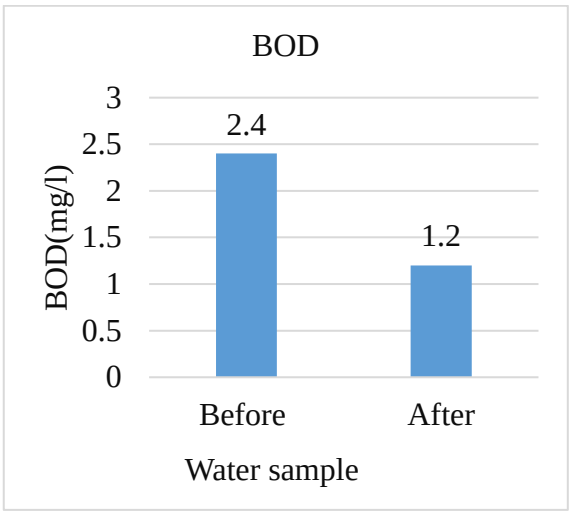

Fig. 1. BOD of the water before and after filtration

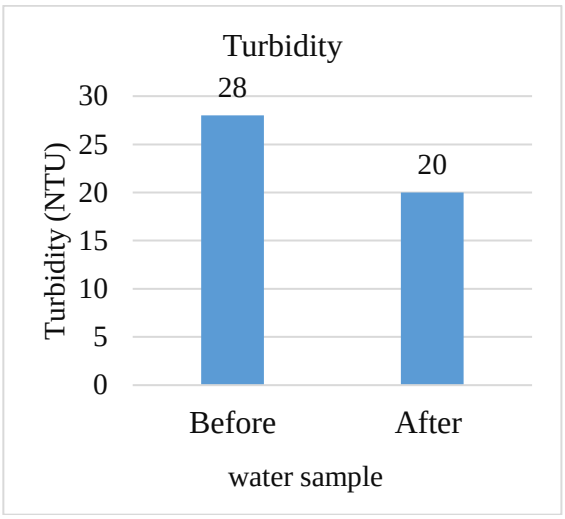

Fig. 2. Turbidity of the water before and after filtration

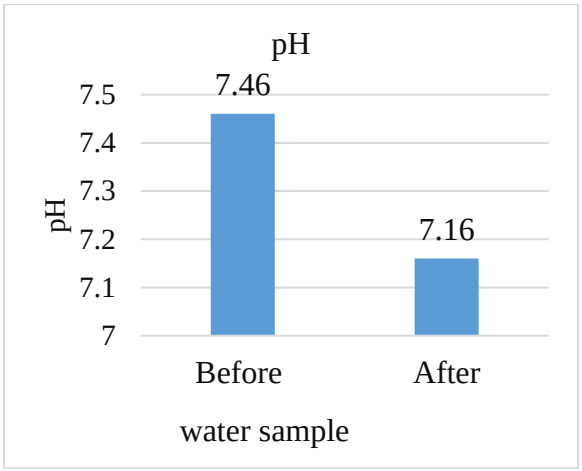

Fig. 3. pH of the water before and after filtration

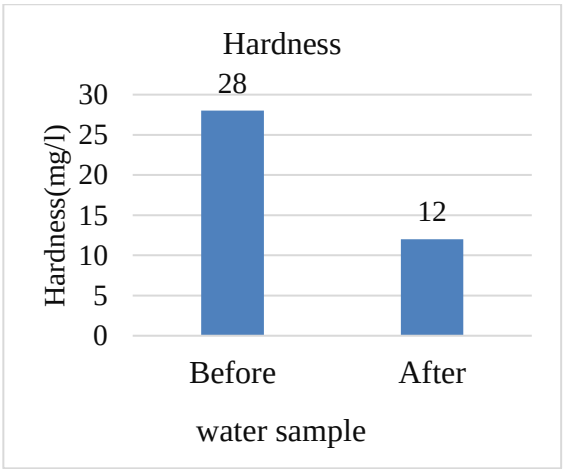

Fig. 4. Hardness of the water before and after filtration

K. Nath & S. Muralikumar carried out study in 2023. The study sought to assess the relative filtration rates of two freshwater mussels, *L. marginalis* and *Pila globosa* (Swainson, 1822) The mussel demonstrated much greater turbidity and chlorophyll clearing abilities than the snail [5]. M. Smith & J. Shaffer devised a laboratory exercise in 2012 that allows students to test the impacts of freshwater mussel filtration on water turbidity. In this experiment, water clarity was measured using a Secchi disk, and they determined that mussels are responsible for the enhanced clarity [8]. Jakab Kryger and Hans Rissgard used the filtration technique 1988 to evaluate six species of European freshwater bivalves with varying filtration rate capacities. They discovered that polymorphs, typically seen in huge numbers, had a greater influence on freshwater habitats [11]. Strayer, Caraco, et.al. [12] conducted a case study in 1999 on zebra mussels in the Hudson River, concluding that human-caused changes in bivalve populations can significantly impact ecosystem structure and function. Bivalve populations have a strong filtering activity, which causes these alterations [12]. Danielle a. kreeger, Catherine M. et. al.conducted an experiment in 2018 to assess the filtration capacities of various freshwater and marine mussels and discovered that mussels play an important role in water quality maintenance, as well as explaining the importance of mussel restoration [13]. Francisco Sylvester 1,3, Jimena Dorado et.al. did one experiment in 2005 to check the Clearance rates of *Limnoperna fortunei* (Bivalvia) were investigated in laboratory studies employing

monocultures of the alga *Chlorella vulgaris* and concluded that these mussels aid to preserve the water quality [14]. James E. Vereycken and David C. Aldridge did an experiment in the year 2023 on bivalves and found that Bivalves are a useful tool for water quality biosensors. Their relevance in bioindication and biomonitoring tactics has been demonstrated by extensive research, which has sparked interest in using them as BEWS sensor organisms [15].

Based on these findings, we can conclude that mussels can help to keep ponds and other freshwater resources healthy.

4. CONCLUSION

Freshwater mussels contribute to water filtration since they rely on filter feeding for nourishment. They also help to reduce turbidity in the water, allowing sunlight to penetrate deeper, which is essential for oxygen-producing plants and other species that rely on sunshine. Changes in bivalve populations caused by humans have a substantial impact on ecosystem structure and function. Bivalve populations exhibit considerable filtering activity, which produces these changes. According to these studies, mussels can help to keep ponds and other freshwater resources healthy. Despite their appeal, freshwater mussels are the most endangered group of creatures in the United States.

Water pollution has wreaked havoc on these clean-water-loving organisms, while dams have degraded water quality and separated mussels from the host fish on which they rely for survival. Thirty-five species have already been declared extinct, and many more are doomed to die. The conservation of freshwater mussels is critical.

CONFERENCE DISCLAIMER

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DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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