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Small Indigenous Fish species diversity, conservation and their importance in Koshi Province, Nepal

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Abstract

Small Indigenous Fish Species (SIS) on the smaller side play a crucial role in aquatic ecosystems, offering valuable nutrients such as Omega-3 fatty acids, Vitamin A, and critical elements like Calcium, Phosphorus, and Iron that sustain human life. Unfortunately, their habitats are being destroyed by climate change and human activities, which possess a significant threat to SIS. In Koshi Province , Nepal, a two-year survey of SIS recorded 114 species belonging to 8 orders and 25 families.This paper focuses on the diversity, ecosystem services, economic importance,s status and aesthetic values of SIS.

Keywords: *Aesthetic value ,Climate change,Conservation , Nutrient value, SIS.*

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Introduction

Fish are cold-blooded vertebrates that inhabit freshwater and marine water. However, Nepal being a landlocked country, only freshwater fish species can exist there. Small indigenous fish species which are available in freshwater serve as an important role in the ecosystem by consuming micro-organisms, acting as a food source for the secondary consumers in the tropic level, and food web also indicating pollution levels. Additionally, they are rich sources of essential vitamins, minerals, fatty acids and chemicals with medicinal properties. Nevertheless, there is limited literature available on SIS indicating their status in the face of climate change, their conservation, and their role in important fish species conservation by means of polyculture.

Numerous studies have been conducted on the nutritional and therapeutic values of small indigenous fish species (Roos et ai.2003,Njinkoue et al. 2005, Mazumder et al.2008, and Sujatha et al. 2013). Similarly, Mahanty (2014)has documenteds the use of fish as a source of protein in animal and human diets. However, the identification of important small indigenous fish species based on their chemical compounds is still crucial. Reports on the culture and production of a few SIS are available in works by Felts et al. (1996), Mazumder and Lorezen (1999), , Kohinoor (2000), Wahab et al. (2011), and Nandi et al. (2012), which inspire the culture of small indigenous fish species in fresh waters.

However, the government authorities and non-government organizations in Nepal have given little attention to important issues related to small indigenous fish species, such as habitat protection, aesthetic value, ecosystem services, and market management schemes and SIS culture. Roos et al .(999) have used SIS In the field. local (folk) expertise was used to identify SIS by local namess . Samples of mature fish were measured to confirm a maximum length of 25cm. During the visits to the water sources, the condition of the water, fishing pressure, use of non-traditional fishing methods, and reasons for habitat loss, anthropogenic activities, and impacts of climate change were observed and noted. Direct contact with several regular fish

consumers was made and they were asked about the uses of SIS in traditional medicine, and their present status.

Materials and Methods

In Koshi Province Nepal, a variety of water sources, including rivers, streams, natural and manmade ponds, reservoirs, marshy lands, swamps, canals, pools, and ditches were chosen to collect indigenous fish species. Local fishing methods, such as small mesh cast nets, scoop nets, and bamboo basket traps, were utilized to catch the fish. Over two years, regular visits were made to local fish markets to (SIS) after being cleaned and photographed, the fish were taken to the ichthyological lab at the Department of Zoology, Degree Campus, Biratnagar for identification and preservation. Collected fish were identified with the help of standard literature (Talwar and Jhingran 1991; Jayaram 2010 ; Shrestha 2019) and other available literature. Samples of mature fish were measured to confirm a maximum length of 25cm. During the visits to the water sources, the condition of the water, fishing pressure, use of non-traditional fishing methods, and reasons for habitat loss, anthropogenic activities, and impacts of climate change were observed and noted. Direct contact with several regular fish consumers was made and they were interrogated several things about the uses of SIS, and present status of SIS.

Results and Discussion

During a survey conducted in Koshi Province, Nepal, researchers recorded a total of 114 small indigenous fish species (SIS) with a maximum length of 25cm. These species were classified into 8 orders and 25 families. The Cyprinidae family was found to be the most diverse with 40 species, followed by the Sisoridae and Sisuridae families with 17 and 16 species, respectively. In the fourth and fifth positions families Ambassidae and Bagaridae stand with five and four representatives (Table1}.The researchers estimated that the population of SIS in natural habitats is greater than that of larger fish species. As primary and secondary consumers in the trophic levels, SIS play an important role in balancing the aquatic ecosystem. They also serve as biological pollution indicators, which is valuable information for conservationists and naturalists. There are several larvivorous small indigenous fish species such as *Brilius. Rasbora, Esomus, Puntius, Danio, Chela, Aplocheilus Colisa, Anabus, Badis, Glosogobius* etc. which play a crucial role in controlling mosquitoes (vectors of malaria, filaria, dengue etc.) population feeding on their larvae. This is one of the crucial services of SIS to human existence.

Map of Koshi Province, Nepal

Table 1.

Order	Family	Species	Local Name
Clupeiformes	Clupeidae	1. *Gudusia chapra* (Hamilton- Buchanan)	Suiya
		2. *Gudusia variegata*(Day)	Suiya
	Engraulidae	3. *Setipinna phasa* (Hamilton- Buchanan)	Phasi
Cypriniformes	Cyprinidae	4. *Cirrhinus reba* (Hamilton- Buchanan)	Chaguni
		5. *Labeo bata* (Hamilton- Buchanan)	Rohu, bata
		6. *Labeo boga* (Hamilton- Buchanan)	Mrigal
		7. *Labeo caeruleus* (Day)	Gardi
		8. Osteobrama cotio (Hamilton- Buchanan)	Boga Tikauli
		9. Osteobrama neilli (Day)	Sidhre Pothiya
		10. *Puntius chola* (Hamilton- Buchanan)	Sidhre Pothiya
		11. *Puntius conchonius* (Hamilton- Buchanan)	Silver Barb
		12. *Puntius gonionotus* (Bleeker)	Bada Pothi
		13. *Puntius phutunio* (Hamilton- Buchanan)	Pate Sidhra
		14. *Puntius sophore* (Hamilton- Buchanan)	Pothi
		15. *Puntius terio* (Hamilton- Buchanan)	Tite Pothi
		16. *Puntius ticto* (Hamilton- Buchanan)	Deduwa
		17. *Chela labuca* (Hamilton- Buchanan)	Silver Razor
		18. *Salmostoma acinaces (Valenciennes)*	Galphulani
		19. *Salmostoma bacaila* (Hamilton- Buchanan)	Finescale
		20. Salmostoma phulo (Hamilton- Buchanan)	Mada
		21. *Amblyphryngodon microlepis* (Bleeker)	Mada
		22. *Amblyphryngodon mola* (Hamilton- Buchanan)	Karangi
		23. *Aspidoparia jaya* (Hamilton- Buchanan)	Faketa, chahela
		24. *Aspidoparia morar* (Hamilton- Buchanan)	Faketa
		25. Barilius barila (Hamilton- Buchanan)	Khasree chala
		26. *Barilius barna* (Hamilton- Buchanan)	Fakete
		27. *Barilius bendelisis* (Hamilton- Buchanan)	Lamfaketa
		28. *Barilius shacra* (Hamilton- Buchanan)	Chitharipothi
		29. *Barilius vagra* (Hamilton- Buchanan)	Bhitti
		30. *Brachydanio rerio* (Hamilton- Buchanan)	Dedhawa
		31. *Danio devario* (Hamilton- Buchanan)	Dedhawa
		32. Danio aequipinnatus (McClelland)	Dedhaura
		33.*Esomus danricus* (Hamilton- Buchanan)	Gogha
		34. *Parluciosoma daniconius* (Hamilton- Buchanan)	Thople bola
		35. *Raiamas bola* (Hamilton- Buchanan)	Buduna

Contd….

		36. *Raiamas guttatus* (Day)	Lahare Buduna
		37. *Crossocheilus latius latius* (Hamilton- Buchanan)	Dhumke buduna
		38. *Garra annandalei* (Hora)	Khurpe buduna
		39. *Garra gotyla* (Gray)	Buduna
		40. *Garra Mullya* (Sykes)	Gurda
		41. *Garra rupecula* (McClelland)	Gurda
		42. *Garra nasuta* (McClelland)	
		43. *Rasbora rasbora* (Hamilton Buchnon)	
	Psilorhynchidae	44. *Psilorhynchus balitora* (Hamilton- Buchanan)	Balotora Minow
		45. *Psilorhynchus pseudecheneis* (Menon & Datta)	Titae
		46. *Psilorhynchus sucatio* (Hamilton- Buchanan)	Titae
	Belitoridae	47. Balitora brucei (Gray)	Patherchata, stone loach
	Cobitidae	48. *Acanthocobatis botia* (Hamilton- Buchanan)	Pate Gadela,
		49. *Nemacheilus corica* (Hamilton- Buchanan)	Baghe
		50. *Schistura himachalensis* (Menon)	Raiga Dero
		51 .*Schistura horade* (Menon)	Gadela
		52. *Schistura scaturigina* (McClelland)	Suli Gadero
		53. *Schistura rupecula* (McClelland)	Bhotee Gadelo
		54 *Schistura savona* (Hamilton-Buchanan)	Lata, Gainche
		55. *Lepidocephalus guntea* (Hamilton- Buchanan)	Golpara Loach
		56. *Lepidocephalus menoni* (Pillai & Yazdani)	Pangia collie-loach
		57. Neoeucirrhichthys maydelli (Banarescu and Nalbant)	Goira
		58.Pangio pangio (Hamilton- Buchnan)	Latai
		59. *Somileptes gangota* (Hamilton- Buchanan)	Bothn
		60.*Botia almorhae* (Gray)	Loach
		61 .*Botia dario*(Hamilton- Buchanan)	
		62. *Botia geto* (Hamilton- Buchanan)	
		63 .*Botia lohachata* (Chaudhuri)	
		64. *Botia histrionica* (Blyth)	
Siluriformes	Bagridae	65. *Mystus bleekeri* (Day)	Baghi,Getu
		66. *Mystus cavaius* (Hamilton-Buchnan)	Tenger
		67*Mystus tengra* (Hamilton-Buchnan)	Tenger
		68. *Mystus vittatus* (Bloch)	Tenger
			Tenger Kanti
	Siluridae	69. *Ompok bimaculatus* (Bloch)	Papta Naini
		70. *Ompok pabda* (Hamilton- Buchanan)	Pabdah,catfish

Contd….

		71. *Ompok babo* (Hamilton.-Buchanan 1822)	bohari
	Schilbeldae	72. *Ailia coila* (Hamilton- Buchanan)	Patasi Jalkapoor Jalkapoor Goongwaree vacha Cherkibachawa
	Amblycipitidae	73. *Amblyceps mangois* (Hamilton- Buchanan) 74. *Amblyceps* Waikhomi (Darshan, Kachari, Dutta, Ganguly and Das 2016)	Bokshi macho Bokshi macho
	Sisoridae	75. *Gagata cenia* (Hamilton- Buchanan) 76. *Glyptothorax alaknandi* (Tilak) 77. *Glyptothorax annandalei* (Hora) 78. *Glyptothorax cavia* (Hamilton- Buchanan) 79. *Glyptothorax kashmirensis (Hora)* 80. *Glyptothorax pectinopterus* (Mc Clelland) 81. *Glyptothorax telchitta* (Hamilton- Buchanan) 82. *Glyptothorax trilineatus* (Blyth) 83. *Hara hara* (Hamilton- Buchanan) 84. *Hara jerdoni* (Day) 85. *Pseudolaguvia kapuri* (Tilak & Husain) 86. *Pseudolaguvia ribeiroi* (Hora) 87 Nangra assamensis (Sen and Biswas) 88. *Nangra nangra* (Hamilton- Buchman) 89. *Nangra viridescens* (Hamilton- Buchanan) 90. Pseudecheneis sulcatus (Mc Clelland) 91' *Sisor rhabdophorus* (Hamilton- Buchanan) 92. *Sisor rheophilus* (Ng)	Ganfak Kapre Kapre Vedro Capre Tel Capre Tel capre Tinkana Sylhet hara Bistuiya Nanagra Befuni Nanagra Kabre Katenga Kirkire
	Heteropneustidae	93. *Heteropnenustes fossillis* (Bloch)	Singhi
	Olyridae	94. *Olyra longicaudata* (MeClelland)	Himalayan olyra
	Chacidae	95. *Chaca chaca* (Hamilton- Buchanan)	Kurkuree
Beloniformes	Belonidae	96. *Xenentodon cancila* (Hamilton- Buchanan)	Kauwa
Cyprinodontiformes	Aplocheilidae	97. *Aplocheilus panchax* (Hamilton- Buchanan)	Tikuli
Symbranchiformes Perciformes	Mastacembelidae	98 *Macrognathus pancalus* (Hamilton- Buchanan)	Bami,Gainchi
	Ambassidae(Chandidae)	99. *Chanda nama* (Hamilton- Buchanan) 100. *Pseudombassis baculis* (Hamilton- Buchanan) 101. *Pseudombassis lala* (Hamilton- Buchanan)	Chanerbijuwa Chanari Chanerbijuwa

Contd….

	Sciaenidae	102. *Pseudombassis ranga* (Hamilton- Buchanan) 103 *Johnius coiter* (Hamilton- Buchanan)	Chanerbijuwa Bhola
	Nandidae	104. *Nandus nandus* (Hamilton- (2.25%) 105. *Badis badis* (Hamilton- Buchmam)	Dhoke Khesalei
	Gobiidae	106. *Glossogobius giuris* (Hamilton- Buchanan)	Bulle
	Anabantidae	107. *Anabas cobojius* (Hamilton- Buchanan) 108. *Anabas testudineus* (Bloch)	Kabai Kabai
	Belontiidae	109. *Colisa faciatus* (Bloch and Schneider) 110 *Colisa lalius* (Hamilton- Buchanan) 111 *Polycanthus sota* (Hamilton- Buchanan)	Kotari Lal Kotari Gourami
	Channidae	112 *Channa orientalis* (Bloch & Schneider) 113. *Channa punctatus* (Bloch)	Garahi Hile
Tetraodontiformes	Tetraodontidae	114. *Tetraodon cutcutia* (Hamilton- Buchanan)	Pokcha

The researchers documented various valuable services of SIS for humans and, nature conservation in situ.

SIS as an Ecosystem service provider

Fish farmers often overlook the crucial role that small indigenous species (SIS) play in maintaining aquatic ecosystem balance and increasing fish pond production. Proper management skills are necessary to regulate the population of both cultured fish and SIS in fish ponds. A strategy of polyculture, combining major carp with selected SIS, can lead to increased profits due to the high demand and market value of SIS. Relying solely on capture fisheries for small indigenous species (SIS) is not enough to meet the demand. Hence, SIS needs to be included in culture practices separately or in polyculture with suitable compatible major carp species for better production balancing the ecosystem of fish farms. Fishermen possess valuable knowledge about fish that they have gained since childhood, they should be encouraged to increase the production of SIS through cultural practices, which can help them overcome economic challenges, educate their children, and preserve local fish species and the environment. This will also ensure that their children grow up safely and healthily in ecologically balanced environment.

SIS roles in Aquaculture and conservation

It's clear that the habitats of aquatic organisms, including fish, have undergone significant changes due to human activities such as road construction, urbanization, industrialization, and the diversion of rivers for hydropower. Additionally, wetlands are being filled up for urban expansion and global climate change has resulted in rising temperatures. These factors pose serious threats to aquatic life, particularly inland aquatic life. Unfortunately, the rate at which organisms are disappearing from the planet is unknown. By looking at the visible population of terrestrial invertebrates and vertebrates, it's evident that many species have become rare or extinct. The same situation applies to SIS (small indigenous species). Frequent visits to local fish markets revealed that the SIS population is declining rapidly. Without SIS national conservation policy and fishers' maximum awareness activities the increasing threat to SIS existence is, not possible to be reversed. It is. therefore, the most crucial step towards the conservation must be a government policy for their habitats conservation and motivation programs for SIS culture for its conservation. A successful aquaculture requires effective management programs as SIS play a vital role in cleaning the aquatic environment, which is essential for aquaculture.

SIS Nutritional values

Based on a study of various reports on the proximate analysis of the chemical composition of selected small indigenous species (SIS), it is evident that fish are an excellent source of protein, unsaturated fatty acids such as Omega-3, essential elements like calcium, phosphorus, iron, and vitamin A, which are crucial for sustaining human life. As SIS can be cultured even in small water bodies like kitchen gardens, this technique should be

made available to people so that they can produce SIS in their own gardens to meet their daily needs and to overcome several nutritional deficiency diseases and to lead a healthy life. Despite their small size, SIS are an excellent source of almost all the nutrients necessary for human survival.

Aesthetic values of SIS

Small indigenous fish species (SIS) are highly convenient due to their compact size and compatibility with various environments. They are not only visually appealing as aquarium decorations, but also serve as fascinating subjects for research. Alien hybrid aquarium fish, in particular, exhibit striking color patterns that attract attention. By utilizing potential breeding techniques, even native fish species can be transformed into vibrant, multi-colored hybrids. Those with a genetic background or trained in fish genetics can successfully achieve this creative endeavor of breeding colorful freshwater aquarium fish. This aspect of work on SIS adds a new dimension to the value of SIS.s

Therapeutic value of SIS

For centuries, people have known about the ailments healing properties of fish, especially among certain ethnic groups. However, with the rise of modern medicine, synthetic drugs have become more popular. This has led to confusion about whether to use organic or synthetic drugs. Recent studies have shown that regular consumption of various marine and freshwater fish species can boost immunity and help fight both common and lethal diseases caused by viruses and bacteria. Small indigenous fish species (SIS) are particularly valuable for their therapeutic properties. Scientists have extracted chemical compounds from some SIS and used them to treat viral and bacterial illnesses. It is important to conserve SIS for their potential as a source of organic drugs and to preserve traditional medical knowledge. To ensure the future of SIS, it is essential to identify the chemical compounds in each species.

SIS status in Koshi province, Nepal

During the collection process, it was discovered that several small indigenous fish species (SIS) are currently vulnerable. This may be due to various factors, including habitat loss caused by climate change and human activities such as electro-fishing, poisoning, evacuating ponds and ditches using pumping machines to catch fish, and overfishing. Unfortunately, the government's lack of interest in SIS conservation is also a contributing factor. Unless conservation efforts are put into place and passed in a timely manner, more than half of the SIS population will face severe threats in the time to come. A number of vulnerable SIS were identified during a two-year survey in Eastern Nepal, including the following:

1 *Osteobrama cotio* (Hamilton- Buchanan) 2. *Labeo boga* (Hamilton- Buchanan) 3. *Puntius phutunio* (Hamilton- Buchanan) 4. *Puntius terio* (Hamilton-Buchanan),5. *Puntius gonionotus* (Bleeker) 6. *Puntius chola* (Hamilton- Buchanan),7. Salmostoma phulo (Hamilton- Buchanan), 8. *Barilius vagra* (Hamilton- Buchanan), 9. *Brachydanio rerio* (Hamilton- Buchanan), 10. Danio aequipinnatus (McClelland), 11. Salmostoma phulo (Hamilton-Buchanan)12. *Garra rupecula* (McClelland), 13. *Acanthocobatis botia* (Hamilton-Buchanan), 14. *Lepidocephalus menoni* (Pillai & Yazdani). 15. *Pangio pangio* (Hamilton- Buchnan) 16. *Botia histrionican* (Blyth).

Conclusion

Small indigenous fish species(SIS) are more abundant in number compared to larger fish species, but they are often neglected due to their size. However, their presence in the aquatic ecosystem cannot be ignored. These small fish provide various ecosystem services, have great nutritional and therapeutic value, and are aesthetically valuable. In fact, they are more valuable than large indigenous fish species. Unfortunately, due to climate change, anthropogenic activities, and negligence of fish farmers and government authorities, the SIS population is gradually declining a few species are vulnerablde. This puts a demand for their conservation.

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