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Comparative Study on Impact Assessment of Dead Fish on the Quality Parameters of Fresh and Sea Water

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Water is vital for ecosystems, supporting biodiversity and sustaining life. Changes in water quality can affect the ecosystem's animal inhabitants. Decomposition of fish carcasses can lead to deterioration in water quality, posing risk to aquatic animals. This investigation was aimed evaluate the impact of fish carcass on freshwater and seawater quality, by analysing physical and chemical parameters, temperature, salinity, density, pH, Total Dissolved Solids (TDS) and Dissolved Oxygen (DO). Water quality is characterised by physical, chemical, and biological attributes and could be assessed by analysing several parameters such as pH, Temperature, Salinity, DO, and TDS. It was

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observed that the temperature of freshwater to be 29°C and sea water to be 27°C. There was a decline in density, Dissolved Oxygen, Total Dissolved Solids and pH in both seawater and freshwater, after introducing fish carcass, over the period of three weeks. This study summarizes natural calamities, anthropogenic activities and varied pollution in aquatic environments leading to death of large numbers of aquatic animals which may cause deterioration of water quality and depletion of aquatic biota.

Keywords: Water quality parameters; fish carcass; decomposition of fish; pollution in water.

1. INTRODUCTION

Water quality is regarded as the second most important prerequisite for life, after oxygen. It is crucial to comprehend the possible impact of fish carcasses on water parameters, as they may result in unfavourable outcomes including the spread of water borne diseases to humans and animals [1]. On August 20, 2014, dead fish were discovered floating and deposited along the northern shore of the Ennore Estuary due to coastal pollution [2]. The aquatic population, with humans tied in the repercussions, can be devastating, not only does it result in a significant reduction in the number of fish available within water bodies and hence the food chain, but it also has far-reaching impacts such as diminishing biodiversity and oxygen levels. The year 2023 portrayal of Dal Lake unveils the drastic repercussions of poor water quality. It devours the entire ecosystem, about 27 species of bacteria in 18 genera can cause life-threatening diseases such as: Cholera and Typhoid [3]. Assessment of water quality parameters includes physical parameters. In addition to biological factors, waterbodies also have chemical and physical factors [4]. This study was conducted to determine the possible effects of fish carcasses on freshwater and seawater quality, by analysing physical and chemical parameters: temperature, density, salinity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO). *Labeo rohita*, a freshwater fish commonly known as the “rohu”, it is one of the most important carp species in Indian aquaculture and it was selected for freshwater sample [5-9]. In sea water sample, the fish introduced was *Sardinella*, also known as small pelagic fish widely distributed among south asian subcontinent [10,11,12]. The effect of corpses on water quality can be assessed based on the following -

2. MATERIALS AND METHODS

Seawater and freshwater samples were collected respectively from Juhu Beach (19.1075°N, 72.8263°E) and Arey talav chota Kashmir (19.1629400302321°N, 72.87077282329281°E). Fish used for the experiment were *Labeo rohita* and *Sardinella*. Both fish samples were collected from local markets. This freshwater and seawater samples are placed in dedicated tanks. Length, width, height dimensions of the two water tanks are 47 cm, 22.8 cm and 31 cm respectively. The water carrying capacity of both tanks was 25L and 20L of water samples were added to both the tanks before the fish carcass were introduced. Fish introduced were *Labeo Rohita* and *Sardinella*, each weighing 400 grams for freshwater and sea water respectively. Both sample fish carcass was kept in a separate nylon net and then immersed in the tank containing water samples. Temperature, salinity, density, pH, TDS and (DO) were analysed during three weeks of introducing fish carcass.

A calibrated thermometer was used to measure the temperature to ensure an accurate record of the water sample. The device features automatic temperature compensation to account for sample fluid temperature fluctuations. Readings were automatically adjusted when ambient temperature varies from 68°F (20°C), compensating for temperatures between 50°F to 86°F (10°C to 30°C) [13]. A refractometer was used to measure density; it provided precise measurements by examining the water sample's refractive index. The argentometric method, a dependable approach that involves the precipitation of chloride ions with silver ions, was utilized to assess the salinity levels [14,15]. Concerning TDS analysis, water samples were evaporated using evaporating method until they were completely dry, and the residue was then weighed to calculate the TDS content [16]. DO in the water sample were determined using the Winkler method, where titration was used to quantify the amount of oxygen dissolved [17]. The pH levels were tested using a calibrated pH meter was used to check the acidity or basicity of the respective water sample [18,19]. Recordings during the experiment included a lot of documentation in terms of details of sample sites, methods used and data gathered. This was to ensure safety issues were taken into consideration, and that we base our conclusions on information collected with dependability and integrity such as estimates of acidity or alkalinity. The impact of fish carcass degradation on water was a topic of significant interest.

Fig. 1. Variation of the appearance of water over a period of 3 weeks

Fig. 2. Fish carcass of *Labeo rohita* used for freshwater

Fig. 3. Fish carcass of *Sardinella sp.* used for sea water

3. RESULTS AND DISCUSSION

The study of a water sample includes a detailed review of its physical and chemical properties, where temperature is one of the parameters considered. This comprehensive assessment includes level, TDS, DO concentration, salinity, and density. It imparts valuable knowledge about what water is made of – a complex yet crucial component. Quality, one important information to help make decisions about their use and management. The carcass decomposition process is important in aquaculture and involves nutrients. Recycling through the dynamics of the ecosystems upon which biomes depend, closely connected to each other [20].

The development of fish carcass can be divided into five stages: Fresh, Early Floating, Floating Decay, Late Floating Decay and Sunken Wreck [20]. The initial phase was fresh immersion, starting shortly after a death occurs at the corpse's location. As the heart failure no longer guarantees the supply of oxygen, it gradually begins to get wet. This creates a lack of oxygen environment where microorganisms from the respiratory plus digestive systems can thrive. When the carcass bloats, fluids might gush out from body openings due to pressure that results from gasses inside. Microbial activity continues to break down the body from the outer surface, leading to rapid mass loss during the active decay stage, which includes floating decay and advanced floating decay. As soft tissues decompose, identifying the corpse becomes increasingly challenging. The carcass debris gradually breaks down more in the advanced stages of decomposition.

3.1 Temperature

As temperature had a significant impact on dissolved oxygen levels, it was essential to check temperature in water sample containing fish carcass. Over the course of three weeks, our investigation revealed constant temperatures of 29°C in freshwater and 27°C in sea water**.** As Temperature affects various factors such as viscosity, solubility, doors, and chemical reactions the observed results indicate similar effects due to fish carcass decomposition in an enclosed water body [21]. Consequently, processes like sedimentation and chlorination, as well as Biological Oxygen Demand (BOD), are dependent on temperature [22]. Because water has a high specific heat capacity, which enables it to absorb and hold heat, it maintains a relatively consistent temperature during the decomposition of fish carcasses, which accounts for their stability. Furthermore, the surrounding water helps to disperse any heat generated during decomposition process, maintaining the temperature of the water sample. Comprehending these dynamics was essential to appreciating the ecological consequences of temperature variations on aquatic environments.

3.2 Density

The analysis lasted for a period of twenty-one days and sought to explore the impact of salinity reduction on the density of fresh and salt water bodies. Before introduction of fish carcass, the density of freshwater was 1.000g/ml, while the density of seawater was 1.028g/ml (Fig. 6). After the first week of introducing fish carcass the density decreased to 1.002g/ml in freshwater and 1.026g/ml in seawater. Both densities continued to drop in the second week at 1.001g/ml and 1.025g/ml for fresh and sea water respectively. Both densities were 1.001g/ml and 1.024g/ml of fresh and sea water respectively by the third week (Fig. 6). This reduction which leads to the influence of salinity in altering density gradients can be observed in ocean currents, affecting nutrient flow and ultimately disrupting ecosystem dynamics, as well as freshwater systems' sediment transport. This underscores the Interrelations among salinity, density, and ecosystems.

3.3 Salinity

Freshwater and sea water sample were seen to have a reduced level of salinity that took place in an uncomplicated way. In both freshwater and sea water samples, the salinity levels were taken before introducing fish carcass to the tank. The sample values were noted as 1‰ for freshwater and 34‰ for sea water (Fig. 7).

During the experiment, the freshwater salinity in the first, second and third weeks was 2‰, 1‰ and 3‰ respectively. The observed values of seawater salinity within 3 weeks were 37‰, 35‰ and 39‰ respectively, with a difference of 7 days (Fig. 7). The observed increase in salinity can be attributed to several factors, including precipitation events and microbial metabolism. As these environmental processes like fish carcass decomposition in waterbodies may lead to consumption of salt, causing salinity to increase over time [20].

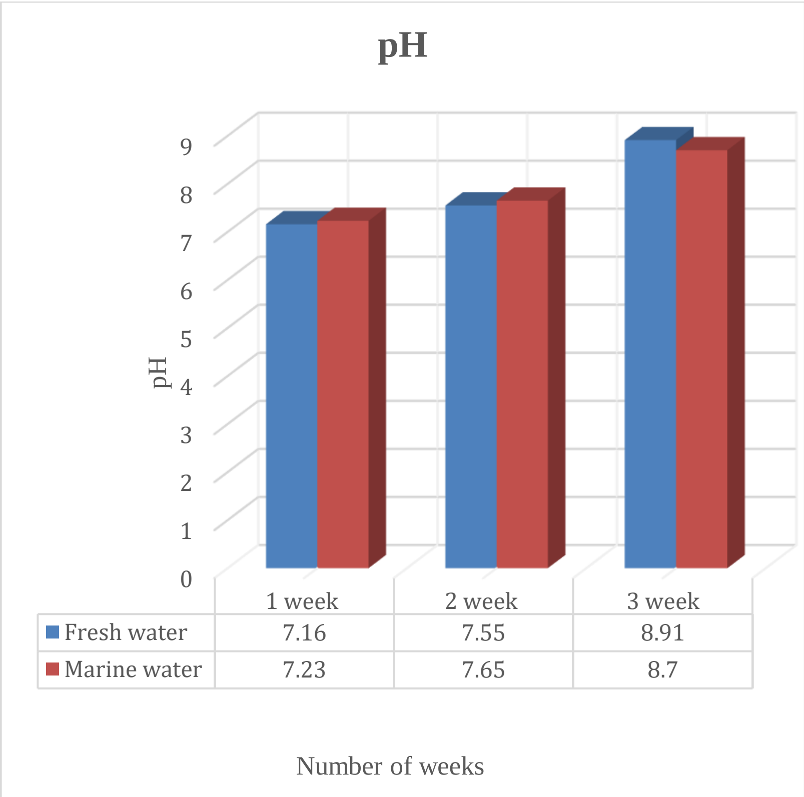

Fig. 4. Evolution of pH after introduction of fish carcass in fresh and sea water

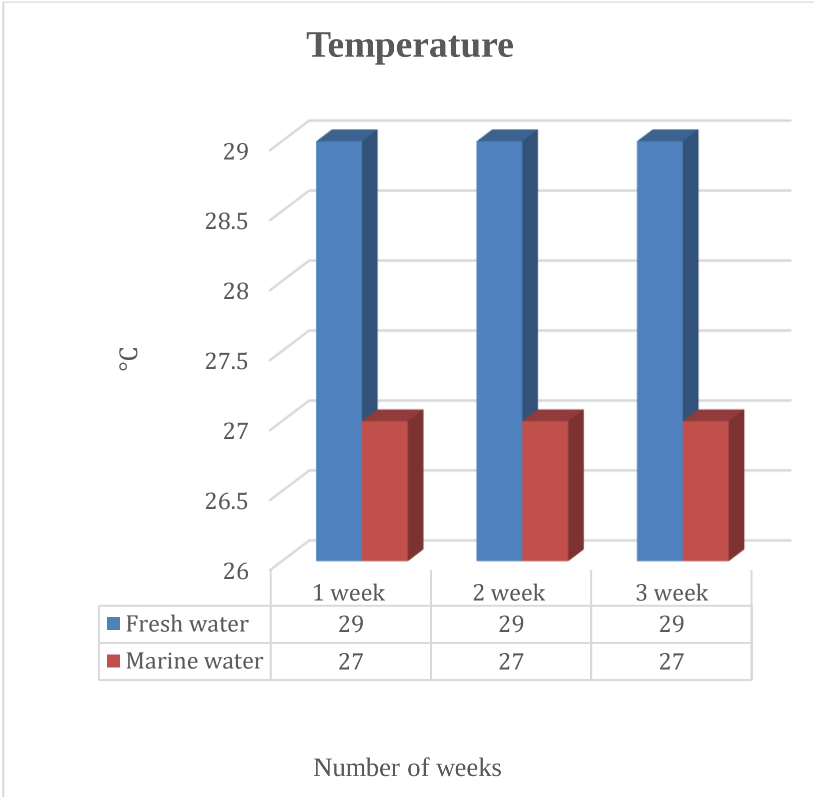

Fig. 5. Evolution of temperature after introducing fish carcass in fresh and sea water

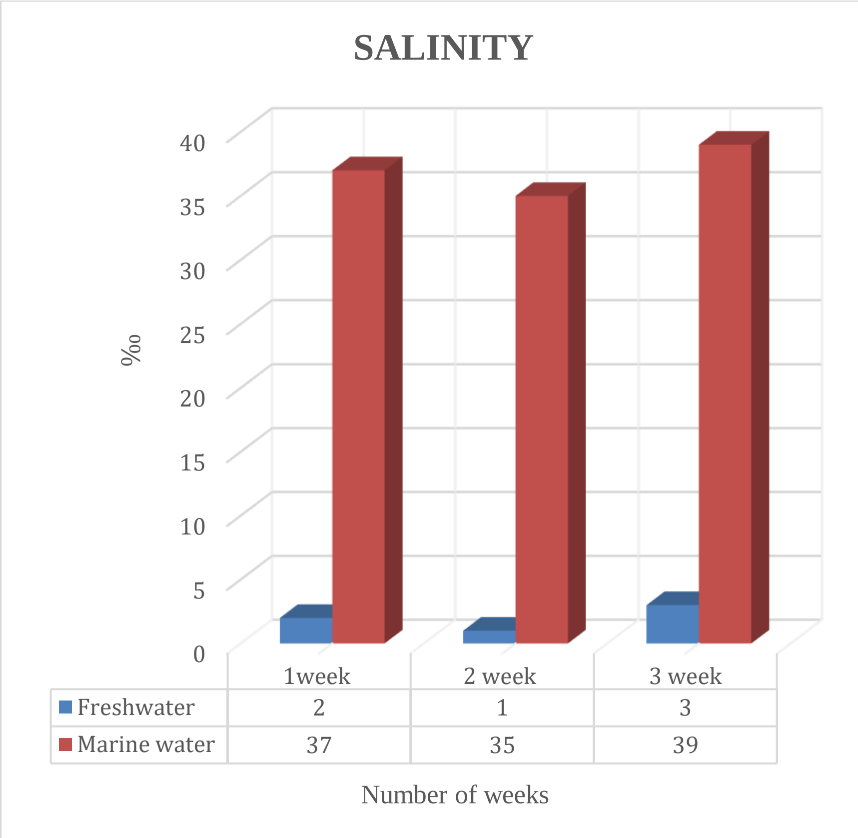

Fig. 6. Evolution of salinity after introducing fish carcass in fresh and seawater

Fig. 7. Evolution of density after introducing fish carcass in fresh and seawater

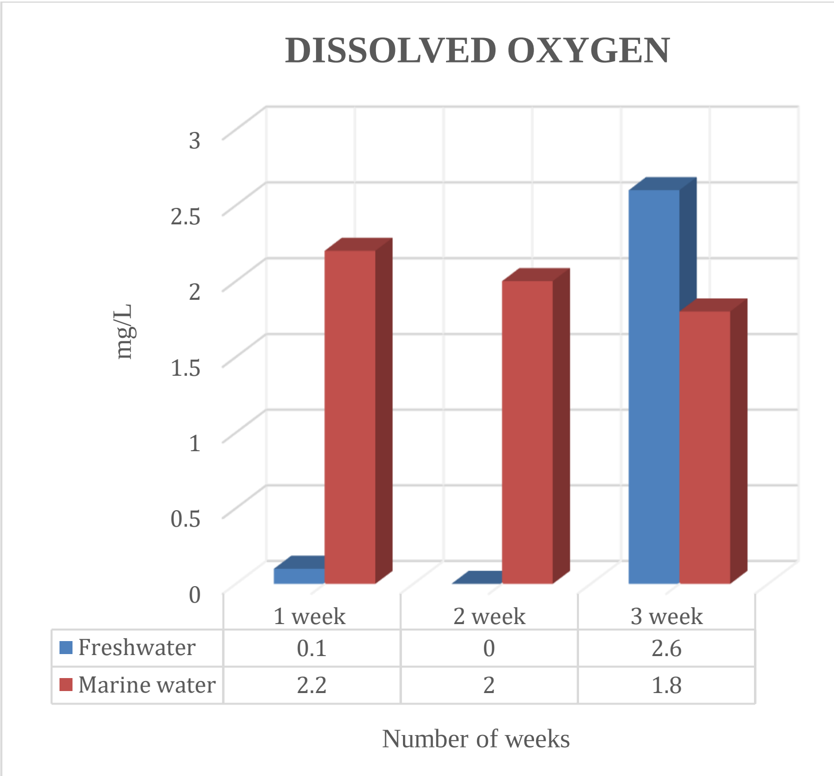

Fig. 8. Evolution of dissolved oxygen after introducing fish carcass in fresh and sea water

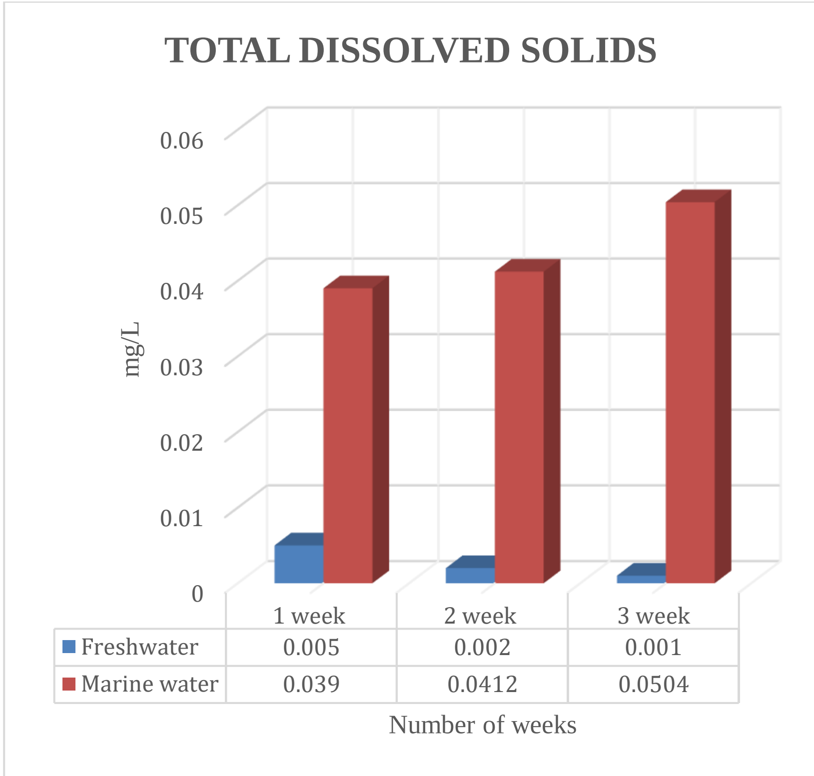

Fig. 9. Evolution of total dissolved solids after introducing fish carcass in fresh and sea water

3.4 Dissolved Oxygen

DO values were measured in the first, second and third weeks after the fish carcasses were placed in the seawater samples 2.2 mg/L, 2.0 mg/L and 3.2 mg/L respectively. The same applies to changes in dissolved oxygen in freshwater samples. The observed values in the first, second and third weeks were 0.01 mg/L, 0.00 mg/L and 2.6 mg/L respectively. DO decline in the second week values of freshwater and seawater samples with fish carcasses may be attributed to this increased microbial activity during decomposition.

DO is a key parameter for assessing the water quality of various water bodies and biological processes like fish carcass decomposition may affect the DO posing threat to aquatic ecosystem [23]. DO levels are affected by factors such as temperature, pressure, salinity and saturation. The concentration changes accordingly. How to measure dissolved oxygen concentration is based on the traditional Winkler titration method [24].

3.5 Total Dissolved Solids

TDS refer to the solids left behind when the filtered portion of a water sample is evaporated in a small dish.

In freshwater TDS was less than 1500mg/L and in sea water TDS was more than 5000mg/L (Fig. 9). as TDS denote the concentration of inorganic salts such as calcium, magnesium, and sodium, coupled with a minor portion of organic matter in water [23]. Throughout the study, TDS levels were 0.005 mg/L, 0.002 mg/L and 0.001 mg/L in the first, second, and third weeks, respectively for the freshwater samples; and 0.0390 mg/L, 0.0412 mg/L and 0.0504 mg/L respectively for the seawater (Fig. 9). The decline in TDS of freshwater sample with fish carcass might be because of dilution, microbial activity, adsorption, sedimentation, biological uptake, and physical processes. Whereas in sea water it might be due to organic matter release during decomposition predominantly fosters microbial activity.

3.6 pH : Before the introduction of fish carcass, the pH levels were recorded 7.51 in freshwater sample and 7.81 in sea water sample (Fig. 4). After seven days of introducing the fish carcass, there was a significant change in pH. The pH dropped to 7.16 in freshwater and it slightly decreased to 7.23 in sea water after 14 days (Fig. 4). Both the freshwater and sea water had their levels stabilized at 7.55 and 7.65 respectively. By the 21st day, an increase in pH was observed in both freshwater and sea water samples to 8.91 and 8.70 respectively (Fig. 4).

pH stands out as a crucial parameter in assessing water quality and according to the observed changes in pH of water samples indicates its impacts a lot of other water quality parameters [25]. It serves as a dimensionless indicator of acidity or alkalinity, with a range from 0 to 14. Pure water at 25°C has a pH close to 7.0 and safe pH ranges for drinking water typically fall between 6.5 and 8.5 [26] Both excessively high and low pH levels can negatively impact water quality. High pH levels can impart a bitter taste and reduce chlorine disinfection effectiveness, necessitating additional chlorine [27]. Conversely, low pH levels can lead to metal corrosion and impact aquatic life. Pollution can alter water pH, posing risks to aquatic organisms.

Noting the changes of pH over the course of three weeks it indicates that effects of pH on aquatic life include decreased hatching success of fish eggs, irritation to gills, and membrane damage in fish and aquatic insects [28]. Extremely low or high pH levels can be fatal to aquatic organisms, with values below 4 or above 10 proving lethal for most fish and amphibians were particularly vulnerable to low pH levels due to their sensitive skin, potentially exacerbated by acid rain, contributing to global population declines [29]. Changes in pH can alter the chemical forms present in water, potentially impacting aquatic plants and animals.

The indication of an increasing alkalinity shift is probably affected by the fish carcass decomposition which leads to release of organic compound: this dynamic control related to pH is likely promoted within aquatic systems due to fish death. Organic inputs, such as fish carcasses, have been found to trigger unique responses within ecosystems and thus deserve further attention due to their long-term impact on water quality as well as overall system health [20]. The levels of dissolved solids exhibited a gradual upward trend throughout the 14 days while dissolved oxygen decreased steadily over the period.

4. CONCLUSION

Over the course of three weeks the experiment was conducted to observe the effects of adding the fish carcasses in freshwater and seawater samples. After the introduction of fish, the temperature in both types of water samples slightly increased initially before the stabilization. As salinity levels dropped, density dropped as well. Organic matter release during decomposition, microbial activity, and dilution all had an impact on the fluctuations in TDS. The steady decrease in DO suggests possible effects on aquatic life and ecosystem health.

The breakdown of fish carcasses and the release of organic compounds caused the pH to fluctuate, first falling, then stabilizing, and then rising noticeably. Adding fish carcasses has a significant impact on water quality parameters. This suggests that aquatic ecosystems are dynamic and respond to organic inputs. Fully understand the long-term impacts on ecosystem health and management. Its recommended to prevent and protect possible damage to aquatic ecosystems. This experiment helps to understand the impact of fish carcass on water quality parameters which may cause risk to aquatic, terrestrial as well as arboreal ecosystems.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: An International Conference on Coastal and Marine Conservation CMC-2024 dated from 1st and 2nd March, 2024 in Mumbai, India. Web Link of the proceeding: https://mithibai.ac.in/wp-content/uploads/2024/02/CMC2024-CONFERENCE-brochure..pdf

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.

REFERENCES

1. Gorde SP, Jadhav MV. Assessment of water quality parameters: A review. J Eng Res Appl. 2013;3(6):2029-2035.
2. Sachithanandam V, Mageswaran T, Sridhar R, Arumugam K, Purvaja R, Ramesh R. Rapid assessment on mass mortality of fishes in Ennore estuary of Tamil Nadu, India; 2017.
3. Shah TH, Ojha, SN, Biradar RS, Ali S. Elevating fishers of Dal Lake in Jammu and Kashmir; 2003.
4. Mansano CFM, Vanzela LS, Américo-Pinheiro JHP, Macente BI, Khan KU, Fernandes JBK, De Stéfani MV. Importance of optimum water quality indices in successful frog culture practices. In Limnology-Some New Aspects of Inland Water Ecology; 2018.
5. Sarma KAMAL, Dey A, Kumar S, Chaudhary BK, Mohanty S, Kumar T, Bhatt BP. Effect of salinity on growth, survival and biochemical alterations in the freshwater fish Labeo rohita (Hamilton 1822). Indian J Fish. 2020;67(2):41-47.
6. Gul, Nazar, Hafiz Abdul Salam, Muhammad Ashraf, Naveed Iqbal. Response of Different Fish Species to Highly Saline Water under Desert Climate Condition - Finding Options for Local Food Security. Asian Journal of Fisheries and Aquatic Research. 2023;24(4):1-9. Available:https://doi.org/10.9734/ajfar/2023/v24i4637.
7. Gichana Zipporah. Water Quality and Growth Performance of Nile Tilapia (Oreochromis niloticus), Chia (Salvia Hispanica) and Lemon Grass (Cymbopogon Citratus) in a Media-Based Aquaponics System. Asian Journal of Biology. 2024;20(5):12-22. Available:https://doi.org/10.9734/ajob/2024/v20i5402
8. Majumdar RK, Basu S. Characterization of the traditional fermented fish product Lona ilish of Northeast India.
9. Kuklina I, Kouba A, Kozák P. Real-time monitoring of water quality using fish and

crayfish as bio-indicators: A review. Environmental monitoring and assessment. 2013;185:5043-53.
10. Mahrus SS, Widodo N, Sartimbul A. The association between genetic variations and omega-3 production on Sardinella lemuru in Lombok Strait. Journal of Agriculture and Veterinary Science. 2012;1(6):12-16.
11. Ghosh S, Rao MV, Sumithrudu S, Rohit P, Maheswarudu G. Reproductive biology and population characteristics of Sardinella gibbosa and Sardinella fimbriata from north west Bay of Bengal; 2013.
12. Kothari V, Vij S, Sharma S, Gupta N. Correlation of various water quality parameters and water quality index of districts of Uttarakhand. Environmental and Sustainability Indicators. 2021;9:100093.
13. Pearce G, Ramzan Chaudhry M, Ghulam S. A simple methodology for water quality monitoring; 1998.
14. CoxRA,The physical properties of sea water, in Chemical Oceanography, J.P. Rileyand G.Skirrow, Eds, Academic Press, London, UK. 1965;1(3).
15. Hong TK, Kim MH, Czae MZ. Determination of chlorinity of water without the use of chromate indicator. International Journal of Analytical Chemistry; 2010.
16. Islam MR, Sarkar MKI, Afrin T, Rahman SS, Talukder RI, Howlader BK, Khaleque MA. A study on total dissolved solids and hardness level of drinking mineral water in Bangladesh. Am J Appl Chem. 2016;4 (5):164-169.
17. Helm I, Jalukse L, Leito I. A highly accurate method for determination of dissolved oxygen: Gravimetric Winkler method. Analytica chimica acta. 2012;741: 21-31.
18. Tchobanoglous G, Peavy HS, Rowe DR. Environmental Engineering. New York:McGraw-Hill Interamericana; 1985.
19. Tomar M. Quality Assessment of Water and Wastewater. Boca Raton: CRC Press; 1999.
20. Zhou R, Wang Y, Hilal MG, Yu Q, Feng T, Li H. Temporal succession of water microbiomes and resistomes during carcass decomposition in a fish model. Journal of Hazardous Materials. 2021;403: 123795.
21. APHA. Standard Methods for the Examination of Water and Wastewater. 21st ed. Washington, DC: American Public Health Association; 2005
22. Davis ML. Water and Wastewater Engineering—Design Principles and Practice. New York: McGraw-Hill; 2010.
23. Omer NH. Water quality parameters. Water quality-science, assessments and policy. 2019;18:1-34.
24. Carvalho A, Costa R, Neves S, Oliveira CM, da Silva RJB. Determination of dissolved oxygen in water by the Winkler method: Performance modelling and optimisation for environmental analysis. Microchemical Journal. 2021;165: 106129.
25. Spellman FR. The Drinking Water Handbook. 3rd ed. Boca Raton: CRC Press; 2017.
26. World Health Organization Guidelines for drinking-water quality. 4th ed. Geneva: WHO; 2011.
27. DeZuane J. Handbook of Drinking Water Quality. 2nd ed. New York: John Wiley & Sons; 1997.
28. Kiprono SW. Fish parasites and fisheries productivity in relation to exreme flooding of lake Baringo, Kenya. Nairobi: Kenyatta University; 2017.
29. Cole S, Codling I, Parr W, Zabel T, Nature E, Heritage SN. Guidelines for Managing Water Quality Impacts within UK European Marine Sites; 1999.

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