Asian J Biol Life Sci., 2026; 15(2):493-498.
https://ajbls.com

Research Article

Nutritional Potential of the Invasive Armored Catfish *Pterygoplichthys pardalis*: Seasonal Variation in Proximate Composition from the Ujani Reservoir, Maharashtra, India

Sudarshan Markad[1], Ravindra Chaudhari[1], Somnath Waghmare[2,*]

[1]Department of Zoology, Shri Shiv Chhatrapati College, Junnar, Pune (Affiliated to Savitribai Phule Pune University), Pune, Maharashtra, INDIA.
[2]Department of Zoology, Nowrosjee Wadia College, Pune (Affiliated to Savitribai Phule Pune University), Pune, Maharashtra, INDIA.

ABSTRACT

Background: The invasive armored catfish, Pterygoplichthys pardalis, has become widely established in the Ujani Reservoir, Maharashtra, India. Despite its increasing abundance and ecological significance, information regarding its nutritional composition and potential for human consumption remains limited. Objectives: To evaluate the proximate composition and seasonal variation in the nutritional profile of Pterygoplichthys pardalis collected from different locations in the Ujani Reservoir. Materials and Methods: Specimens of P. pardalis were collected from four sampling sites in the Ujani Reservoir across different seasons. Standard proximate analyses were performed to determine moisture, crude protein, lipid, ash, carbohydrate, and energy content. Seasonal variations in the nutritional composition were assessed and compared. Results: The protein content ranged from 11.50 to 15.86 g/100 g, with the highest values observed during the summer season. Lipid content remained consistently low (0.74-1.72 g/100 g), indicating that P. pardalis is a lean fish species. Carbohydrate levels were highest during the monsoon season, while moisture content exhibited an inverse relationship with protein and lipid concentrations. The estimated energy value varied from 67.45 to 87.72 kcal/100 g, reflecting seasonal fluctuations in proximate composition. Conclusion: Pterygoplichthys pardalis is a protein-rich, low-fat fish with promising nutritional and economic potential. The observed seasonal variations provide valuable baseline information for promoting its sustainable utilization as a food resource while supporting management strategies aimed at controlling this invasive species.

Keywords: Invasive Species Utilization, Nutritional Value, *Pterygoplichthys pardalis*, Seasonal Variation, Ujani Reservoir.

Correspondence:
Dr. Somnath Waghmare
Department of Zoology, Nowrosjee Wadia College, Pune, Affiliated to Savitribai Phule Pune University, Pune, Maharashtra, INDIA.
Email: drsomnathwaghmare@gmail.com

Received: 05-03-2026;
Revised: 13-05-2026;
Accepted: 21-07-2026.

INTRODUCTION

Fish are among the most valuable vertebrate resources, playing a vital role in human nutrition and global food security. They provide an excellent source of high-quality proteins, lipids, vitamins, essential minerals, and other nutrients that are readily digestible and beneficial for human health (Shinde *et al*., 2009). Beyond their nutritional significance, fish support the livelihoods and well-being of millions of people worldwide. It is estimated that nearly one billion individuals, particularly in developing countries, rely on fish as their primary source of animal protein, underscoring its crucial contribution to nutritional security and sustainable food systems (Food and Agriculture Organization, 2002). Consequently, understanding the nutritional value of fish species is essential for promoting food security, public health, and the sustainable utilization of aquatic resources.

The Bhima River, one of the major river systems of western Maharashtra, is an important tributary of the Krishna River. Originating from the ecologically and culturally significant Bhimashankar region in Ambegaon Tehsil of Pune District, the river traverses approximately 861 km through Maharashtra, Karnataka, and Telangana before joining the Krishna River. Its extensive drainage network is sustained by several tributaries, including the Mula-Mutha, Kukadi, Meena, and Chandani rivers (MPCB, 2018-19). Among the major water bodies within the basin, the Ujani Reservoir supports a rich and diverse fish fauna, with nearly 60 species representing 36 genera, 15 families, and 6 orders reported from the reservoir (Sarwade and Khillare, 2010). This ichthyofaunal diversity not only contributes to the ecological integrity of the reservoir but also provides substantial economic benefits to local fishing communities and serves as an important source of fish for nearby urban centers such as Pune and Mumbai. Furthermore, the reservoir plays a crucial role in supporting agricultural productivity through irrigation (Samant, 2002).

DOI: 10.5530/ajbls.20260176

The introduction and establishment of exotic fish species in freshwater ecosystems have emerged as a major conservation concern, often resulting in ecological imbalances and adverse impacts on native biodiversity (Ozdilek *et al.*, 2007). Indigenous species frequently face competitive disadvantages when confronted with non-native organisms possessing greater ecological adaptability and reproductive success. One such invasive species is *Pterygoplichthys pardalis* (Castelnau, 1855), an armored catfish belonging to the family Loricariidae and order Siluriformes, commonly known as the sailfin catfish, pleco, or suckermouth catfish. Together with *Pterygoplichthys disjunctivus*, this species has established populations in several regions of India, including Andhra Pradesh, West Bengal, Bihar, and Uttar Pradesh (Singh, 2014). In Maharashtra, its first documented occurrence was reported from the Bhima River basin in 2018, raising concerns regarding its potential ecological impacts on native aquatic communities and fisheries resources (Kumbhar *et al.*, 2018).

The proliferation of *Pterygoplichthys pardalis* in freshwater ecosystems has raised considerable ecological and socioeconomic concerns. As an invasive species, it competes aggressively with native fishes for food and habitat resources and may contribute to the decline of indigenous fish populations, thereby accelerating biodiversity loss (Hill and Lodge, 1999; Chapin *et al.*, 2000). The species has also been reported to consume demersal fish eggs, potentially reducing recruitment success and affecting the long-term sustainability of native fish communities (Chaichana and Jongphadungkiet, 2012). In addition, its characteristic burrowing behavior during reproduction can destabilize riverbanks, increase erosion, and elevate water turbidity, leading to habitat degradation and altered ecosystem dynamics (Gibbs *et al.*, 2010). The hard, armored body and prominent spines of *P. pardalis* frequently damage fishing gear, imposing economic burdens on local fishing communities that depend on inland fisheries for their livelihoods (Chavez *et al.*, 2006; Nico, 2010).

Despite its invasive status, evaluating the nutritional attributes of *P. pardalis* may offer opportunities for its sustainable utilization and management. Nutritional profiling provides essential information on the biological quality and potential value of fish species as sources of proteins, lipids, carbohydrates, minerals, and energy. Assessment of proximate composition serves as a scientific basis for determining the suitability of a species for human consumption and other value-added applications. Such investigations are particularly important for non-conventional and underutilized fish species, for which nutritional information remains limited. Generating baseline nutritional data not only enhances our understanding of the species but also supports evidence-based decisions in fisheries management, food security planning, and resource utilization. Therefore, the present study contributes to both invasion biology and sustainable fisheries research by exploring the nutritional potential of *P. pardalis* while addressing the broader challenge of managing invasive aquatic species.

MATERIALS AND METHODS

Study Area

The Ujani Dam is one of the largest multipurpose irrigation projects in Maharashtra, India, constructed across the Bhima River near Bhimanagar in Solapur District (18.0662° N, 75.1269° E). In addition to its importance for irrigation, fisheries, and water supply, the reservoir supports diverse aquatic habitats and fish communities. For the present investigation, four representative sampling locations within the reservoir and its backwater region were selected, namely Bhigwan, Kettur, Ajoti, and Bhimanagar (Figure 1).

Sample Collection and Preparation

Specimens of *Pterygoplichthys pardalis* were obtained from local fishermen operating at the selected sampling sites. Freshly collected fish were transported to the laboratory under chilled conditions to preserve sample quality and minimize biochemical changes. In the laboratory, the specimens were thoroughly washed with distilled water to remove adhering debris and other extraneous materials.

The edible muscle tissue was carefully dissected and used for nutritional analysis. To ensure sample homogeneity and analytical accuracy, the muscle tissues were homogenized prior to biochemical examination. The homogenized samples were subsequently subjected to proximate composition analysis for the determination of moisture, crude protein, lipid, ash, carbohydrate, and energy content, following standard analytical procedures. These analyses were conducted to evaluate the nutritional quality and potential food value of *P. pardalis* from the Ujani Reservoir.

Proximate Composition Analysis

The nutritional composition of *Pterygoplichthys pardalis* muscle tissue was evaluated through standard proximate analysis. Crude protein content was determined using the Kjeldahl method following IS 7219:1973, which estimates protein concentration based on total nitrogen content. Total lipid content was measured by solvent extraction according to AOAC Method 2003.05. Moisture content was determined using the oven-drying method as described in AOAC Method 930.15, whereas ash content was estimated following AOAC Method 942.05 by incinerating a pre-weighed dried sample in a muffle furnace until complete oxidation of organic matter was achieved.

Carbohydrate content was calculated by difference, obtained by subtracting the combined percentages of moisture, crude protein, lipid, and ash from 100. The gross energy value of the samples was subsequently estimated indirectly using the Atwater general factor system, which calculates energy contribution based on the

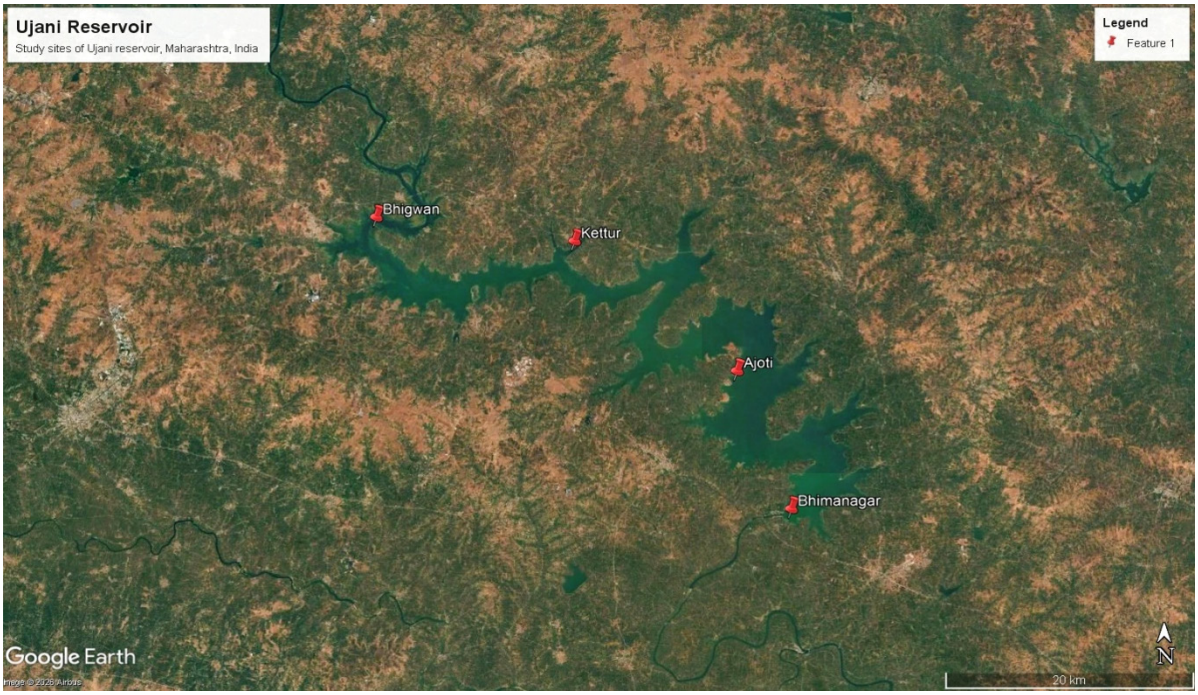

Figure 1: Showing Study sites of Ujani reservoir, Maharashtra.

proportions of protein, lipid, and carbohydrate present in the tissue. These analyses provided a comprehensive assessment of the nutritional quality and food value of *P. pardalis* collected from the Ujani Reservoir.

RESULTS

Energy Value

The energy content of *Pterygoplichthys pardalis* exhibited spatial and seasonal variation across the study area. Among the sampling sites, the highest energy value was recorded at Bhigwan (87.72 kcal/100 g), followed by Ajoti (75.23 kcal/100 g), Kettur (73.80 kcal/100 g), and Bhimanagar (72.15 kcal/100 g). Seasonal analysis revealed that energy content was greatest during the monsoon season (73.80 kcal/100 g), followed by summer (69.81 kcal/100 g), whereas the lowest value was observed during winter (67.45 kcal/100 g) (Tables 1 and 2). The observed variation in energy content may be attributed to seasonal fluctuations in nutrient accumulation and metabolic activity, reflecting changes in food availability and physiological condition of the fish.

Protein Content

The crude protein content of *P. pardalis* varied considerably among the four sampling locations in the Ujani Reservoir. The highest protein concentration was recorded at Bhigwan (15.86 g/100 g), followed by Bhimanagar (13.29 g/100 g) and Ajoti (12.47 g/100 g), while the lowest value was observed at Kettur (11.50 g/100 g). Seasonal variation was also evident, with the highest protein content recorded during summer (15.36 g/100 g), followed by winter (13.55 g/100 g), whereas the lowest value occurred during the monsoon season (11.50 g/100 g) (Tables 1 and 2). The elevated protein levels observed during summer may reflect enhanced feeding activity and nutrient accumulation, while reduced protein content during the monsoon could be associated with increased moisture content and physiological adjustments linked to seasonal environmental changes. Overall, the results indicate that *P. pardalis* constitutes a moderately protein-rich fish species with potential nutritional value for human consumption (Figures 2 and 3).

Total Fat Content

The total lipid content of *Pterygoplichthys pardalis* exhibited noticeable spatial and seasonal variation. Among the sampling sites, the highest lipid content was recorded at Kettur (1.72 g/100 g), followed by Ajoti (1.01 g/100 g) and Bhigwan (0.97 g/100 g), whereas the lowest value was observed at Bhimanagar (0.74 g/100 g). Seasonal analysis revealed that lipid content was highest during summer (4.76 g/100 g), followed by winter (3.78 g/100 g), and lowest during the monsoon season (1.72 g/100 g) (Tables 1 and 2). The overall low lipid levels indicate that *P. pardalis* is a lean fish species with limited fat reserves.

Carbohydrate Content

Carbohydrate content showed variation among the sampling locations, with the highest value recorded at Kettur (4.53 g/100 g), followed by Ajoti (3.75 g/100 g) and Bhigwan (3.64 g/100 g). The lowest carbohydrate content was observed at Bhimanagar (2.23 g/100 g). Seasonal fluctuations were pronounced, with carbohydrate content being absent during summer (0.00 g/100 g), increasing substantially during the monsoon season (4.53

Table 1: Showing site wise nutritional values of *P. pardalis.*

Sites	Energy (Kcal/100 g)	Protein (g/100 g)	Carbohydrate (g/100 g)	Total fat (g/100 g)	Ash (g/100 g)	Moisture (g/100 g)
Bhigwan	87.72	15.86	3.64	0.97	1.08	78.45
Kettur	73.8	11.5	4.53	1.72	1.20	81.51
Ajoti	75.23	12.47	3.75	1.01	1.15	81.62
Bhimanagar	72.15	13.29	2.23	0.74	1.12	82.62

Table 2: Showing season wise nutritional values of *P. pardalis.*

Season	Energy (Kcal/100 g)	Protein (g/100 g)	Carbohydrate (g/100 g)	Total fat (g/100 g)	Ash (g/100 g)	Moisture (g/100 g)
Summer	69.81	15.36	00	4.76	0.93	78.95
Monsoon	73.8	11.5	4.53	1.72	1.20	81.51
Winter	67.45	13.55	0.86	3.78	1.09	80.72

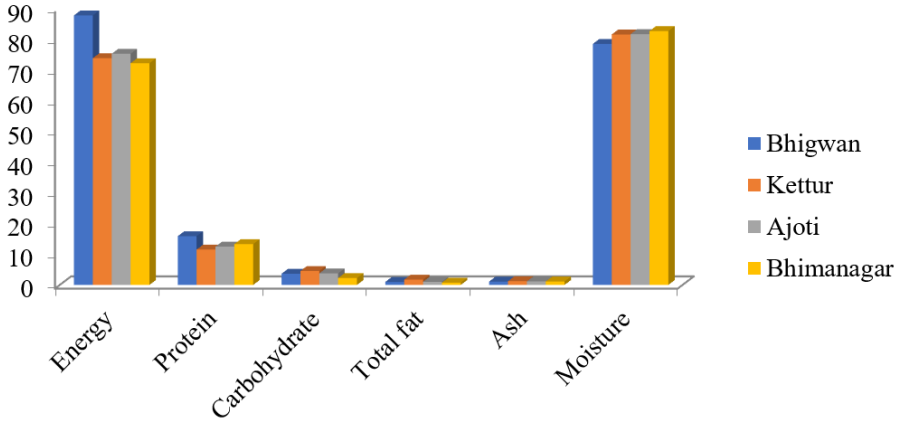

Figure 2: Site wise comparison of nutritional value of *P. pardalis.*

g/100 g), and declining during winter (0.86 g/100 g) (Tables 1 and 2). These variations may reflect seasonal changes in feeding patterns and energy storage within the fish.

Moisture Content

Moisture content varied across sampling sites, ranging from 78.45 to 82.62 g/100 g. The highest moisture content was recorded at Bhimanagar (82.62 g/100 g), followed by Ajoti (81.62 g/100 g) and Kettur (81.51 g/100 g), while Bhigwan exhibited the lowest value (78.45 g/100 g). Seasonal analysis showed that moisture content was highest during the monsoon season (81.51 g/100 g), followed by winter (80.72 g/100 g), and lowest during summer (78.95 g/100 g) (Tables 1 and 2). An inverse relationship between moisture and nutrient-rich components such as protein and lipid was evident throughout the study period.

Ash Content

Ash content, representing the total mineral fraction of the fish tissue, showed relatively minor variation among sampling locations. The highest ash content was recorded at Kettur (1.20

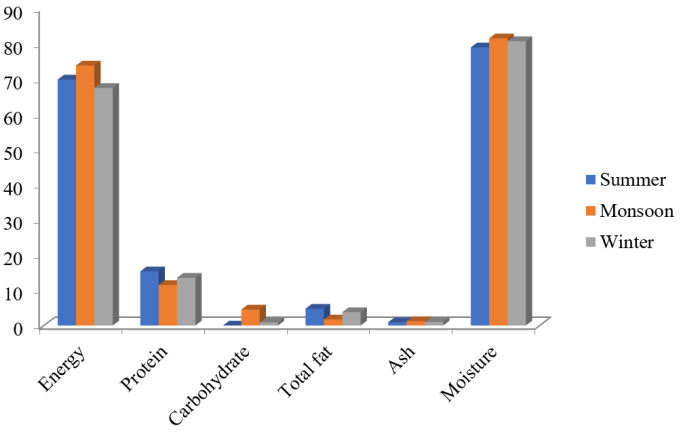

Figure 3: Season wise comparison of nutritional value of *P. pardalis.*

g/100 g), followed by Ajoti (1.15 g/100 g) and Bhimanagar (1.12 g/100 g), whereas the lowest value was observed at Bhigwan (1.08 g/100 g). Seasonal variation indicated the highest ash content during the monsoon season (1.20 g/100 g), followed by winter (1.09 g/100 g), while the lowest value was recorded during

summer (0.93 g/100 g) (Tables 1 and 2). The relatively stable ash content suggests limited seasonal fluctuation in the mineral composition of *P. pardalis* muscle tissue.

DISCUSSION

The present study revealed significant spatial and seasonal variation in the proximate composition of *Pterygoplichthys pardalis* from the Ujani Reservoir, highlighting the influence of environmental conditions on the nutritional profile of this invasive species. Variations in protein content among sampling locations may be attributed to differences in habitat characteristics, organic matter availability, benthic productivity, and food resources. As a predominantly detritivorous and benthic-feeding species, *P. pardalis* is strongly influenced by substrate composition and nutrient availability, which can directly affect its biochemical composition (Orfinger and Goodding, 2018; Jumawan *et al.*, 2020).

Seasonal fluctuations in protein and lipid content were evident, with higher values recorded during summer and lower values during the monsoon season. These patterns may reflect seasonal changes in feeding intensity, metabolic activity, and energy allocation associated with growth and reproduction. Similar trends have been reported in other populations of *Pterygoplichthys* inhabiting tropical freshwater ecosystems, where nutrient reserves tend to increase during periods of favorable environmental conditions and decline during energetically demanding phases of the life cycle (Hossain *et al.*, 2008; Bijukumar *et al.*, 2015).

The elevated carbohydrate content observed during the monsoon season may be associated with increased detrital input and nutrient enrichment resulting from runoff and enhanced organic matter accumulation. Such dietary flexibility enables *P. pardalis* to exploit a wide range of food resources, a characteristic that likely contributes to its successful establishment and persistence in invaded habitats (Nico *et al.*, 2012; Ramirez *et al.*, 2015). This adaptive feeding strategy represents one of the key ecological advantages of the species in non-native environments.

Moisture content exhibited an inverse relationship with protein and lipid concentrations, with higher moisture levels corresponding to reduced nutrient density, particularly during the monsoon season. This pattern is commonly reported in freshwater fishes and reflects seasonal physiological responses to environmental conditions and tissue hydration dynamics (Orfinger *et al.*, 2016; Wakida-Kusunoki *et al.*, 2016). In contrast, ash content showed relatively limited variation throughout the study period, suggesting a stable mineral composition that may be linked to the species' continuous ingestion of sediment-associated materials during feeding (Capps *et al.*, 2011; Chavez *et al.*, 2019).

Energy values closely followed variations in protein and lipid content, indicating that these components are the primary contributors to the calorific value of the species. Although *P. pardalis* exhibited relatively low lipid content, its moderate protein concentration and corresponding energy value suggest potential nutritional benefits for human consumption. From a management perspective, promoting the utilization of this invasive fish as a food resource may provide a practical approach for reducing population pressure while simultaneously generating socioeconomic benefits for local communities. Therefore, nutritional evaluation of *P. pardalis* not only enhances our understanding of its biological characteristics but also supports the development of sustainable strategies that integrate invasive species management with resource utilization (Orfinger and Goodding, 2018).

CONCLUSION

The present study demonstrates that the nutritional composition of *Pterygoplichthys pardalis* in the Ujani Reservoir is influenced by both spatial and seasonal factors, reflecting the effects of habitat characteristics, resource availability, and environmental conditions. Variations in protein, lipid, carbohydrate, moisture, and energy content highlight the species' physiological adaptability and ecological plasticity within the reservoir ecosystem. Despite its status as an invasive species, *P. pardalis* exhibited moderate protein content, low lipid levels, and appreciable energy values, indicating its potential as a nutritionally valuable fish resource.

These findings provide important baseline information on the nutritional attributes of *P. pardalis* and contribute to a better understanding of its ecological success in invaded freshwater habitats. Furthermore, the study highlights the possibility of integrating nutritional utilization with invasive species management, thereby transforming an ecological challenge into a potential socioeconomic opportunity. Sustainable exploitation of this abundant invasive fish may support local livelihoods, enhance resource recovery, and contribute to ecosystem-based management strategies in freshwater environments.

ABBREVIATIONS

AOAC: Association of Official Analytical Chemists; **IS:** Indian Standard; **MPCB:** Maharashtra Pollution Control Board.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS CONTRIBUTION

First Author: Sudarshan Markad- Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing- Original Draft. Ravindra Chaudhari: (Author)-Validation, Supporting Investigation. Somnath Waghmare: (Corresponding Author): Conceptualization, Supervision, Project Administration, Resources, Final Review, Writing- Final Editing, Correspondence.

REFERENCES

Bijukumar, A., Smrithy, R., Sureshkumar, U., & George, S, (2015). Invasion of South American suckermouth armored catfish *Pterygoplichthys* spp. (Loricariidae) in Kerala, India - a case study. Journal of Threatened Taxa, 7(3), 6987-6995.

Capps, K. A., Flecker, A. S., & Nico, L. G, 2011. Invasive fishes alter river food webs by changing consumer diets. Oecologia, 166, 921-931.

Chaichana, Ratcha, and Sirapat Jongphadungkiet, (2012). Assessment of the invasive catfish *Pterygoplichthys pardalis* (Castelnau, 1855) in Thailand: ecological impacts and biological control alternatives. Tropical Zoology 25.4 (2012): 173-182.

Chapin FS III, ES Zavaleta, VT Eviner, RL Naylor, PM Vitousek, HL Reynolds (2000). Consequences of changing biodiversity. Nature 405: 234-242.

Chavez M.J., De La Paz R.M., Manohar S.K., Pagulayan R.C., Vi C., (2006). New Philippine record of South American sailfin catfishes (Pisces: *Loricariidae*). Zootaxa, 1109: 57-68.

Chavez, J. M., De La Paz, R. M., Manohar, S. K., Pagulayan, R. C., & Carandang, J. R, (2019). New Philippine record of an invasive alien armored catfish *Pterygoplichthys pardalis* (Castelnau). BioInvasions Records, 8(1), 46-53.

Kumbhar D.S., Shaikh S.A., Mhaske D.K., (2018). Fish faunal diversity of Bhima River at Pedgaon, Sgrigonda (Ahmednagar District) IJCRT: 6 (2): 2320-2882.

Gibbs, M.A., J.H. Shields, D.W. Lock, K.M. Talmadge & T.M. Farrell, (2008). Reproduction in an invasive exotic catfish *Pterygoplichthys disjunctivus* in Volusia Blue Spring, Florida, U.S.A. Journal of Fish Biology 73: 1562-1572.

Hill, A. M., & Lodge, D. M. (1999). Replacement of resident crayfishes by an exotic crayfish: the roles of competition and predation. Ecological Applications, 9(2), 678-690.

Hossain, M. Y., Rahman, M. M., Jewel, M. A. S., Hossain, M. A., Ahamed, F., & Tumpa, A. S, (2008). Life-history traits of the invasive suckermouth catfish *Pterygoplichthys disjunctivus* in Bangladesh. Journal of Applied Ichthyology, 24, 548-553.

Jumawan, J. H., Vallejo, B. M., & Herrera, A. A, (2020). Population biology and condition factor of invasive janitor fish *Pterygoplichthys pardalis* in tropical freshwater ecosystems. Iranian Journal of Ichthyology, 7(2), 123-134.

Maharashtra Pollution Control Board, Water Quality Status of Maharashtra 2018-19: h ttps://www.mpcb.gov.in/focus-area/reports

Nico LG., (2010). Nocturnal and diurnal activity of armoured suckermouth catfish (Loricariidae: *Pterygoplichthys*) associated with wintering Florida manatees (*Trichechus manatus latirostris*). Neotrop. Ichthyol, 8(4).

Nico, L. G., Jelks, H. L., & Tuten, T, (2012). Non-native suckermouth armored catfishes in Florida: description of nest burrows and burrow colonies with assessment of shoreline conditions. Aquatic Nuisance Species Research Program Bulletin, 12, 1-30.

Orfinger, A. B., & Goodding, D. D, (2018), The global invasion of the suckermouth armored catfish genus *Pterygoplichthys* (*Siluriformes*: Loricariidae): annotated list of species, distributional summary, and assessment of impacts. Zoological Studies, 57, 7.

Orfinger, A. B., Goodding, D. D., & Levesque, E. M, (2016). Feeding ecology and trophic role of invasive *Pterygoplichthys* in freshwater ecosystems. Environmental Biology of Fishes, 99, 1-15.

Ozdilek SY (2007) Possible threat for Middle East inland water: an exotic and invasive species, *Pterygloplichthys disjuntivus* (1991) in Asi river Turkey (Pisces: Loriicaridae) J Fisheries Aquat Sci 24:303-306

Ramirez, E., Mendoza, R., López, R., & Ortiz, E, (2015). Reproductive biology of the invasive armored catfish *Pterygoplichthys pardalis* in a tropical reservoir. Journal of Fish Biology, 86, 1271-1285.

Samant, J. (2002) Wetland Conservation in Maharashtra: Need, Threats and Potential. Development Research Awareness and Action Institute, Raai, Kolhapur.

Sarwade J.P and Khillare Y. K. (2010). Fish Diversity of Ujani Wetland, Maharashtra, India. Journal of The Bioscan, Special issue, Vol. 1; 173-179.

Shinde S. E., Pathan T. S., Raut K. S., Bhandare R. Y., & Sonawane D. I. (2009). Fish Biodiversity of Pravara River at Pravara Sangam District Ahmednagar, (MS) India. World Journal of Zoology, 4(3): 176-179.

Singh AK, (2014). Emerging alien species in Indian aquaculture: prospects and threats. J. Aquat. Biol. Fish. 2:32-41.

Wakida-Kusunoki, A. T., Amador-del-Angel, L. E., & Alejandro-Espinosa, M, (2016). Biological and ecological traits of the invasive armored catfish *Pterygoplichthys pardalis* in Mexican freshwater systems. Latin American Journal of Aquatic Research, 44(4), 773-783.

Cite this article: Markad S, Chaudhari R, Waghmare S. Nutritional Potential of the Invasive Armored Catfish *Pterygoplichthys pardalis*: Seasonal Variation in Proximate Composition from the Ujani Reservoir, Maharashtra, India. Asian J Biol Life Sci. 2026;15(2):493-8.