DOI: https://doi.org/10.36094/sc.v91.2025.Reviving_Heteropneuster_Fossillis_Ensuring_Sustainable.Kumari.576

ARTICLE

Sci. and Cult. 91 (11–12) : 576-580 (2025)

REVIVING *HETEROPNEUSTES FOSSILIS*: ENSURING SUSTAINABLE FISHERIES AND LIVELIHOODS

SUMAN KUMARI*[1], ANJANI KUMAR[2], A.M. SAJINA[1], R.K. MANNA[1] AND B.K. DAS[1]

The Asian sting catfish, Heteropneustes fossilis, is a commercially important species found across various habitats in Southeast Asian countries. Locally known as Singhi, this species is highly nutritious and rich in protein, iron, and calcium. However, its population has declined by 20% in the last two decades. While existing research has focused on aspects such as reproductive biology and population structure, little attention has been given to establishing its population naturally in its habitat. This study presents a successful case of establishing H. fossilis in the wetlands of Eastern India. A total of 312 specimens were collected through seasonal sampling from June 2021 to May 2022, with sizes ranging from 7.94 cm to 28.36 cm in total length and 1.57g to 126.7g in weight respectively. The abundance of fish, particularly in June, contributed significantly to commercial catches in the wetlands of Khagaria district of Bihar. Notably, 90% of the captured fish by weight were mature brooders, indicating the reproductive capability of the species' during this period. A systematic approach to harvesting and post-harvest management was implemented in Khagaria, with focus on identifying priority breeding habitats and implementing in-situ natural management strategies in post-breeding. The study recommends policy guidelines for the capture-based fisheries, aquaculture, conservation, and management of H. fossilis amidst changing eco-climatic conditions, emphasizing specific management measures for sustainable fisheries and livelihood generation.

Introduction

Heteropneustes fossilis, commonly known as the stinging catfish or Singhi, is a freshwater catfish species native to the Indian subcontinent. It has been an integral part of India's aquatic ecosystems and cultural heritage for centuries. *H. fossilis* is valued for its palatability, texture, and flavour, making it a popular choice in traditional cuisines across India. Its firm flesh and mild taste make it versatile for various culinary preparations, including curries, fries, and grills. Moreover, *H. fossilis* is preferred for its low bone content, which enhances its culinary appeal[1.] Studies have elucidated the nutritional composition of *H. fossilis*, emphasizing its high protein content and essential nutrients. According to Gupta et al.[2] *H. fossilis* is rich in proteins, containing essential amino acids crucial for human health. Additionally, it provides essential fatty acids, vitamins, and minerals, including Omega-3 fatty acids, vitamin D, calcium, and phosphorus[3]. *H. fossilis* is prized for its high protein content, which makes it a valuable dietary component, especially in regions where access to protein-rich foods is limited. Protein is essential for muscle growth, repair, and overall body function, making *H. fossilis* an important nutritional resource for communities relying on freshwater fisheries[4]. Omega-3 fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are essential for cardiovascular health, brain function, and reducing inflammation[5]. The presence of Omega-3 fatty acids in *H. fossilis* enhances its nutritional value and contributes to

[1] ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata-700120
[2] Department of Fisheries, Government of Bihar, Patna-800001
* Corresponding Author: sumankumari.icar11@gmail.com

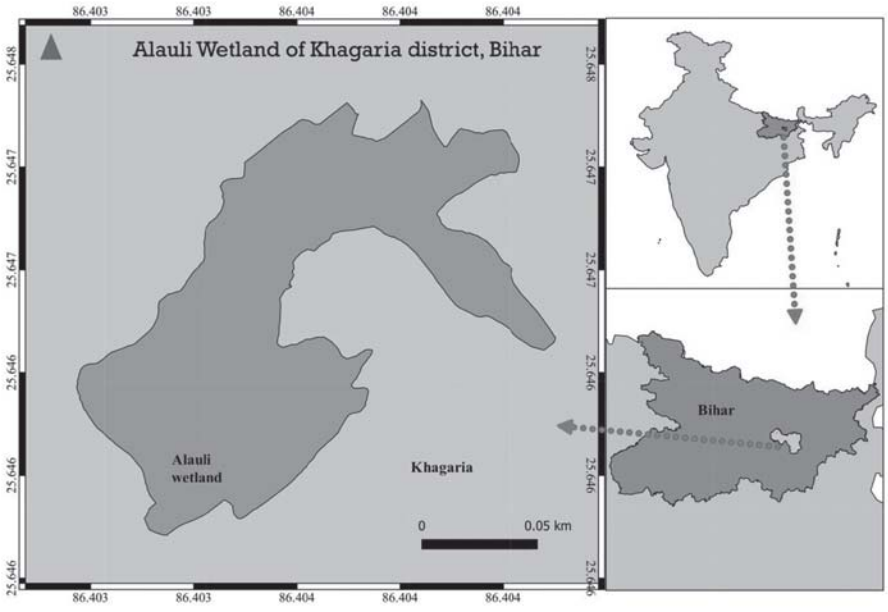

Fig. 1. Map of Alauli wetland, Khagaria, Bihar.

human well-being. *H. fossilis* contains essential vitamins and minerals necessary for overall health and well-being. Vitamin D is crucial for bone health and immune function, while calcium and phosphorus support bone strength and development[1]. The presence of these vitamins and minerals in *H. fossilis* adds to its nutritional significance in local diets. However, recent studies indicate a concerning decline in its population across various regions of India. Several studies have documented the decline of *H. fossilis* populations in India. A study by Gupta et al.[2] conducted in the Ganga River Basin reported a significant reduction in the abundance of *H. fossilis* over the past two decades. Similarly, Biswas and Chandra[1] noted a decline in *H. fossilis* populations in the Brahmaputra River system, emphasizing the impact of habitat degradation and overexploitation. Our study deals with identifying priority breeding habitats of *H. fossilis* and implementing in-situ natural management strategies in post-breeding period along with its role in sustainable fisheries and livelihood generation.

Materials and Methods

Study Site: Khagaria district of Bihar (25°30' 23.9724'' N, 86°28' 21.0972'' E) is bounded by the river Ganga in the south and it is also drained by several rivers such as Kosi, Kamala, Baghmati, etc (Figure 1). As a result, the district is inundated almost every year during rainy season and there is a vast network of floodplain wetlands in the district. As per National Wetland Atlas Bihar (2020), the total wetland area in the district is 11645 ha, which includes the area contributed by 75 small wetlands (< 2.25 ha), which comprises about 8 percent of the geographical area of the district. Rivers/streams comprise about 70 percent of wetland extent of the district that accounts for 8084 ha. The other major wetland types are ox-bow lakes/cut-off meanders (1264 ha), natural waterlogged areas (1217 ha), riverine wetlands (509 ha) and lakes/ponds (416 ha).

Data Collection and Analysis: The floodplain wetlands, oxbow lakes and waterlogged areas are the natural water resources that consist of biodiversity in the form of amphibians, aquatic plants as well as aquatic animals, including fishes. The wetlands are suitable grounds for the breeding and culture of indigenous

Fig. 2. Fishing at Dainee maun (Wetland), Khagaria

freshwater fishes and will be a revenue-generating resource from wetlands, if managed properly. We have surveyed wetlands of Khagaria (Figure 2), namely Dainee maun (25°32’52"N 86°17’49"E), Sindhiyahi Wetland (25°35’54"N 86°47’14"E), Khelwa Wetland (25°39’58"N 86°24’02"E), Kasraiya Wetland (Ferah Gadhiya) (25°32’07"N 86°39’56"E), Baraiya Wetland (25°33’14"N 86°20’44"E), and Maira Wetland (25°28’12"N 86°43’32"E) based on structured questionnaire for understanding the fish population and production pattern. Experiment was conducted in Alauli wetland for revival of *H. fossilis* under guidance of department of fisheries According to reports from fish farmers of Khagaria wetland, there has been a significant decline in *H. fossilis* populations over the past decade. During the period from June 2021 to May 2022, a comprehensive study was conducted utilizing a total of 312 specimens collected from various wetlands across Khagaria districts through seasonal sampling. Throughout the study period, the total length (TL) of the specimens ranged from 7.94 cm to 28.36 cm, while their body weight varied between 1.57 g and 126.7 g. This wide range in size and weight reflects the diversity within the population and provides valuable insights into the species’ growth patterns and distribution across different habitats. It’s crucial for the Department of Fisheries, along with scientific experts and local fish farmers, to collaborate on implementing effective management strategies and raising awareness to ensure the sustainability of *H. fossilis* within the wetland ecosystem.

Results and Discussion

Declining Fish Populations of H. fossilis: The study on farmer perceptions and experimental fishing reveals a significant decline in *H. fossilis* populations, with farmers observing a decrease in abundance and species diversity over the years. Farmers attributed this decline to factors such as water quality degradation from agricultural runoff, overfishing, climate change, habitat loss, and the spread of invasive species. Experimental fishing confirmed these observations, showing a 42% reduction in *H. fossilis* abundance, a 35% decline in species diversity, and shifts in species composition, with resilient species like *Channa sp.* The decline in *H. fossilis* populations is driven by several interconnected factors. The declining population of *H. fossilis* fish in their natural habitat can be attributed to various factors, as supported by scientific research[2-8]. Habitat loss and degradation, primarily caused by rapid urbanization, industrialization, and agricultural expansion, significantly impact these fish species. As rivers, streams, and wetlands are fragmented, polluted, and altered, *H. fossilis* loses vital breeding and feeding grounds. Pollution from industrial effluents, agricultural runoff, and domestic waste further exacerbates this issue by contaminating freshwater ecosystems. Elevated levels of harmful substances like heavy metals and pesticides disrupt water quality, impair reproductive cycles, and cause physiological stress, all contributing to reduced survival rates[9]. Additionally, overexploitation through unsustainable fishing practices poses a major threat to *H. fossilis* populations, as the species is heavily targeted for its meat, often through indiscriminate methods like dynamite and electrofishing. Invasive species, such as the African catfish, compete for resources and habitat, displacing *H. fossilis* and reducing its reproductive success. Climate change also plays a significant role, altering water temperature, precipitation patterns, and hydrological regimes, which disrupt the fish’s spawning behavior, larval development, and prey availability. Compounding these issues is the lack of effective conservation initiatives and the failure to implement fishing regulations, which further hinder efforts to protect *H. fossilis*. Finally, limited knowledge about its reproductive biology and breeding behavior makes it difficult to develop effective breeding and conservation strategies, exacerbating the decline of this species.

Revival of H. fossilis Fishery for Sustainable Livelihood: Conservation strategies integrated scientific research, habitat restoration, community engagement, and policy interventions to ensure the long-term survival of *H. fossilis* in its natural habitat. The variable size and weight of was recorded during study reflects the diversity within the population and provides valuable insights into the species’ growth patterns and distribution across different habitats. The abundance of fish, particularly in the month of June, played a significant role in commercial fishing activities in the wetlands of Khagaria. This observation signifies the importance of understanding seasonal variations in fish populations for effective fisheries management and conservation efforts. Among the fishes collected, 90 % were collected in June were found to be matured. This assessment was based on the examination of gonadal stages, indicating that the fish population was largely comprised of individuals capable of reproduction during this crucial period. The comprehensive flow chart of study is given below (Fig. 3)

One notable study by Bala and Ayyappan reported a successful breeding attempt of *H. fossilis* in a controlled aquaculture environment [10]. This research contributed valuable insights into the reproductive biology of *H. fossilis* and provided a foundation for further breeding and conservation efforts (Fig. 4). Breeding and conservation of *H. fossilis* present several challenges, primarily due to

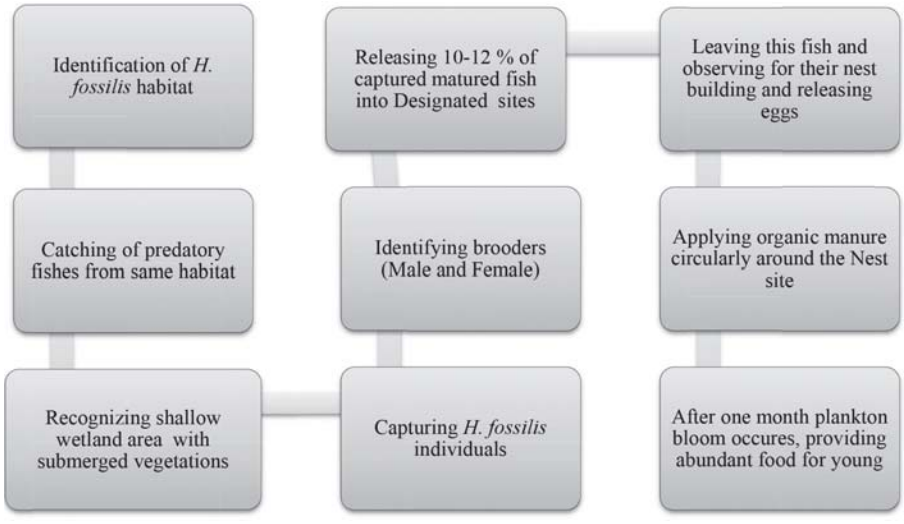

Fig. 3. Systematic flow chart for sustainable fisheries enhancement and conservation of *Heteropneustes fossilis* in wetlands

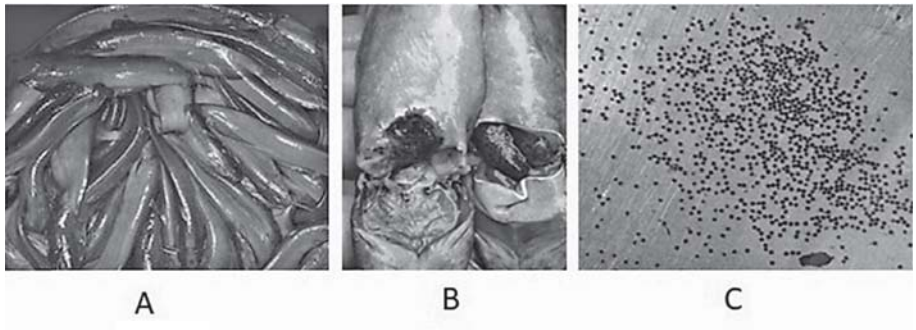

Fig. 4. A) Captured mature *H. fossilis* from wetlands of Khagaria with mature egg intact, B) Dissection of fish showing mature ovary C) Ripped egg of *H. fossilis*

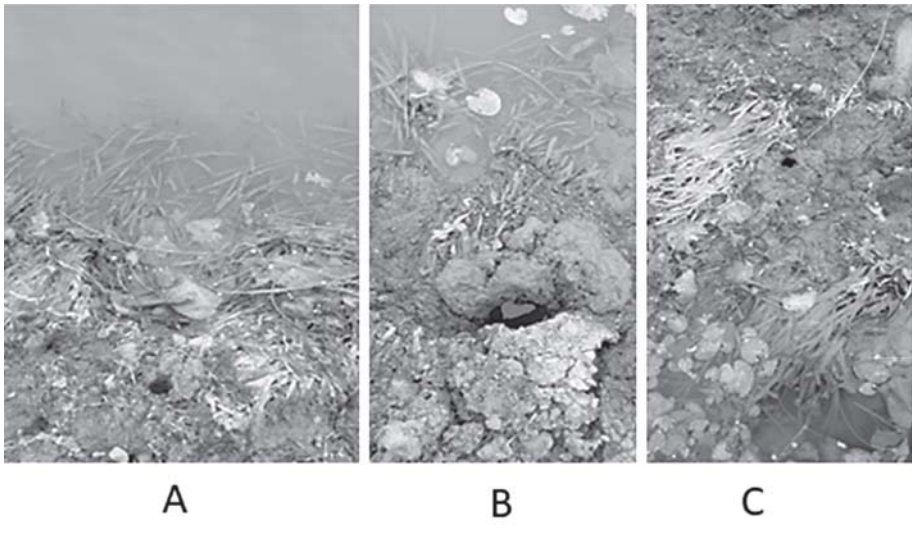

Fig. 5. The different size of circular whole adjacent to the inundated wetland site with submerged macrophytes as nesting site of *H. fossilis*, Alauli wetland

habitat degradation, overexploitation, and limited understanding of its reproductive biology. In addressing these issues collaborative efforts have been taken among government agencies, researchers, and local communities.

The nest-building behaviour of *H. fossilis* typically involves the male fish selecting a suitable location within its habitat, often near submerged vegetation or other structures. Using its mouth, the male creates a depression or pit in the substrate, often in a circular shape (Fig. 5). Once the pit is formed, the male fish begins to gather small debris, such as pieces of plant matter or substrate, and arranges them in and around the pit to construct a nest. This process can involve meticulous arranging and rearranging of materials to create a suitable environment for egg deposition. Once the nest is completed, the male fish will entice a female to deposit her eggs within it through various courtship displays and behaviours. The male than guards the nest and the eggs until they hatch, providing protection and ensuring the survival of the offspring.

Conclusion

In conclusion, the findings from both farmer perceptions and experimental fishing clearly highlight a concerning decline in fish populations, primarily driven by environmental degradation, overfishing, climate change, and habitat loss. The observations made by farmers, which align with experimental data, show reduced fish abundance, species diversity, and an increase in the prevalence of smaller fish, indicating that current practices are unsustainable. To address these issues, it is crucial to implement effective conservation measures, including sustainable fishing practices, improved water quality management, and habitat restoration. A collaborative approach involving government

agencies, conservation organizations, local communities, and fisheries experts is executing strategies that ensure the long-term fish populations. Successful initiatives, such as those in the wetlands of Khagaria, demonstrate the potential for positive outcomes through cooperative efforts and strict regulation. These findings stress the need for scientific research, better aquaculture practices, and strong conservation efforts to protect fish populations in the region.

Acknowledgements

The authors thank the Director of ICAR-CIFRI, Bararckpore, for providing the necessary facilities. We are thankful to Staff members of the Fisheries Department of Khagaria district, who contributed to the sampling for the study. Author would like to Acknowledge Vaisakh Gopinathan for helping in map. We thank the reviewers for their valuable comments. ❐

References

1. S. Biswas, and K. Chandra, *Journal of Threatened Taxa*, **12**(4): 15597-15601(2020).
2. S. Sarkar, U. K. Sarkar, S. Ali, S. Kumari, and M. Puthiyotti, *Lakes & Reservoir*. **26**: 76-91 (2021). https://doi.org/10.1111/lre.12353
3. U. K. Sarkar, P. Mishal, S. Borah, G. Karnatak, G. Chandra, S. Kumari, D. K. Meena, D. Debnath, S. Yengkokpam, P. Das, P. DebRoy, A. K. Yadav, Md Aftabuddin, P. Gogoi, A. Pandit, B. K. Bhattacharjya, T. Tayung, L. Lianthuamluaia, B. K. Das, *Reviews in Fisheries Science & Aquaculture*. **29**(1): 1-32 (2020) https:// doi.org/10.1080/23308249.2020.1779650.
4. R. K. Manna, S. Kumari, L. Lianthuamluaia, P. Majhi and B. K. Das, *Adv Agri Tech Plant Sciences* 7(2): 180149 (2024).
5. S. Gupta, P. Kumar and R. K. Srivastava, *International Journal of Fisheries and Aquatic Studies*, ***6***(4): 191-196 (2018).
6. A. Kumar, S. Sharma, and M. Gopi, *Journal of Environmental Biology*, **40**(5): 1059-1064 (2019).
7. A. Dutta, S. K. Singh and D. Roy, *Journal of Aquatic Sciences*, **7**(2): 65-70 (2019).
8. S. Sarkar, B. Das and S. K. Basak, *Journal of Biodiversity Management & Forestry*, **10***(*1): 1-5 (2021).
9. A. Pandit, A. Sharma, and S. Gupta, *Journal of Aquatic Science*, **23**(2), 45-56 (2019).
10. B. Bala and S. Ayyappan, *Asian Fisheries Science*, **14**(1): 1-14 (2001).