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Research Paper

**Application of Artificial Intelligence in Monitoring and Conservation
of Freshwater Fish Diversity: A Review with Reference to Jayakwadi
Dam (Nathsagar Reservoir), Maharashtra**

Bhitre Ritul Sandesh

Research Student, Department of Zoology, Dr. Babasaheb Ambedkar Marathwada
University, Chhatrapati Sambhajinagar, Maharashtra, India

Email- bhitreritul@gmail.com

Abstract

Freshwater reservoirs are ecologically important inland aquatic ecosystems that support high biodiversity and sustain inland fisheries. Artificial Intelligence (AI) has recently emerged as a powerful tool for ecological monitoring and fisheries management. The present review integrates conventional ichthyofaunal studies with modern AI-based approaches for monitoring freshwater fish diversity in the backwaters of Jayakwadi Dam (Nathsagar Reservoir) near Kaigaon Toka, Maharashtra. The reservoir, formed by impoundment of the Godavari River, supports diverse habitats including open waters, vegetated littoral zones, and shallow backwaters that sustain rich fish assemblages. Published studies indicate the occurrence of approximately 50–65 freshwater fish species belonging to major taxonomic orders such as Cypriniformes, Siluriformes, Osteoglossiformes, and Anabantiformes. AI techniques including machine learning-based species identification, remote sensing analysis, and predictive habitat modelling significantly enhance biodiversity monitoring and conservation planning. Integration of classical fish taxonomy with AI-driven ecological analytics provides a modern framework for invasive species detection and sustainable fisheries management.

Keywords: Artificial Intelligence, Fish diversity, Jayakwadi Dam, Nathsagar Reservoir, Machine learning, Biodiversity monitoring, Fisheries management

1. Introduction

Freshwater ecosystems occupy less than one percent of the Earth's surface but support a disproportionately high share of global biodiversity [1]. In India, rivers and reservoirs serve as biodiversity hotspots and provide livelihood security to millions through inland fisheries [2,3]. However, large-scale river impoundments have transformed natural lotic systems into artificial lentic reservoirs, resulting in ecological modifications [2]. The Jayakwadi Dam constructed across the Godavari River led to the formation of the Nathsagar Reservoir, one of the largest reservoirs in Maharashtra [4]. The backwaters near Kaigaon Toka form ecologically productive transition zones that function as breeding and nursery habitats for many fish species.

Traditional ichthyological surveys rely on manual sampling and morphological identification [3,5]. These approaches are time-consuming and limited in spatial coverage. Recent advancements in Artificial Intelligence (AI), including machine learning and deep learning algorithms, have revolutionized biodiversity monitoring by enabling automated species recognition and ecological prediction [6,7]. Integrating AI with fisheries research enhances monitoring efficiency and conservation outcomes.

2. Ecological Context of Jayakwadi Reservoir

The reservoir receives inflow mainly from the Godavari River and the Pravara River and exhibits pronounced seasonal water-level fluctuations [2,4]. The backwaters are shallow and characterized by soft substratum and dense aquatic vegetation such as *Hydrilla*, *Vallisneria*, and *Potamogeton* [2]. Habitat heterogeneity supports diverse fish assemblages. Modern AI-supported satellite image classification and remote sensing techniques allow accurate mapping of aquatic vegetation, shoreline dynamics, and seasonal habitat changes [7]. Such tools reduce dependence on labor-intensive field surveys.

3. Importance of Fish Diversity and Role of AI

Fish diversity maintains ecosystem stability through trophic regulation and nutrient cycling [1]. Freshwater fishes provide affordable protein and livelihood to fishing communities around Jayakwadi reservoir [2].

AI applications in fisheries biology include:

- Automated species identification using convolutional neural networks (CNNs) [6]
- Underwater acoustic monitoring of fish shoals [7]
- Machine learning-based population prediction models [8]
- Early detection of invasive species [7,9]

These tools enable real-time ecological monitoring and improve biodiversity documentation accuracy.

4. Status of Fish Diversity in Jayakwadi Reservoir

4.1 Species Richness

Published studies report approximately 50–65 freshwater fish species belonging to 7–8 orders and nearly 20 families in the Jayakwadi region [3,4,5]. These records provide a baseline for biodiversity assessment and ecological monitoring.

4.2 Dominant Taxonomic Groups

The order Cypriniformes dominates the assemblage, particularly the family Cyprinidae [3,5]. Siluriformes constitute an important group of commercially valuable catfishes. Vegetation-rich backwaters favor species of Channidae and Notopteridae.

Exotic species such as *Oreochromis mossambicus* and *Oreochromis niloticus* have been introduced for fisheries enhancement but have ecological consequences [9]. AI-based image recognition systems can assist in distinguishing native and exotic species during monitoring [6].

5. AI-Based Techniques in Fish Diversity Monitoring

Recent technological advancements allow integration of AI in fisheries research:

1. **Computer Vision Systems:** Deep learning models classify fish species from digital images with high accuracy [6].
2. **Acoustic and Sonar Monitoring:** AI algorithms analyze underwater acoustic signals to estimate fish abundance [7].
3. **Environmental DNA (eDNA) + Machine Learning:** Species presence can be predicted from genetic traces in water samples.
4. **Water Quality Prediction Models:** Neural networks forecast dissolved oxygen, pH, and nutrient levels affecting fish survival [8].

These approaches significantly enhance traditional biodiversity surveys.

6. Diversity Drivers and Habitat Influences

Fish diversity in Jayakwadi backwaters is influenced by hydrological fluctuations, aquatic vegetation cover, water quality parameters, and fisheries stocking practices [2,4]. AI-based predictive analytics can analyze long-term environmental datasets to forecast fish abundance under changing climatic conditions [8].

7. Threats to Fish Diversity

Major threats include:

- Siltation
- Agricultural runoff and pollution
- Overfishing

- Invasive species such as Tilapia [9]

Machine learning-based environmental monitoring systems can detect water quality deterioration and predict ecological stress events [7,8]. Early identification of invasive species through AI image classification can reduce biodiversity loss [6].

8. Conservation and Management Implications

Effective conservation strategies require regular monitoring and adaptive fisheries management [2]. AI-assisted decision-support systems can guide stocking policies, regulate fishing intensity, and monitor habitat changes.

Smart sensors and IoT-based water quality monitoring systems integrated with AI models provide continuous ecosystem assessment [8]. Community-based mobile applications can further support participatory conservation initiatives.

9. Conclusion

The backwaters of the Jayakwadi Dam support rich freshwater fish diversity typical of large Indian reservoirs. Dominance of Cyprinidae and Siluriformes reflects ecological transformation following river impoundment. While traditional ichthyological studies provide baseline biodiversity data, integration of Artificial Intelligence offers a transformative approach for ecological monitoring, invasive species detection, habitat analysis, and sustainable fisheries management. Combining classical taxonomy with AI-driven analytics ensures long-term conservation and efficient resource utilization in the Jayakwadi reservoir ecosystem.

References

- 1) Barman, R. P., et al. (2018). Ichthyofaunal diversity of inland waters of India. *Journal of Threatened Taxa*, 10(5), 11660–11672.
- 2) Sugunan, V. V. (2019). *Ecology and Fisheries Management of Indian Reservoirs*. ICAR-CIFRI.
- 3) Talwar, P. K., & Jhingran, A. G. (1991). *Inland Fishes of India and Adjacent Countries*. Oxford & IBH.
- 4) Khedkar, G. D. (2005). Fish diversity of Nathsagar Reservoir (Jayakwadi), Maharashtra. *Journal of Aquatic Biology*, 20(2), 123–131.
- 5) Jayaram, K. C. (2010). *The Freshwater Fishes of the Indian Region*. Narendra Publishing House.
- 6) Villon, S., et al. (2018). Deep learning for fish species classification in underwater images. *Scientific Reports*, 8, 10226.
- 7) Salman, A., et al. (2019). Machine learning approaches in aquatic ecosystem monitoring. *Ecological Informatics*, 49, 110–120.
- 8) Li, X., et al. (2020). Artificial neural networks for water quality prediction. *Environmental Modelling & Software*, 124, 104601.
- 9) Pawar, S. K., & Sonawane, S. R. (2020). Impact of invasive Tilapia on native fish diversity. *Journal of Applied Ichthyology*, 36(4), 567–575.

