Journal of Scientific Enquiry
Research Article
Vol: 2(2), Pages: 73-82

Studies on Biodiversity and Resource Potential of Small Indigenous Freshwater Fish Species of Purulia District, West Bengal, India.

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Received: 05.10.2022; Accepted: 26.11.2022; Published Online: 31.12.2022

ABSTRACT:

Small Indigenous Freshwater Fish Species (SIFFs) have long been recognised as the cheapest source of protein, essential fatty acids, vitamins, minerals, and micronutrients and as a readily available source of essential nutrition. The significance of this fish species as a natural resource depends on its multifunctional roles, particularly in food security, livelihood, ornamental value, and as a mosquito biocontrol agent, which are also applicable for the rural and tribal communities of District Purulia, West Bengal. A total of 40 Small indigenous freshwater fish species (SIFFs) belonging to 14 families and 7 orders were recorded during the survey period. The most dominant family was Cyprinidae, comprising 14 species. *Puntius* was the largest genus, including four species. Among all the specimens collected, the family Cyprinidae shows the species diversity at its peak, followed by Badidae, Schilbeidae, Ambassidae, Channidae, Anabantidae, etc. The most abundant SIFFs were *Puntius chola, Amblypharyngodon mola*, and *Ailia coila* during the investigation period, whereas the least abundant SIFFs was *Xenentodon cancila*.

The purpose of the current study was to find the diversity and richness of the small indigenous freshwater fish species that are found in the Purulia district of West Bengal, India.

KEYWORDS:

Small Indigenous Freshwater Fish Species (SIFFs), Species diversity, Resource potential, Purulia.

1. INTRODUCTION:

Small Indigenous Freshwater Fish Species (SIFFs) are fish species that reach a maximum length of 25 to 30 cm (9 inches) during their life span [1-4]. Information on the exploitation pattern is crucial for determining the value of SIS as a natural resource because of the multifunctional roles they play, in terms of livelihood, food security, and biological control [5-9]. The SIFFs are significant as they contain vital nutrients like high-quality proteins, fatty acids, trace elements, vitamins, minerals, and essential fatty acids omega-3 and omega-6 are Polyunsaturated Fatty Acids (PUFAs) [10-13]. The majority of the population of West Bengal, particularly in Purulia, is not vegetarian, with a particular preference for fish. The majority of the essential elements for human nutrition are present in the SIFFs, which are consumed whole along with bone, head, and eyes. Zinc, iron, iodine, selenium, copper, magnesium, chromium, and cobalt are some of the trace elements found in SIFFs. In addition to these microminerals, they are rich in macrominerals, including phosphorus and calcium. Vitamins B1, B2, and B3 are very abundant in the SIFFs, along with vitamins A, D, and E [14,15]. It is well recognised that the SIFFs is a highly effective mosquito biocontrol agent. SIFFs are sold in the local market, particularly by rural women and kids [5,12]. In addition to being crucial for food security, SIFFs is a key resource in the ornamental fish industry and is linked to livelihood. In the market for ornamental fish, SIFFs are highly sought-after [16].

It is widely known that fish serve as "ecological indicators" for evaluating the ecological health of any aquatic habitat [17]. A number of factors, such as water temperature, habitat type, food availability, predator abundance, ecological barriers, and more, affect how species are distributed in aquatic habitats [18]. The small indigenous freshwater fish species (SIFFs) are exploited in India, Bangladesh, and other Asian countries as catch fisheries. [19]. Fish meal is a staple diet for the inhabitants of West Bengal. Consequently, it puts more strain on freshwater bodies. Lack of knowledge regarding the species diversity of the SIFFs may make it difficult to formulate the necessary policies for the sustainable exploitation of these priceless natural resources [12].

The senior people living in the area claim that small native freshwater fish species are quickly going extinct from the natural stock, although there is no prior information regarding the SIFFs availability [20]. People need to be made aware of the importance of little fish since it is simply due to the farmers' and people's ignorance [21]. The widespread use of pesticides and medications in agricultural fields leads to

 DOI: https://doi.org/10.54280/jse.222205

bioaccumulation and biomagnification of pollutants, which has led to a considerable reduction in fish biodiversity in any aquatic system. Excessive fishing, pesticides, agricultural runoff, and other types of pollution should be limited to preserve the biodiversity of freshwater fish [22]. It is possible to come to the conclusion that creating a regional database about SIFFs and implementing it through the government and various non-governmental organisations will be the essential tools for conserving the biodiversity of freshwater fish [23]. The implementation of flood control by means of drainage, irrigation projects, along with the establishment of hydroelectric power, is going on. As a result, Small Indigenous Freshwater Fish Species (SIFFs) lost their natural habitat and spawning grounds [24]. Concern should be expressed over the loss of SIFFs. In the Purulia district, very few studies on the diversity of ichthyofauna have been conducted. There is a knowledge gap regarding the diversity of small indigenous freshwater fish species. Along with the establishment of current information on the diversity of small indigenous freshwater fish species and the creation of a sustainable conservation strategy.

2. MATERIALS AND METHODS:

Study area: In the western edge of West Bengal, at 23° 20' 32.1252" N and 86° 21' 46.2204" E, is the Purulia district. The "Chhota Nagpur Plateau" in eastern India is linked to this region's undulating terrain, which is usually covered with dense forest. The Kangsabati, Kumari, Dwarkeshwar, Damodhar, Shilabati, Bandu, Patlui, Arkasha, Tatko, Dangra, and Sahar jor rivers, along with its tributaries and feeder canals, all pass through this region. Several water reservoirs are also found in this territory in addition to that [16].

With an average annual rainfall of 1200 mm, the climate is tropical and sub-humid. Monsoon rain is the only source of water for the rivers, seasonal streams, reservoirs, natural ponds, lakes, beels, lowland areas, and wetlands of the region [22]. These bodies of water are serving as breeding grounds and naturally rich sources of Small Indigenous Freshwater Fish Species (SIFFs). Under a suitable environment, these fish may multiply and grow quickly. They can also survive in extreme climatic conditions (Fig. 1) [25].

Markets from ten blocks (Hura, Purulia-I, Purulia-II, Puncha, Manbazar-I, Jhalda-I, Baghmundi, Joypur, Nituria, Kashipur) and two municipality areas (Purulia Municipality and Raghunathpur Municipality), as well as some catch points under Purulia District, were selected to collect fish samples and related data for the present investigation from March 2021 to February 2022. The primary data was collected from the local fishermen, fish sellers and other relative important ecological information was collected from the resident adjacent to the selected study sites [20,26].

The secondary data came from the relevant government agencies, authorities, and academic journals [27]. In order to assure diversification and species richness, fish samples for this investigation were taken from various sources of fish (SIFFs) sellers and mixed at random as well [28]. With the assistance of fish farmers from the study area, many traditional fishing techniques, including Ghuṇi, Palui, Dughare, Baṛaśi, Cāp Jāl, Drag net, Ghuṇ Jāl, Chip, Ṭōgi, Jaṭā, etc. were utilised to collect specimens (Fig. 8) [28].

Fish samples were photographed immediately so that correct documentation could be made [22,28]. For future identification, the specimens were preserved in 4-6% formalin. The fish samples were divided into groups according to species in the lab using the appropriate keys and online resources [29,30].

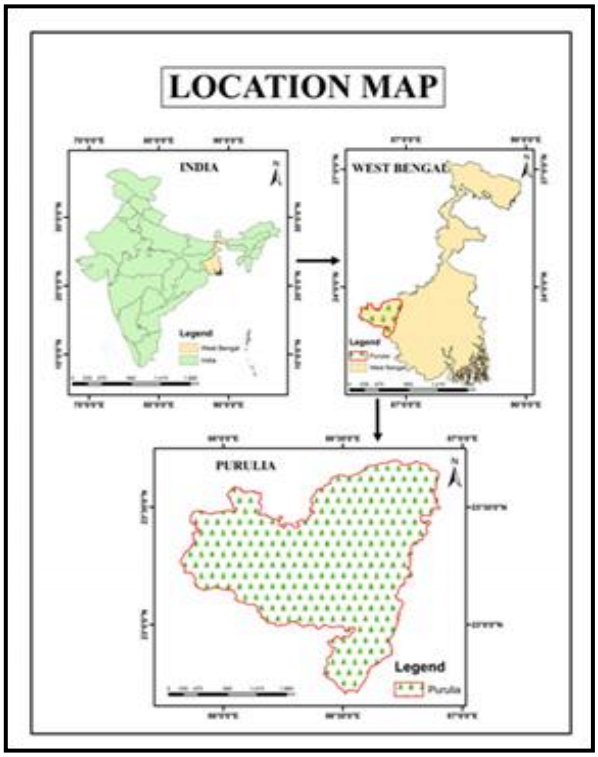

Fig. 1. Location map of the study area.

Analysis method:

The Microsoft Office Excel software was used to represent the data graphically and conduct the statistical analysis.

Fish species:

Statistical analysis and diversity index of fish congregation was done by using the following formulas**:**

Relative Abundance (RA): The relative abundance (percentage of catch) of fish from each site was calculated by employing the following formula:

$$RA = \frac{\text{Number of samples of particular species} \times 100}{\text{Total number of samples}}$$

Species Richness: Species richness is calculated by the number of species observed in a sample. According to the Menhinick's diversity index [49].

$$D = \frac{s}{\sqrt{N}}$$

Where,

s = the number of different species represented in your sample and

N =the total number of individual organisms in your sample.

Shannon-wiener index (H'): This is a common method used for calculating biotic diversity in any ecosystems and is indicate as SWI, Shannon-wiener [50]

$$H = \sum_{i=}^{n} \left(\frac{ni}{N}\right) log2 \left(\frac{ni}{N}\right)$$

Where H'= Shannon-wiener index of diversity,

n_i = Total number of individuals species and

N= Total number of individual of all species.

Evenness index (J): This is relative distribution of individuals among taxonomic groups within a community and is expressed as Pielou's evenness (J) – [51]

$$J = \frac{H'}{\log S}$$

Where, H'=SWI, and log S=Natural log of the sum of species (S defined as species richness) recorded. It is used to measure the degree to which the abundances among the groups represented in a sample or community are equal.

Simpson's dominance index (D): Simpson's Index (D) is calculated using the following equation- [52]

$$D = \frac{\sum ni\ (ni - 1)}{N\ (N - 1)}$$

Where, n = the summation of organisms of a particular species and

N = the summation of organisms of all species

3. RESULT AND DISCUSSION:

In the present study, 40 Small Indigenous Freshwater Fish Species (SIFFs) belonging to 7 orders, and 14 families were identified (Table 1). The dominant order, with 16 species, was Cyprinoiformes. The most SIFFs belonged to the family Cyprinidae. With four species, Puntius was the dominating genus. With 15 SIFFs, the order Perciformes ranks second in terms of SIFFs at Purulia. Every one of the three orders—Beloniformes, Clupeiformes, and Cyprinodontiformes- only one species was discovered (Fig. 2,5,6).

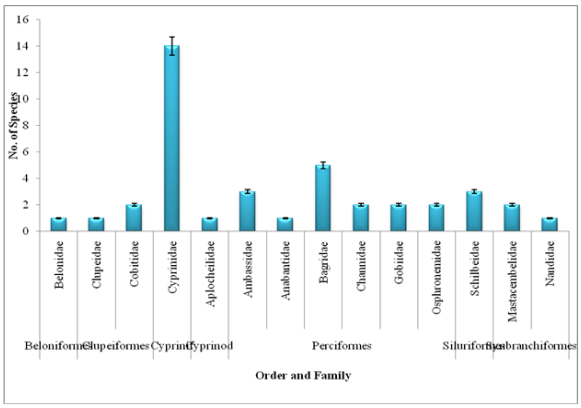

Fig.2. Relative Abundance (RA) of fish species habit in different water bodies of Purulia district during the research process.

The Shannon-wiener index (H') within the 12 sites of the SIFFs is 2.61; Evenness index (J) is 0.35; Simpson's dominance index (D) is 0.09; Simpson's diversity index (1-D) is 0.91 (Table 2).

The catch of SIFFs varied seasonally over the study period, with the biggest catch occurring in August–September and the lowest in March. When rivers, floodplains, beels, ponds, and ditches are filled with water during the rainy season, the amount of SIFFs increases. Following the post-monsoon season, SIFFs availability begins to decline. It is simple to collect SIFFs during the winter as the water area decreases (Fig. 3).

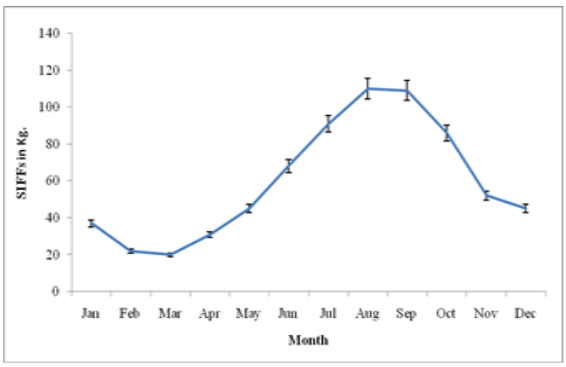

Fig.3. The catch of SIFFs varied seasonally over the study period

The highest available SIFFs during the experimental period in terms of their amount and seasonal abundance were *Puntius chola, Amblypharyngodon mola*, and *Ailia coila*. The lowest abundances were identified in the least number of *Xenentodon cancila, Dario dario*. SIFFs abundance showed seasonal variations during the period of the study. Throughout the year, there were plenty of *Amblypharyngodon mola, Pethia ticto, Puntius sophore, Mystus bleekeri, Lepidocephalichthys guntea* were found. In the post-monsoon and winter season, when the water area began to dry up *Pethia conchonius*, *Gudusia chapra, Rasbora rasbora, Chanda nama, Parambassis lala, Anabas testudineus, Ailia coila* etc. they are most plentiful. Throughout the monsoon season, the remaining species were accessible (Table. 1), (Fig. 7).

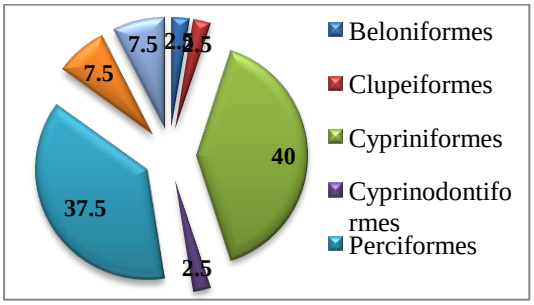

Fig. 4. Availability of the fish community by order (%) from Purulia district during the study period.

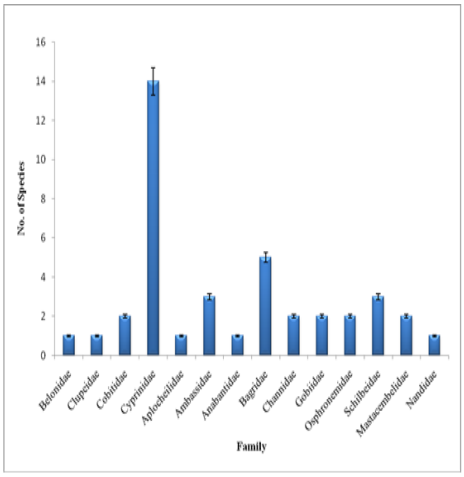

Fig.5. Fish species' (family) availability in different water bodies of Purulia district during the study period

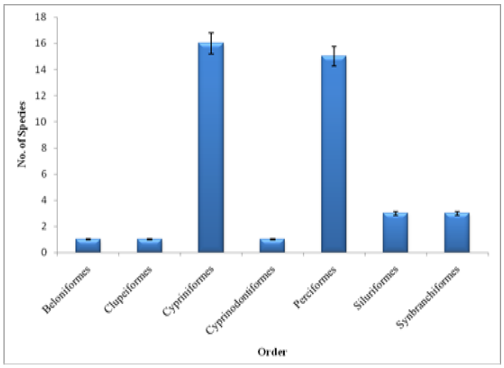

Fig.6. Fish species' (Order) availability in different water bodies of Purulia district during the study period.

Order	Family	Scientific Name	Local Name	Seasonal Abundance
Beloniformes	Belonidae	1. *Xenentodon cancila* (Hamilton, 1822)	Kakila	Monsoon
Clupeiformes	Clupeidae	2. *Gudusia chapra* (Hamilton, 1822)	Khaira	Post-Monsoon
Cypriniformes	Cobitidae	3. *Acanthocobitis botia*	Geto	Post-

		(Hamilton, 1822)		Monsoon
		4. *Lepidocephalichthys guntea* (Hamilton, 1822)	Guntea	All season
	Cyprinidae	5. *Amblypharyngodon mola* (Hamilton, 1822)	Mourala	All season
		6. *Aspidoparia jaya* (Hamilton, 1822)	Chua	Post-Monsoon
		7. *Aspidoparia morar* (Hamilton, 1822)	Chira	Winter
		8. *Danio rerio* (Hamilton, 1822)	Uli	Monsoon
		9. *Esomus danrica* (Hamilton, 1822)	Darke	Monsoon
		10. *Osteobrama cotio* (Heckel, 1843)	Dhela/Nanda	Monsoon
		11. *Pethia conchonius* (Hamilton, 1822)	Punti	Winter
		12. *Pethia ticto* (Hamilton, 1822)	Tit Punti	All season
		13. *Puntius chola* (Hamilton, 1822)	Punti	Post-Monsoon
		14. *Puntius sarana* (Hamilton, 1822)	Sar puti	Post-Monsoon
		15. *Puntius sophore* (Hamilton, 1822)	Bara Punti	All season
		16. *Puntius terio* (Hamilton, 1822)	Punti	Monsoon
		17. *Rasbora rasbora* (Hamilton, 1822)	Darke	Post-Monsoon
		18. *Securicula gora* (Hamilton, 1822)	Chua	Monsoon
Cyprinodontiformes	Aplocheilidae	19. *Aplocheilus panchax* (Hamilton, 1822)	Techokha	Monsoon
Perciformes	Ambassidae	20. *Chanda nama* (Hamilton, 1822)	Chandkora	Post-Monsoon
		21. *Parambassis ranga* (Hamilton, 1822)	Chandkora	Post-Monsoon
		22. *Parambassis lala* (Hamilton, 1822)	Lal Chandkora	Post-Monsoon
	Anabantidae	23. *Anabas testudineus* (Bloch, 1792)	Koi	Winter
Perciformes	Bagridae	24. *Badis badis* (Hamilton, 1822)	Kalo punti	Monsoon
		25. *Dario dario* (Hamilton, 1822)	Lal Punti	Post-Monsoon
		26. *Mystus bleekeri* (Day, 1877)	Tangra	All season
		27. *Mystus cavasius* (Hamilton, 1822)	Pat Tangra	All season
		28. *Mystus vittatus* (Bloch, 1794)	Sona Tangra	All season
	Channidae	29. *Channa gachua* (Hamilton, 1822)	Shishir Cheng	Winter
		30. *Channa punctata* (Bloch, 1793)	Letha	Winter
	Gobiidae	31. *Brachygobius nunus* (Hamilton, 1822)	Bhelso	Monsoon
		32. *Glossogobius giuris*	Bele	Monsoon

		(Hamilton, 1822)		
	Osphronemidae	33. *Trichogaster fasciata* (Bloch & Schneider, 1801)	Kholse	Winter
		34. *Trichogaster lalius* (Hamilton, 1822)	Kholse	Winter
Siluriformes	Schilbeidae	35. *Ailia coila* (Hamilton, 1822)	Banspata	Winter
		36. *Eutropiichthys vacha* (Hamilton, 1822)	Bacha	Monsoon
		37. *Silonia silondia* (Hamilton, 1822)	Vacha	Monsoon
Synbranchiformes	Mastacembelidae	38. *Macrognathus guentheri* (Day, 1865)	Penkal	Monsoon
		39. *Macrognathus pancalus* (Hamilton, 1822)	Penkal	Monsoon
	Nandidae	40. *Nandus nandus* (Hamilton, 1822)	Nados	Winter

Table 1: Fish species, their local name, and the seasonal abundance of Purulia district while conducting the study.

Species Richness (D)	Shannon-wiener index (H')	Evenness index (J)	Simpson's dominance index (D)	Simpson's diversity index (1-D)
0.61	2.61	0.35	0.09	**0.91**

Table 2. Diversity index of fish assemblages of Purulia district during the study period

Fig.7. Pictorial presentation of some SIFFs of Purulia (*Trichogaster lalius, Trichogaster fasciata, Puntius ticto, Channa punctata, Puntius sophore, Lepidocephalichthys guntea, Parambassis* sp, *Dario dario, Rasbora rasbora, Glossogobius giuris, Parambassis sp, Macrognathus guentheri*)

Fig.8. Pictorial presentation of some indegenous fishing gear used for catching SIFFs in Purulia (Ghuṇi ara, Cāp Jāl, Ghuṇ Jāl, Maya jal, Ghuṇ Jāl, Palui, Ghuṇi

Ecological resilience refers to an ecosystem's capacity to bounce back from shocks and surprises and carry on functioning and providing ecological benefits [31-35]. Typically, only a few species play a significant part in ecosystem activities. More species provide a balancing or buffering role when the ecosystem is stressed or disturbed. Many ecologists contend that biodiversity conservation encourages ecological resilience [36-39].

Water, lands, and other natural resources are all continuously deteriorating on a worldwide scale. At the local level, the situation is the same. SIFFs are threatened by pollution, habitat degradation, water extraction, habitat fragmentation, disease, and the introduction of exotic species. Small fish populations are reduced by the inappropriate use of pesticides in agricultural fields, runoff from agricultural and urban areas [40-42]. Recent dam construction, water diversion, drainage, and irrigation projects have significantly reduced floods, but at the expense of natural habitat and spawning grounds for small indigenous fish. Overfishing, chemicals, and other forms of pollution are the most important factors that should be restricted for the conservation of fish biodiversity [43].

In addition, indigenous peoples often have a broad understanding of how complex natural systems behave in their own communities. This information has been built up over a lengthy period of observations that have been passed down from generation to generation. Indigenous peoples have traditionally relied on their local ecosystems to provide a variety of resources [44-46] In fact, maintaining the health of aquatic ecosystems and caring for and conserving aquatic bio-resources require an ecologically sustainable method, often known as an "integrated ecosystem approach." In fact, using sustainable agriculture methods should provide food security.

The survey gave a general overview of the exceptional richness and diversity of SIFFs in Purulia, West Bengal. There may be some unique species in other areas that were not studied because the data was only collected from carefully chosen places. More species may be discovered through comprehensive sampling carried out year-round in every potential catchment region. The creation of a zone-by-zone database of this information, as well as its implementation by government and non-governmental organizations, would be critical tools for freshwater fish biodiversity conservation [47,48].

Another significant environmental concern facing the world today is the conservation of fish biodiversity, which will remain in danger unless strong governmental measures are taken to reduce anthropogenic activities. The conservation of fish biodiversity in freshwater bodies is a significant environmental concern. A few significant management strategies for preserving fish biodiversity should be incorporated into government fishery regulations.

4.CONCLUSION:

In order to sustainably conserve the ecological, dietary, and economical balance, the SIFFs must be protected in their natural habitat. Using sustainable aquaculture methods should provide food security. Small Indigenous Freshwater Fish Species conservation can be significantly assisted by campaigning, public awareness, and nutrition education. Sustainable, low-cost methods for the management, conservation, production, and accessibility of small fish are needed. In addition to prioritization, advancing cultural technology, expanding the market, and creating policies and support systems are the main areas where planning and research should concentrate. Fish biodiversity conservation will remain threatened unless strong government measures to reduce human activity are implemented. The formulation of successful conservation measures for SIFFs should involve input from government officials, policymakers, scientists, and farmers. Future research should focus on an integrated ecosystem approach and the adoption of in-situ and ex-situ conservation measures, such as aquaculture, live gene banking, tissue banking, valuation, evaluation, and registration of genetic resources, monitoring crucial parameters, and ranching as a replacement for natural stocks.

FUTURE SCOPE:

The current inspection will support the conservation of biodiversity and effective management methods for Small Indigenous Freshwater Fish Species (SIFFs) of the Purulia District.

ACKNOWLEDGEMENTS:

The author would like to thank the local people, fishermen and fish sellers for data collection during the research period.

CONFLICT OF INTEREST:

The author declares that there are no conflicts of interest.

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