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Taxonomic Study on Hill Stream Fishes

Dambar Singh Khatri
Teacher, Department of Science and Technology
Dhaulagiri Multiple Campus, Baglung
Email: dambar32khatri@gmail.com

Abstract

Hill stream fishes are the cold water fishes found in the large river of Nepal. They are distributed from upper riches of river to lower plane area where river flow with less velocity and finally meets ocean. Taxonomy is crucial for understanding species diversity, conservation efforts, and the possible impacts of global warming and habitat destruction. Taxonomy serves as a beacon of knowledge, guiding toward a deeper understanding of fish habitat in the natural world and responsibility of protection. Unraveling the relationships built out via taxonomic efforts also provides clues to issues regarding lost species, and reasons surrounding their extinction. The current study was focused on Mahakali River, its tributaries, irrigation canal and Ghols. The collected fishes were preserved in 10% formalin and photograph had been taken before preservation. On the basis of colour pattern, mouth structure, no of barbels, eyes diameter, snout structure, body length, shape of body, fin rays, lateral line scales, suckers present on ventral side, enlisted nineteen hill stream fish species by applying morphometric and meristic method.

Keywords: Taxonomy, morphometric, meristic, hill stream fish

Introduction

Fish taxonomy involves the process of identifying and classifying fish species or subspecies according to the established principles of fundamental taxonomy. Traditional classification divides fish into three extant classes: Agnatha, Chondrichthyes, and Osteichthyes (Benton, 1998). Fish account for more than half of vertebrate species. There are over 32,000 described species of bony fish, over 1,100 species of cartilaginous fish, and more than 100 species of hagfish and lampreys. A third of these fall within the nine largest families; from largest to smallest, these are Cyprinidae, Gobiidae, Cichlidae, Characidae, Loricariidae, Balitoridae, Serranidae, Labridae, and Scorpaenidae. About 64 families are monotypic, containing only one species (Nelson, 2016).

Fish taxonomy focuses on recognizing and categorizing fishes down to the species or subspecies level, adhering to the fundamental principles of traditional taxonomy. The Swedish botanist Carolus Linnaeus (1707-1778) is recognized as the pioneer of modern taxonomy, having created a framework known as Linnaean classification for organizing organisms and introducing binomial nomenclature for naming them. Nonetheless, the term "taxonomy" was first introduced by French Professor A. P. de Candolle as "Taxonomie" in 1813. Taxonomy consists of three phases: (i) alpha taxonomy, which focuses on the identification of new species and their organization into well-defined genera, (ii) beta taxonomy, which explores the relationships at the species level, and (iii) gamma taxonomy, which examines intraspecific variations and their evolutionary connections.

Various methods of classifying fish have been developed over time. J. Muller introduced the earliest classification in 1844 who identified seven subclasses within the class ‘Pisces.’ Subsequently, Berg in 1940 and Romer in 1959 provided comprehensive classifications of fish that have gained worldwide acceptance. Berg's classification in 1940 divided the Super-class Pisces into seven classes: Acanthodii, Coccostei, Pterichthys, Elasmobranchii, Holocephali, Dipnoi, and Teleostomi. Among these, the first three classes are entirely extinct and are grouped under the term Placodermi, which translates to "plate-skinned." Consequently, the existing modern fish species are represented by only four major classes: Elasmobranchii, Holocephali, Dipnoi, and Teleostei. The cold-water fish of Nepal fall under two orders: Cypriniformes and Siluriformes. Berg (1947) classified the order Cypriniformes into two divisions based on the presence or absence of scales: Cyprini, characterized by a body with scales, and Siluri, characterized by a body without scales.

There are a total of 92 indigenous cold-water fish species in Nepal. The family Cyprinidae dominates with 46 species, followed by the family Sisoridae with 13 species and the family Balitoridae with six species. Some of the Nepal cold-water fish species show a resemblance to fish from Kashmir in6 India and Afghanistan. Five fish species are endemic to the cold waters in Nepal. Three of them are found in the high-altitude lake Mahendra Tal (Rara Lake, Rara National Park) at 2,990 m.

Khatri (2010) identified 19 hill stream fish species from the Mahakali River. Bhusal and Chitrakar (2017) studied the Rishi Khola of Kavrepalanchok district of Bagmati zone of Nepal and identified five hill stream species, two from Cyprinidae, two from Cobitidae, and one from Siluridae as Schizothoraichthys labiatus, Schizothorax plagiostomus, Schistura beavani, Schistura rupecula, and *Glyptosternum maculatum.*

The current study heighted about the taxonomic study of hill stream fish collected from Mahakali river so that the status and conservation of fish can addressed in future.

Materials and Methods

The methods and material utilized during the study were as mentioned in the following headings.

Study area

The study area was the Mahakali river which is located in the Sudurpachhim province, western part of Nepal. This river lies on Latitude: 27° 20' 59.99" N and Longitude: 81° 22' 59.99" E. this river flows between the Nepal and India border. Descending, it enters the Indo-Gangetic Plain at Brahmadev Mandi in Nepal, where it expands above the Sharda Barrage. From that point onward, it is known as the Sharda River. The river proceeds southeastward into India through northern Uttar Pradesh before merging with the Ghaghara River southwest of Bahraich, covering a distance of approximately 300 miles (Midha & Mathur, 2014). The study area was taken first at the Sarada barrage and second 10km from the Sarada barrage near the suspension bridge of Dodhara and Chadani.

Data collection

Fishes are collected at regular intervals from the Mahakali River. The collected fish were preserved in 10 percent formalin. Before preservation, the colour of the fish was noted down. The collected fish were taken to the lab for further measurements.

Taxonomic study

The identification of fish species was done with the help of standard reference books. The taxonomic study was conducted using morphometric and meristic methods. In the morphometric method, measurements were taken of total body length (TL), standard length, body diameter, mouth-to-operculum length, and eye diameter. Meristic measurements in fish refer to the counting of countable structures, like fin rays, gill rakers, or scales, which are useful for species identification and stock discrimination. In the meristic method, fin ray counts, such as pectoral (p), Ventral (V), dorsal (D), caudal (C), lateral line count (Ll), length up to the trunk (L.tr.), and number of barbels were counted.

Results

From the morphometric and meristic analysis, the following results were gained, which are presented in Table

Table 1

Morphometric and meristic characters of hill stream fishes

S.N.	Name of Fishes	Diagnostic characters
1.	*Tor tor* (Hamilton-Buchanan) Sahar	D12 (3/9); P17; V9; A7(2/5); C19; L1-25 L.tr 8; L=30cm
2.	*Labeo dero* (Hamilton-Buchanan) Gurdi	D12-13(3/9-10); P16-17; V9; A8(3/5); C19; Ll38- 43 L.tr8/6-7; TL=30cm
3.	*Barilius barna* (Hamilton-Buchanan) Poti	D9 (2/7); P15; V9; A13-14(3/10-11);C19; L139-42 L.tr8-9/6;TL=9cm
4.	*Barilius bendelisis* (Hamilton-Buchanan) Gurdi	D 9(2/7); P15; V9; A 9-10;C18; L140-43; L.tr7-8/5,TL=8.5c
5.	*Barilius vagra* (Hamilton-Buchanan) Faketa	D9 (2/7); P16; V9; A13-15; C19; L1 42-44; L.tr7- 8/4, TL=10cm
6.	*Raiamas bola* (Hamilton-Buchanan) Bhutte, Chala	D10; P13; V9; A3/10; C19; L184-89; L.tr.13- 8 14/15, TL =30cm
7.	*Brachydanio rerio* (Hamilton-Buchanan) Zebra fish	D 9(2/7); P13; V8; A15-16; C19; L127-30; L.tr8; TL= 3.6cm
8.	*Esomus denricus* (Hamilton-Buchanan) Dedhawa	D8-9(2/6-7); P11-12; V8; A9(3/6); L110-114; L.tr20/1/30;TL=25cm
9.	*Schizothoraichthys progastus* (McClelland) Chuchhe Asla	D11-13(3/8-9); P19; V11; A7 (2/5); C19; L110-114; L.tr20/1/30;TL=25cm
10.	*Schizothorx plagiostomus* (Heckel) Buche Asla	D10 (3/7); P16-17; V10; A7 (2/5); C19-20; L1105; L.tr23/23;TL=32cm
11.	*Crossocheilus latius* (Hamilton-Buchanan) Buduna	D11 (3/8); P15; V9; A7 (2/5); C19; L139; L.tr 6/6; TL=20cm

12.	*Garra annandalei* (Hora) Buduna	D11 (3/8); P15; V8; A7(2/5); C17; 3 L13-34; TL=20cm
13.	*Garra gotyla gotyla* (Gray) Buduna	D11 (3/8); P15; V9; A7(2/5); C17; L139 TL=8cm
14.	*Schistura corica* (Hamilton Buchanan) Stone loach	D10 (2/8); P13; V8; A7(2/5); C17; TL=5.5cm
15.	*Schistura rupecola* (McClelland) Bhotte gadelo	D9-11(2-3/7-8); P10; V8; A7(2/5); C18; L139; TL=8cm
16.	*Acanthocobatis botia* (Hamilton-Buchanan) Baghe	D. 12-14 (2/10-12); P. 11; V. 8; A. 7 (2/5); C. 17 TL=6.5cm
17.	*Lepidocephalus guntea* (Hamilton -Buchanan) Guntea	D 8(2/6); P8; V7; A7(2/5); C16; L115; TL=8cm
18.	*Botia lohachata* (Chaudhuri) Baghi	D11 (2/9); P13-15; V8; A7(2/5); C19; TL=8cm
19.	*Glossogobius giuris* (Hamilton-Buchanan) Bulla	D6/1/8-9; P20; V1/5; A1/8-9(2/5); C17;L130-34 TL=8cm

From Table 1, two orders, i.e., Cypriniformes and Perciformes, were identified. cypriniformes has 18 species where as perciformes has only one species. The order cypriniformes consists of dominant species. The classification of fish from order to species is presented in Table 2. as follows.

Table 2

Taxonomic classification of hill stream fishes

Order	Family	Subfamily	Genus	Species
Cypriniformes	Cyprinidae	Cyprinini	*Tor* (Gray) 1833	*Tor tor* (Hamilton-Buchanan) 1822, Mahaseer
			Genus- *Labeo* (Cuvier) 1817	*Labeo dero* (Hamilton-Buchanan) 1822, Gurdi
		Danioninae	*Barilius* (Hamilton) 1822	*Barilius vagra* (Hamilton-Buchanan) 1822, Faketa *Barilius barna* (Hamilton-Buchanan) 1822, Poti *Barilius bendelisis* (Hamilton-Buchanan) 1822, Gurdi
			Brachydanio (Weber de Beaufort) 1916	*Brachydanio rerio* (Hamilton-Buchanan) 1822, Zebra fish
			Esomus (Swainaon) 1839	*Esomus denricus* (Hamilton-Buchanan) 1822, Dedhawa
			Raiamas (Jordon) 1919	*Raiamas bola* (Hamilton-Buchanan) 1822, Bhutte, Chalwa
		Schizothoracinae	*Schizothoraichthys* (Misra) 1959	*Schizothoraichthys progastus* (McClelland) 1839, Chuche Asla
			Schizothorx (Heckel) 1838	*Schizothorx plagiostomus* (Heckel) Buche Asla
		Garrinae	*Crossocheilus* (van Hesselt) 1823	*Crossocheilus latius* (Hamilton-Buchanan) 1822, Buduna
			Garra (Hamilton) 1822	*Garra annandalei* (Hora) 1921, Buduna Garra gotyla gotyla (Gray) 1832, Buduna
	Balitoridae	Nemacheilinae	*Acanthocobatis* (Peters) 1861	*Acanthocobatis botia* (Hamilton-Buchanan) 1822, Natwa
			Schistura (McClelland) 1839	*Schistura corica* (Hamilton-Buchanan) 1822, Baghe Schistura rupecola (McClelland) 1839, Bhote gadelo
		Cobitinae	*Lepidocephalus* (Bleeker) 1859	*Lepidocephalus guntea* (Hamilton-Buchanan) 1822, Guntea
		Botinae	*Botia* (Gray) 1831	*Botia lohachata* (Chaudhuri) 1912, Baghi
Perciformes	Gobiodei	Gobiinae	*Glossogobius* (Gill)	*Glossogobius giuris* (Hamilton-Buchanan) 1822, Bulla

Discussion

The current study aimed to investigate the hill stream fish species present in the Mahakali River and its surrounding areas. The collected fish were studied using morphometric and meristic methods. The morphometric approach examines the size and shape using a measurable trait, such as standard length or wet weight, which can be gauged as a length, mass, angle, or ratio of other measurements, whereas in the meristic approach, counting of fin rays, spines, vertebra, and lateral line scales takes place. The body measurement was taken with the help of centimeter scales, and the fish's weight was measured using a small digital weight machine. Fishes were collected mainly from the Mahakali River, the irrigation canal, and Ghols. A total of 19 species were identified as hillstream fishes. They represent two orders, mainly cypriniformes and perciformes. The cypriniformes include 18 species, whereas the perciformes include 1 species. The maximum length of fish was found to be 30 cm, whereas the smallest was Brachidanio rerio, measuring 3.6 cm.

Based on the morphometric analysis, fish species with an upper jaw that is protractile, a mouth (including the jaws and palate) that is toothless, an adipose fin that is either present or absent, a head that is scaleless, and barbels that are either present or absent were classified in the order Cypriniformes. In the case of loaches, *such as Barilius vagra, Barilius barna, Barilius bendelisis, Brachydanio rerio, Schistura corica, and Schistura rupecola, identification is done by counting fin rays, lateral line scales, spines, and barbels, as well as examining the* colour pattern. These fish exhibit characteristic colour patterns on their bodies. *Garra gotyla golyla* and *Garra annadelai* can be distinguished from each other by observing their head pattern and pectoral fin position. *Garra gotyla has cleft or tubercles on the* snout. *Brachidanio rerio* is characterized by a distinctive black and white colour pattern, similar to a zebra, on its body and is the smallest in size. *Esomus denricus*, a small fish characterized by bright pearly iridescence, features a distinctive dark band extending from behind the eye to the base of the caudal fin, which is a unique feature.

The *Schizothorachthys progastus, also known as* Chuchhe Asla, had a silvery body with a pointed snout. Colouration, usually silvery brown above, the sides and belly creamy. Th***e dorsal and caudal fins are spotted black; opercle golden yellow. Mouth large, subterminal with two pairs of barbels. Same character observed in the *Schizothorx plagiostomus* locally called Buche Asla. Other characteristics of Schizothorx plagiostomus noted as heavily spotted with a blunt snout. The body is more cylindrical. The mouth is inferior with a suctorial disc in the chin formed by the edge of the lower lip. Barbels 2 pairs. Horny tubercles cover snout. *Barilius bendelisis has a* medium-sized body with fine pores on the snout. The body is crossed with 8-12 lateral bands and features a bluish-green, silvery tinge. The fish had black spots at the base of each scale. *Crossocheilus latius*, an elongate general body colour greyish above, silvery below. The ventral profile is horizontal or slightly curved. *Acanthocobatis botia* had 10 mottled bands, many small oval patches were distributed along the lateral line, and 3 pairs of barbels. A distinct black ocellus is present at the caudal peduncle above the lateral line. *Lepidocephalus guntea*, a small, cylindrical fish with an elongated caudal peduncle. Its general body colour is black with patterns and a bright dark band. Body colour variable ground colour. The dorsal, pectoral, and caudal fins have black dots and are crossed by stripes. A black ocellus on caudal fin base. Barbels 4 pairs. *Botia lohachata* is found on the Mahakali River and has a distinctive yellowish-brown pattern, popularly known as the Y-loach. Two distinct spots occur posterior to the eye. The body has a Y-shaped yellow band. Barbels 4 pairs. At the caudal peduncle, dark bands are present. It has a mouse-like head and contains spines on its head. *Glossogobius giuris* is a common gobid fish found in rivers and lakes where bottom is stony. Its pectoral fin has broad base and ventral fin are united forming a cup like structure which acts as a sucking disc. The anal fin is pointed posteriorly caudal oblong. The eyes are situated on head region.

Conclusion

The present study focuses on the taxonomic analysis of hill stream fishes found in the Mahakali River and its surrounding areas. Nepal has large water bodies, including large Himalayan rivers, lakes, ponds, Ghols, and swamplands. These water resources are enriched with various fish species over 232 (Shrestha, 2008). The condition of these areas is not uniformly the same, ranging from fast-flowing to slow conditions, and from clear water to saline water. Due to these natural conditions, various adaptive features have been found in the fish's body. In the context of our riverine system, fish that primarily inhabit cold water exhibit certain modifications in their bodies. Mostly, the simple methods, such as counting their fin rays, scales, and measuring body size, weight, barbell count, fin position, eye position, and mouth position, can help distinguish them from one another. Within the same genus, the differences between species are mainly based on their color pattern, body size, fin rays, and mouth structure. Therefore, the identification of fish species using morphometric and meristic approaches for taxonomic purposes enables us to recognize them more effectively.

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References

Benton, M. J. (1998). The quality of the fossil record of vertebrates. In S. K. Donovan & C. R. C. Paul (Eds.), *The adequacy of the fossil record* (pp. 269–303). Wiley.

Bharatpur Khabar. (2016, March). *Part 2: Taxonomy of fishes of Nepal*. http://bharatpurkhabar.blogspot.com/2016/03/partr-2-taxonomy-of-fishes-of-nepal.html *(Retrieved February 23, 2023)*

Bhusal, G., & Chitrakar, P. (2017). Taxonomic investigation and fish diversity study on some hill stream fishes available in Roshi Khola, Panauti of Nepal. *International Journal of Fisheries and Aquatic Studies, 5*(3), 213–217.

Gautam, G. (2003). *Study on fish diversity and aquatic life resources of Lake Rupa, Kaski* (Unpublished master's dissertation).

Jha, D. K., Shrestha, M. K., & Rai, S. C. (1980). Fish fauna of the Narayani and Rapti river system in Chitwan, Nepal. *Journal of the Institute of Agriculture and Animal Science, 10*, 97–107.

Kar, D., & Barbhuiya, M. H. (2000). Ichthyodiversity of Chatla Haor: A floodplain wetland in Barak Valley Region of Assam. In B. N. Pandey & B. K. Singh (Eds.), *Advances in zoology and environmental degradation and biodiversity* (pp. 3–6). Daya Publishing House.

Midha, N., & Mathur, P. K. (2014). Channel characteristics and planform dynamics in the Indian Terai, Sharda River.

Nelson, J. S. (2016). Taxonomic diversity. In *Fishes of the world* (5th ed., p. 3). John Wiley & Sons. https://doi.org/10.1002/9781119174844

Rajbanshi, K. G. (2005). Review on current taxonomic status and diversity of fishes in Nepal. *Nepal Academy of Science and Technology, Occasional Paper, 10*(41).

Shrestha, J. (2001). Taxonomic revision of fishes of Nepal. In P. K. Jha et al. (Eds.), *Biodiversity, agriculture and pollution in South Asia* (pp. 171–180). ECOS.

Shrestha, J. (2003). Taxonomic revision of fishes of Nepal. In *Cold water fisheries in the trans-Himalayan countries* (FAO Fisheries Technical Paper No. 431, pp. 273–288). Food and Agriculture Organization.

Shrestha, J., Singh, D. M., & Saund, T. B. (2009). Fish diversity of Tamor River and its major tributaries of Eastern Himalayan Region of Nepal. *Nepal Journal of Science and Technology, 10*, 219–223.

Shrestha, T. K. (2008). *Ichthyology of Nepal: A study of fishes of the Himalayan waters* (pp. 37–238). Himalayan Ecosphere Publication.

Singh, M. K., Gogoi, S., & Dutta, M. P. (2024). Habitat inventory, diversity and structural modification of hill-stream fishes of Noa Dihing River, Eastern Himalayan Hotspot, Arunachal Pradesh, Northeast India. *Egyptian Journal of Aquatic Biology & Fisheries, 28*(5), 493–527. http://www.ejabf.journals.ekb.eg

Author bio-note

Mr. Dambar Singh Khatri is a Zoology teacher in Dhawalagiri Multiple Campus Baglung. His area of interest is fish & fisheries.