International Journal of Scientific Research and Engineering Development-– Volume 9 Issue 4, Jul – Aug 2026
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

# Ichthyofaunal Diversity of the Godavari River at Kopargaon (Maharashtra, India)

Shashikant Trimbak Hon* and Sandesh Pandurang Jagdale
Department of Zoology, Dapoli Urban Bank Senior Science College Dapoli, Ratnagiri, (MH)
Emali: trimbakraj86@gmail.com* https://orcid.org/0000-0002-1596-5855

## Abstract:
The present study aims to investigate the ichthyofaunal diversity of the Godavari River at Kopargaon between February 2022 - January 2023. A total of **17 fish species belonging to 9 families** were recorded, with Cyprinidae as the most dominant family (7 species). The records also include the introduced taxa *Oreochromis mossambica* and *Gambusia affinis*. The findings highlight the river's ecological richness and provide baseline data for conservation planning and fisheries management in the region. The study also discusses the effects of anthropogenic pressures and invasive species on fisheries in the region. Regular monitoring of fish diversity, protection of riverine habitats, maintenance of ecological flows, regulation of non-native fish introductions, and promotion of sustainable fishing practices are recommended for long-term conservation of the Godavari River ecosystem at Kopargaon.

***Keywords:*** Freshwater Ichthyofaunal Diversity, Godavari River, Kopargaon, Anthropogenic activities, Exotic Species

## Introduction
Freshwater ecosystems occupy a relatively small proportion of the Earth's surface but support disproportionately high levels of biological diversity and provide essential ecological services to human societies. Rivers and associated wetlands provide habitat, breeding grounds, feeding areas, migration routes, and nursery habitats for numerous aquatic organisms. On other hand Freshwater ecosystems are among the most threatened habitats globally, facing pressures from pollution, overfishing, and invasive species (Dudgeon et al., 2006). Freshwater fishes are particularly important components of river ecosystems because they occupy multiple trophic levels and contribute to energy transfer, nutrient cycling, food-web stability, and fisheries production (Allan & Castillo, 2007; Dudgeon et al., 2006; Moyle & Cech, 2004). Freshwater fish communities are also valuable indicators of ecological condition because their distribution and abundance integrate environmental conditions over time (Karr, 1981; Nair et al., 2023).

Freshwater fish diversity is influenced by a combination of environmental, geographical, hydrological, and biological factors. Water velocity, depth, substrate, dissolved oxygen, temperature, turbidity, aquatic vegetation, food availability, connectivity, and seasonal hydrological fluctuations influence fish distribution and community structure (Allan & Castillo, 2007; Welcomme, 1985). India's river systems, particularly the Godavari River, sustain diverse fish communities that are vital for ecological balance and local livelihoods (Talwar & Jhingran, 1991). The freshwater fish resources of the country have considerable ecological and socioeconomic importance, supporting capture fisheries, aquaculture, food security, employment, and local livelihoods (Kapoor et al., 2002; Talwar & Jhingran, 1991). Documenting fish diversity is essential for understanding ecosystem health and guiding conservation strategies (Magurran, 2004).

The Godavari River, often referred to as the "Dakshina Ganga," is the second largest river in India and supports extensive fisheries. The river and its tributaries support diverse aquatic habitats and fisheries. Fish diversity in the Godavari basin, however, is not spatially uniform. Previous investigations have reported substantial differences in fish richness among different stretches of the river, reservoirs, tributaries, and confluence zones (Balkhande & Kulkarni, 2015; Khobragade & Lipokrenba, 2016; Rankhamb, 2011; Shillewar & Nanware, 2008). However, localized assessments of fish diversity remain limited. This study aims to assess ichthyofaunal diversity in the Kopargaon stretch of the Godavari River. By comparing findings

with other Indian rivers, the study provides insights into regional biodiversity patterns and conservation needs.

Studies from Maharashtra have repeatedly documented the importance of Cypriniformes and Cyprinidae in Godavari fish assemblages. Rankhamb (2011) reported 26 fish species belonging to five orders, seven families, and 15 genera from the Godavari at Mudgal in Parbhani district, with Cypriniformes represented by 15 species. Balkhande and Kulkarni (2015) recorded 18 fish species belonging to five orders, eight families, and 14 genera from the Godavari at Dhangar Takli, Parbhani district. At Nanded, Shillewar and Nanware (2008) reported 26 species belonging to 18 genera, six orders, and nine families. Similarly, a study of the confluence of the Pravara and Godavari rivers at Toka recorded 21 fish species, with Cypriniformes being the dominant order (Khobragade & Lipokrenba, 2016).

The Kopargaon region is ecologically and economically important because the Godavari supports agricultural activities, domestic water requirements, local fisheries, and associated riverine biodiversity. A previous investigation of fish biodiversity in the Godavari at Kopargaon recorded 12 species belonging to four orders, eight families, and nine genera during 2013–2014 (Dandawate & Lonkar, 2014). The occurrence of only 12 species in that earlier survey emphasises the importance of repeated monitoring because fish communities can change over time in response to habitat modification, water-quality deterioration, fishing pressure, hydrological changes, and introduction of non-native species.

Recent studies highlight that freshwater biodiversity is experiencing increasing pressure from habitat degradation, pollution, altered flow regimes, overexploitation, invasive species, and climate change (Dudgeon et al., 2006; Reid et al., 2019; Tickner et al., 2020). River regulation and habitat fragmentation can particularly affect fishes that require specific flow conditions or migrate between habitats for feeding and reproduction (Grill et al., 2019; Vörösmarty et al., 2010). Changes in water chemistry and local-scale water abstraction may also alter fish guild composition and species richness (Atkore et al., 2020).

Biological invasions represent an additional challenge. Freshwater fishes have frequently been introduced outside their native ranges for aquaculture, mosquito control, ornamental purposes, sport fishing, and other reasons. Some introduced species become established in natural waters and may compete with native fishes or alter food-web interactions (Bernery et al., 2022; Gozlan, 2008; Gozlan et al., 2010). *Oreochromis mossambicus* is an introduced species in India and is capable of establishing populations in a variety of freshwater environments. FishBase identifies it as introduced in India and documents its broad ecological tolerance and history of establishment outside its native African range (Froese & Pauly, 2026). *Gambusia affinis* is likewise an introduced species in India and has a wide global history of introduction (Froese & Pauly, 2013).

The occurrence of introduced fishes in the present study is therefore noteworthy. However, the mere detection of a non-native species does not by itself demonstrate ecological invasion or measurable impacts on native species. Assessment of invasive impacts requires information on abundance, recruitment, population establishment, habitat use, diet, competition, and temporal trends (Bernery et al., 2022; Gozlan et al., 2010). Consequently, the present study considers these fishes as introduced taxa with potential ecological significance.

A recent review of freshwater fish diversity in Maharashtra emphasized that fish inventories remain incomplete and that systematic long-term monitoring is necessary because habitat degradation, pollution, flow modification, overexploitation, and invasive alien fishes can interact to affect fish communities (Thokal & Wagh, 2026). The present investigation was therefore undertaken to document the ichthyofaunal diversity of the Godavari River at Kopargaon during February 2022–January 2023.

The specific objectives were to: (i) document the fish species occurring in the study stretch; (ii) determine the taxonomic composition of the recorded fish community; (iii) assess the contribution of major fish families; (iv) document the occurrence of introduced taxa; and (v) discuss the implications of the observed fish assemblage for biodiversity conservation and sustainable fisheries management.

## Materials and Methods

### Study Area

The survey was conducted along the Kopargaon stretch of the Godavari River in Maharashtra River (latitude: 19.882389, longitude: 74.476051). This region is characterized by agricultural activity, seasonal fluctuations in water flow, and traditional fishing practices. The study period was from February 2022 - January 2023, covering both

monsoon and post-monsoon seasons to capture seasonal variation in fish diversity. The photographs of fish specimens were taken from local fishermen on the sit and also from the local fish market Fish specimens were identified using standard taxonomic literature and regional fish references, particularly Talwar and Jhingran (1991), Menon (1999), and Nelson et al. (2016). Taxonomic nomenclature was checked against contemporary fish databases and taxonomic resources wherever necessary. Identification was based on external morphological characters including body shape, scale arrangement, fin structure, fin-ray counts, mouth position, barbels, lateral-line characteristics, colouration, and other diagnostic features.

**Table I: Fish diversity of Godavari River from Kopargaon**

| Order | Family | Common Name | Scientific name |
|---|---|---|---|
| | Ambassidae | Bald glassy | *Ambassis gymnocephalus* |
| Osteoglossiformes | Notopteridae | Catla | *Catla catla* |
| | | Stone sucker | *Garra lamta* |
| | | chilhwa | *Chela bacila* |
| | | Bronze featherback | *Notopterus notopterus* |
| Cypriniformes | Cyprinidae | Common carp | *Cyprinus carpio* |
| | | Ticto barb | *Puntius ticto* |
| | | mrigal | *Cirrhinus mrigala* |
| | | Rohu | *Labeo rohita* |
| | | mosquitofish | *Gambusia affinis* |
| | Cobitidae | Guntea loach | *Lepidocephalus guntea* |
| | Bagridae | Long Whiskered catfish | *Mystus aor* |
| | | Giant River- catfish | *Mystus seenghala* |
| Scombriformes | Scombridae | Indian mackerl | *Rastrelliger kanagurta* |
| Siluriformes | Siluridae | freshwater shark | *Wallaga attu* |
| Mugiliformes | Mugilidae | flathead grey mullet | *Mugil cephalus* |
| Synbranchiformes | Cichlidae | Mozambique tilapia | *Oreochromis mossambica* |

**Results**

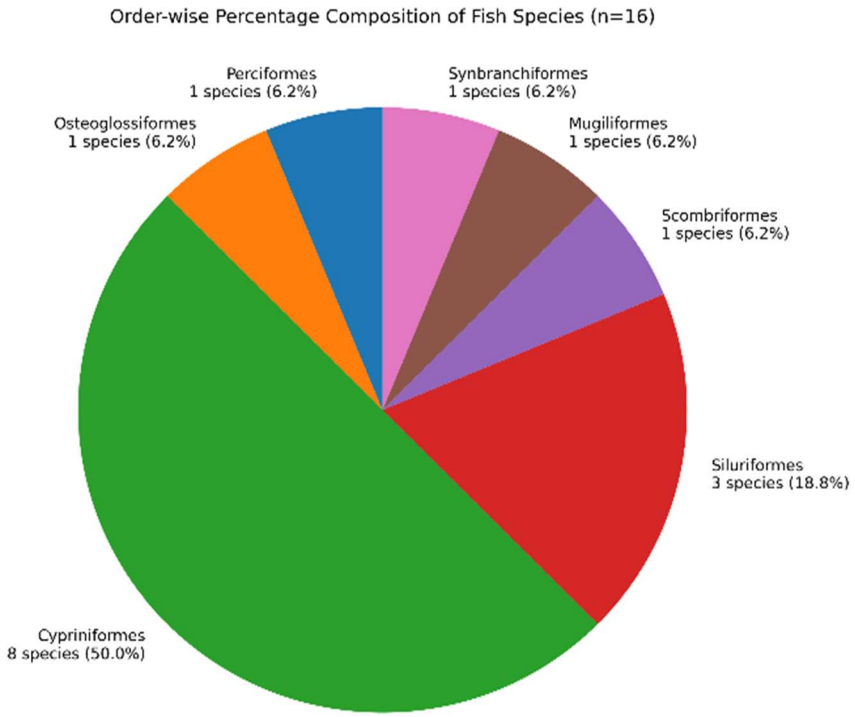
A total of **17 species belonging to 09 families** were recorded from the Godavari River at Kopargaon during February 2022–January 2023. Cyprinidae was the most diverse family (7 species), followed by Bagridae (3 species). The recorded assemblage demonstrates that the Kopargaon stretch supports a heterogeneous freshwater fish community comprising representatives of several taxonomic groups.Exotic species such as *Oreochromis mossambica* and *Gambusia affinis* were also observed.

**Species Composition**

- **Cyprinidae:** *Punctius jerdoni*, *Labeo boggut*, *Rasbora caverii*, *Crossocheilus latius*, *Cyprinus carpio*, *Puntius ticto*, *Labeo rohita*.
- **Bagridae:** *Plystus bleekeri*, *Mystus aor*, *Mystus seenghala*.
- **Channidae:** *Channa punctatus*, *Channa marulis*.
- **Ambassidae:** *Parambassis ranga*, *Ambassis gymnocephalus*.
- **Others:** *Glossogibus giurus* (Gobidae), *Placrognathus spuncalus* (Mastacembelidae), *Catla catla* (Notopteridae), *Oreochromis mossambica* (Cichlidae), *Gambusia affinis* (Poeciliidae).

These values indicate a moderately diverse and evenly distributed fish community, consistent with findings from other Indian rivers (Kharat et al., 2003).




## Discussion

### Dominance of Cyprinidae

The dominance of Cyprinidae reflects their ecological adaptability and prevalence in Indian river systems (Talwar & Jhingran, 1991), consistent with earlier studies conducted in different stretches of the Godavari River and other freshwater ecosystems of Maharashtra. Rankhamb (2011) reported a strong dominance of Cypriniformes in the Godavari at Mudgal, while Balkhande and Kulkarni (2015) also found Cypriniformes to be the dominant order at Dhangar Takli. Similarly, Khobragade and Lipokrenba (2016) reported that Cypriniformes accounted for the largest component of fish diversity at the Pravara–Godavari confluence. Cyprinid taxa are well adapted to varied ecological niches, making them resilient to environmental fluctuations.

### Predatory Species

Predatory species such as *Channa punctatus* and *Channa marulis* suggest a balanced trophic structure. These species play a crucial role in regulating prey populations and maintaining ecological balance.

### Exotic Species

The presence of exotic species (*Oreochromis mossambica*, *Gambusia affinis*) highlights anthropogenic introductions that may threaten native biodiversity (Canonico et al., 2005). The occurrence of both taxa in the Godavari at Kopargaon is significant from a biodiversity-management perspective because the establishment of non-native fishes can influence native fish communities through competition, predation, resource utilization, habitat modification, and alteration of trophic interactions (Bernery et al., 2022; Gozlan, 2008). Tilapia, for instance, is known to outcompete native species, while mosquitofish can disrupt local ecosystems.

The present total of 17 species falls within the range reported by previous studies from different stretches of the Godavari River in Maharashtra. Dandawate and Lonkar (2014) recorded 12 species at Kopargaon during May 2013–April 2014. Rankhamb (2011) recorded 26 species from Mudgal, whereas Shillewar and Nanware (2008) recorded 26 species from Nanded. Balkhande and Kulkarni (2015) recorded 18 species at Dhangar Takli, and Khobragade and Lipokrenba (2016) recorded 21 species from the Pravara–Godavari confluence.

More recently, studies from other sections of the Godavari system have continued to demonstrate considerable fish diversity. A 2026 investigation near Gangakhed recorded 27 species belonging to 12 families, with Cypriniformes again representing the dominant order (Sakhare et al., 2026). The differences among studies may reflect geographical variation, sampling period, sampling effort, habitat

characteristics, hydrological conditions, fishing pressure, and methodological differences

The present study recorded 17 fish species belonging to 09 families from the Godavari River at Kopargaon during February 2022–January 2023. The results confirm that this river stretch continues to support a moderately diverse freshwater fish assemblage. The predominance of Cyprinidae is consistent with the general pattern reported for many Indian river systems and particularly for several stretches of the Godavari.

Cyprinids are highly successful freshwater fishes and include species occupying diverse ecological niches. Their dominance may be associated with their adaptability to variable riverine habitats, diverse feeding strategies, reproductive adaptations, and broad ecological tolerance (Moyle & Cech, 2004; Talwar & Jhingran, 1991). In Indian inland waters, cyprinids also have major economic importance because several species are harvested for consumption and cultured extensively in aquaculture systems (Jayasankar, 2018).

The 36.84% contribution of Cyprinidae recorded in the present study is comparable with the dominance of cyprinid fishes reported from several Godavari investigations. Rankhamb (2011) reported 15 cypriniform species among 26 fishes from Mudgal, while Balkhande and Kulkarni (2015) found eight cypriniform species among 18 fishes at Dhangar Takli. At the Pravara–Godavari confluence, Cypriniformes comprised 10 of the 21 recorded species (Khobragade & Lipokrenba, 2016). These observations suggest that cyprinid fishes represent an important component of the fish assemblage throughout several sections of the Godavari system in Maharashtra.

Community structure is affected by habitat quality, hydrological connectivity, water chemistry, availability of spawning grounds, food resources, fishing intensity, and other environmental variables (Allan & Castillo, 2007; Dudgeon et al., 2006). Consequently, long-term monitoring of abundance, recruitment, size structure, and seasonal distribution is necessary to determine whether the recorded diversity represents a stable community. Such monitoring is particularly important because recent assessments of Maharashtra's freshwater fish fauna have identified substantial gaps in systematic long-term inventories (Thokal & Wagh, 2026).

The presence of *O. mossambicus* and *G. affinis* deserves particular attention. Introduced freshwater fishes are increasingly recognized as important components of human-mediated changes in aquatic ecosystems. Their establishment can result from intentional stocking, aquaculture escape, ornamental-fish release, biological-control programmes, or accidental transport (Bernery et al., 2022; Gozlan et al., 2010).

*Oreochromis mossambicus* is a particularly successful introduced fish because of its ecological flexibility, broad environmental tolerance, reproductive capacity, and ability to exploit modified aquatic habitats. Fish Base records the species as introduced in India and describes its occurrence in freshwater systems and its history of establishment beyond its native African distribution (Froese & Pauly, 2026).

The presence of *G. affinis* is also noteworthy. The species has a long history of introduction for mosquito-control purposes and has subsequently become established in many regions. Its introduction has been associated with ecological effects in some invaded systems, although impacts vary according to local ecological circumstances (Bernery et al., 2022; Saha et al., 2022).

India has a substantial number of non-native freshwater fish taxa, and some have established populations in rivers, wetlands, reservoirs, and other open waters. Degraded aquatic habitats may be particularly susceptible to colonization by tolerant non-native species because environmental disturbance can reduce populations of sensitive native fishes and create ecological opportunities for generalist species (Lakra et al., 2008; Saha et al., 2022). Recent assessments have also emphasized that alien fishes constitute an increasing management concern for India's open-water fisheries (Sarkar et al., 2021).

However, the presence of an introduced fish should not automatically be equated with demonstrated ecological damage. To establish whether *O. mossambicus* or *G. affinis* is exerting measurable pressure on native fish populations at Kopargaon, future studies should quantify their relative abundance, biomass, recruitment, reproductive activity, diet, habitat preference, and population trends. Comparative analysis between sites with high and low abundance of introduced fishes would provide stronger evidence of ecological effects (Bernery et al., 2022; Gozlan, 2008).

Freshwater fishes are affected by multiple interacting anthropogenic pressures. Major threats include pollution, habitat destruction, water abstraction, river regulation, overfishing, invasive species,

sedimentation, loss of riparian vegetation, and climate-related hydrological changes (Dudgeon et al., 2006; Reid et al., 2019; Vörösmarty et al., 2010).

River regulation and fragmentation are particularly important because many fish species depend on longitudinal connectivity for movement between feeding, spawning, and nursery habitats. The global assessment of free-flowing rivers demonstrated the extensive modification of river connectivity by dams, reservoirs, and other infrastructure (Grill et al., 2019). Altered flow regimes can modify water depth, velocity, sediment transport, substrate composition, and availability of spawning habitat (Allan & Castillo, 2007).

Research in Indian rivers has likewise demonstrated relationships between water chemistry, flow regulation, habitat alteration, and fish-community structure. Atkore et al. (2020) showed that water chemistry and local-scale water abstraction can influence fish-guild richness in regulated and non-regulated rivers of India's Western Ghats. Nair et al. (2023) demonstrated the usefulness of fish-based biological assessment for evaluating river health in the Tapti River of the Deccan region.

The Godavari at Kopargaon is exposed to a range of anthropogenic influences associated with agriculture, settlement, water use, and fisheries. Pollution can directly affect fish through toxicity and physiological stress and indirectly influence them by altering food resources, dissolved oxygen, habitat quality, and aquatic productivity. Therefore, fish diversity surveys should ideally be integrated with measurements of physicochemical and biological water-quality parameters.

The fish community of the Godavari has ecological as well as socioeconomic significance. River fisheries provide food, income, and employment to communities dependent on aquatic resources (Welcomme, 1985). In India, freshwater aquaculture and capture fisheries have considerable economic importance, with carp-based systems forming a major component of freshwater fish production (Jayasankar, 2018).

Sustainable fisheries management requires maintaining fish populations above levels at which recruitment is impaired. Excessive fishing pressure, destructive fishing methods, capture of breeding adults, and harvesting of juveniles can reduce population resilience. Management should therefore incorporate closed seasons or protected breeding periods where appropriate, mesh-size regulation, protection of spawning grounds, and community participation.

The conservation of riverine habitats is equally important. Maintaining riparian vegetation, preventing indiscriminate sand and substrate removal, reducing untreated wastewater inputs, and maintaining adequate ecological flows can help preserve habitat complexity. The global emergency recovery framework for freshwater biodiversity emphasizes environmental flows, water-quality improvement, habitat restoration, sustainable resource exploitation, control of non-native species, and restoration of river connectivity as key conservation priorities (Tickner et al., 2020).

The present inventory provides baseline information for future monitoring of fish diversity at Kopargaon. Baseline inventories are particularly important because changes in fish communities can be difficult to detect in the absence of historical reference data. Repeated surveys using standardized methodology can identify changes in species richness, community composition, abundance, and distribution.

The importance of such monitoring is reinforced by evidence of widespread freshwater biodiversity decline. Reid et al. (2019) highlighted the cumulative effects of climate change, pollution, invasive species, hydrological modification, emerging contaminants, and other stressors on freshwater biodiversity. Albert et al. (2021) similarly emphasized that freshwater fish biodiversity is facing a global crisis requiring coordinated conservation action.

The present study should therefore be considered a baseline inventory rather than a complete assessment of the ecological health of the Godavari at Kopargaon. Future research should extend the sampling period to at least one complete annual cycle and preferably several years. Sampling should encompass monsoon, post-monsoon, winter, and summer periods and should include multiple stations representing different habitat types.

## Conclusion

The present investigation recorded 17 fish species belonging to 09 families from the Godavari River at Kopargaon during February 2022–January 2023. Cyprinidae was the dominant family, represented by seven species and contributing 36.84% of total species richness. The occurrence of the introduced fishes *Oreochromis mossambicus* and *Gambusia affinis* is an important finding because non-native fishes may become established in disturbed

freshwater habitats and potentially interact with native fish communities.

Comparison with previous investigations indicates that fish richness varies considerably among different stretches of the Godavari River in Maharashtra. Such variation may result from differences in habitat structure, hydrology, water quality, sampling effort, fishing pressure, and anthropogenic disturbance.

The present findings emphasize the need for continued ichthyological monitoring of the Godavari at Kopargaon. Conservation measures should focus on maintaining river connectivity, protecting spawning and nursery habitats, controlling pollution, regulating excessive fishing, monitoring introduced fish populations, and promoting sustainable fisheries practices. Future investigations should incorporate species-wise abundance, biomass, diversity indices, population structure, seasonal variation, physicochemical water-quality parameters, and habitat characteristics. Such integrated studies would provide a stronger scientific basis for conservation planning and sustainable management of the Godavari River fishery.

**Acknowledgements:** The author is thankful to the principal and HOD of Zoology Department, Dapoli Urban Senior Science College Dapoli as well as local fishermen's of Kopargaon city and around village for their assistance in specimen collection and field observations.

**References**

Albert, J. S., Destouni, G., Duke-Sylvester, S. M., Magurran, A. E., Oberdorff, T., Reis, R. E., Winemiller, K. O., & Ripple, W. J. (2021). Scientists' warning to humanity on the freshwater biodiversity crisis. *Ambio, 50*(1), 85–94. https://doi.org/10.1007/s13280-020-01318-8

Allan, J. D., & Castillo, M. M. (2007). *Stream ecology: Structure and function of running waters* (2nd ed.). Springer. https://doi.org/10.1007/978-1-4020-5583-6

American Public Health Association, American Water Works Association, & Water Environment Federation. (2017). *Standard methods for the examination of water and wastewater* (23rd ed.). American Public Health Association.

Atkore, V. M., Kharat, S. S., & others. (2020). Multiscale investigation of water chemistry effects on fish guild species richness in regulated and nonregulated rivers of India's Western Ghats: Implications for restoration. *Transactions of the American Fisheries Society, 149*, 298–319. https://doi.org/10.1002/tafs.10230

Balkhande, J. V., & Kulkarni, A. N. (2015). Studies of ichthyofaunal diversity of Godavari River at Dhangar Takli, Tq. Purna, Dist. Parbhani, Maharashtra, India. *International Journal of Animal Biology, 1*(5), 187–189.

Bernery, C., Bellard, C., Courchamp, F., Brosse, S., Gozlan, R. E., Jarić, I., Teletchea, F., & Leroy, B. (2022). Freshwater fish invasions: A comprehensive review. *Annual Review of Ecology, Evolution, and Systematics, 53*, 427–456. https://doi.org/10.1146/annurev-ecolsys-032522-015551

Canonico, G. C., Arthington, A., McCrary, J. K., & Thieme, M. L. (2005). The effects of introduced tilapias on native biodiversity. *Aquatic Conservation: Marine and Freshwater Ecosystems, 15*(5), 463–483. https://doi.org/10.1002/aqc.699

Dandawate, R. R., & Lonkar, R. S. (2014). Fish biodiversity of Godavari River at Kopergaon and Pravara River at Pravara Sangam in District Ahmednagar, Maharashtra, India. *Uttar Pradesh Journal of Zoology, 34*(2), 109–112.

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A.-H., Soto, D., Stiassny, M. L. J., & Sullivan, C. A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews, 81*(2), 163–182. https://doi.org/10.1017/S1464793105006950

Froese, R., & Pauly, D. (Eds.). (2013). *FishBase*. World Wide Web electronic publication.

Froese, R., & Pauly, D. (Eds.). (2026). *FishBase: World Wide Web electronic publication*. https://www.fishbase.org

Gozlan, R. E. (2008). Introduction of non-native freshwater fish: Is it all bad? *Fish and Fisheries, 9*(1), 106–115.

Gozlan, R. E., Britton, J. R., Cowx, I. G., & Copp, G. H. (2010). Current knowledge on non-native freshwater fish introductions. *Journal of Fish Biology, 76*(4), 751–786.

Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., Babu, S., Borrelli, P., Cheng, L., Crochetiere, H., Ehalt Macedo, H., Filgueiras, R., Goichot, M., Higgins, J., Hogan, Z., Lip, B., McClain, M. E., Meng, J., Mulligan, M., ... Zarfl, C. (2019). Mapping the world's free-flowing rivers. *Nature, 569*, 215–221. https://doi.org/10.1038/s41586-019-1111-9

Jayasankar, P. (2018). Present status of freshwater aquaculture in India—A review. *Indian Journal of Fisheries, 65*(4), 157–165. https://doi.org/10.21077/ijf.2018.65.4.81300-20

Jinturkar, A. S., Rankhamb, S. V., & Shaikh, M. J. (2024). A systematic literature review on ichthyofaunal diversity in freshwater ecosystems, with special reference to Maharashtra. *International Journal of Innovative Science and Research Technology, 9*(10).

Kapoor, D., Dayal, R., & Ponniah, A. G. (Eds.). (2002). *Fish biodiversity of India*. National Bureau of Fish Genetic Resources.

Khobragade, B., & Lipokrenba. (2016). Ichthyofaunal diversity at the confluence of Pravara and Godavari rivers (M.S.), India. *Journal of Entomology and Zoology Studies, 4*(2), 511–516.

Lakra, W. S., Singh, A. K., & Mahanta, P. C. (Eds.). (2009). *Fish genetic resources*. Narendra Publishing House.

Menon, A. G. K. (1999). *Check list—Freshwater fishes of India*. Zoological Survey of India.

Moyle, P. B., & Cech, J. J. (2004). *Fishes: An introduction to ichthyology* (5th ed.). Pearson Prentice Hall.

Nelson, J. S., Grande, T. C., & Wilson, M. V. H. (2016). *Fishes of the world* (5th ed.). John Wiley & Sons. https://doi.org/10.1002/9781119174844

Nair, S. K., Sreeramulu, K., & others. (2023). Probing river health status: A study based on index of biotic integrity (IBI) in Tapti River of Deccan Plateau, India. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-023-27497-x

Rankhamb, S. V. (2011). Ichthyofaunal diversity of Godavari River at Mudgal, Tq. Pathri, Dist. Parbhani. *Recent Research in Science and Technology, 3*(12), 11–13.

Reid, A. J., Carlson, A. K., Creed, I. F., Eliason, E. J., Gell, P. A., Johnson, P. T. J., Kidd, K. A., MacCormack, T. J., Olden, J. D., Ormerod, S. J., Smol, J. P., Taylor, W. W., Tockner, K., Vermaire, J. C., Dudgeon, D., & Cooke, S. J. (2019). Emerging threats and persistent conservation challenges for freshwater biodiversity. *Biological Reviews, 94*(3), 849–873. https://doi.org/10.1111/brv.12480

Saha, N. C., Sarkar, C., & Raha Roy, A. (2022). Invasive fish species in India: Challenges, threats and impacts. *Research & Reviews: Journal of Ecology, 11*(1).

Sakhare, V. B., Chalak, A. D., & Surve, P. R. (2026). Fish fauna of River Godavari near Gangakhed, Maharashtra. *International Journal of Fisheries and Aquatic Research, 11*(1), 1–3. https://doi.org/10.66856/ijfar.2026.11.1.11001

Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. University of Illinois Press.

Shillewar, K. S., & Nanware, S. S. (2008). Biodiversity of fishes of Godavari River at Nanded, Maharashtra, India. *Biosciences, Biotechnology Research Asia, 5*(2).

Shillewar, K. S., & Totawar, D. V. (2017). Fresh water fish fauna of Vishnupuri Dam, Nanded, Maharashtra, India. *International Journal of Life Sciences, 5*.

Simpson, E. H. (1949). Measurement of diversity. *Nature, 163*, 688. https://doi.org/10.1038/163688a0

Talwar, P. K., & Jhingran, A. G. (1991). *Inland fishes of India and adjacent countries* (Vols. 1–2). Oxford & IBH Publishing.

Thokal, J. A., & Wagh, S. R. (2026). Freshwater fish diversity in Maharashtra, India: A critical review. *Uttar Pradesh Journal of Zoology, 47*(11), 59–79. https://doi.org/10.56557/upjoz/2026/v47i115685

Tickner, D., Opperman, J. J., Abell, R., Acreman, M., Arthington, A. H., Bunn, S. E., Cooke, S. J., Dalton, J., Darwall, W., Edwards, G., Harrison, I., Hughes, K., Jones, T., Leclère, D., Lynch, A. J., Leonard, P., McClain, M. E., Muruven, D., Olden, J. D., Ormerod, S. J., Robinson, J., Tharme, R. E., Thieme, M., Tockner, K., Wright, M., & Young, L. (2020). Bending the curve of global freshwater biodiversity loss: An emergency recovery plan. *BioScience, 70*(4), 330–342. https://doi.org/10.1093/biosci/biaa002

Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S. E., Sullivan, C. A., Reidy Liermann, C., & Davies, P. M. (2010). Global threats to human water security and river biodiversity. *Nature, 467*, 555–561. https://doi.org/10.1038/nature09440

Welcomme, R. L. (1985). *River fisheries*. Food and Agriculture Organization of the United Nations, FAO Fisheries Technical Paper No. 262.