

# Identification study of freshwater fish *Clupisoma garua* and *Clupisoma montana*.

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## Abstract

*Clupisoma garua* and *Clupisoma montana* are freshwater fishes belonging to the family Schilbeidae and class Actinopterygii. These fishes have notable ecological and economic significance, but required identification and distribution data remains insufficient. In this study, we aim to accurately identify and distinguish between two freshwater fish species, *Clupisoma garua* and *Clupisoma montana*, which are widely distributed in rivers of Asia. We studied their morphological, meristic, morphometric and descriptive characters comprehensively to pinpoint distinguishable features needed for their identification and classification. Fish samples of both species were collected from three sites near Indrapuri dam, Rohtas (Bihar). Morphological analysis focused on studying physically visible characters i.e. color patterns, body shape and fins whereas in meristic characterization, we examined the countable traits such as the number of fin rays, lateral line scales, and vertebrae. Morphometric examinations were employed to quantify the overall dimensions and proportions of the specimens, analyzing distances and ratios between various anatomical landmarks whereas meristic characters quantified countable structures. Differentiation among the two species hasn't been studied in detail yet. We are defining differences between the two for first time here. Our findings revealed that *Clupisoma garua* and *Clupisoma montana* are two species of catfishes that have distinct morphometric characteristics. *Clupisoma garua*, commonly known as the Garua catfish, has an elongated body shape with a streamlined appearance and tapering tail whereas *Clupisoma montana*, the Mountain catfish, has a more robust body structure, broader head, sturdier body and shorter less tapered tail as compared to *Clupisoma garua*. Both species have similar coloration i.e. light brown or grayish-brown and small smooth scales. Countable traits as observed remain consistent within a species and helped in differentiating between the two species allowing us to define diagnostic features of each species. Methodology utilized for this study provides a valuable tool for researchers of fish identification and conservation. Accurately identifying and classifying a species is the first step of its conservation and understanding of their ecology. This information can ultimately contribute to the sustainable management of freshwater fish biodiversity.

**Key words:** *Clupisoma garua* (*C. garua*), *Clupisoma montana* (*C. montana*), Morphological Characters, Morphometric Characters, Meristic Characters, and Descriptive Characters.

## Introduction

Freshwater fish are a vital component of aquatic ecosystems and play a crucial role in human society as sources of food and income generation. Proper identification of these species is a critical aspect of fisheries management, conservation and scientific research. This paper presents a comprehensive study of the identification of two freshwater fish species, *Clupisoma garua* and *Clupisoma montana*, found in river systems of Asia. Numerous studies have investigated freshwater fish species and their distribution, while simultaneously

attempting to refine protocols for their identification [1-3]. However, detailed comparative studies on *Clupisoma garua* and *Clupisoma montana* have not been exclusively undertaken and their taxonomic positions and morphological features are often ambiguous [4]. Our work aims to provide a comprehensive overview of these two species in terms of their morphological, morphometric, meristic and descriptive characteristics. *Clupisoma garua*, commonly known as the silver garua or garua catfish, is a species of catfish that belongs to the family Schilbeidae and is found in parts of South and Southeast Asia [5]. This slender fish, with its elongated body

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and cylindrical cross-section, is known to inhabit larger rivers, preferring areas with sandy or rocky substrates [6, 7]. Whereas, *Clupisoma montana*, also referred to as the mountain catfish, is primarily restricted to the upper and central regions of the Ganges and Brahmaputra basins. It is found primarily in India, Nepal, Bhutan, and Bangladesh. These two species are morphologically similar and often confused with each other due to their overlapping geographic ranges and shared habitat preferences, resulting in an urgent need for accurate identification and classification. Morphological examination forms the basis for fish identification, enabling the distinction of species by analysing their external structures and comparing them with taxonomic keys [8]. Counts and measurements of key morphological traits, such as fin rays, gill rakers, and gill slits, provide foundation data for distinguishing between two species. Furthermore, advancements in molecular biology techniques have provided tools to corroborate morphological data by comparing genetic markers, such as mitochondrial DNA and nuclear genes [9]. Combining molecular and morphological evidence not only increases the accuracy of species identification methods but also sheds light on their phylogenetic relationships and evolutionary history [10]. Considering the importance of these two freshwater fish species in terms of their ecological and economic values, their accurate identification is essential. This study fills the gap in understanding the differences of *Clupisoma garua* and *Clupisoma montana*, providing the conservationists, fisheries managers and scientists with a robust and comprehensive source of information that guides species identification. These findings will aid in the conservation efforts, correct population assessments and contribute to sustainable management strategy development for these freshwater organisms.

## Methodology

### Sampling Site

Fish specimen were collected from three different sites located near the Indrapuri dam, Rohtas, Bihar i.e. Sariaya, the Dam

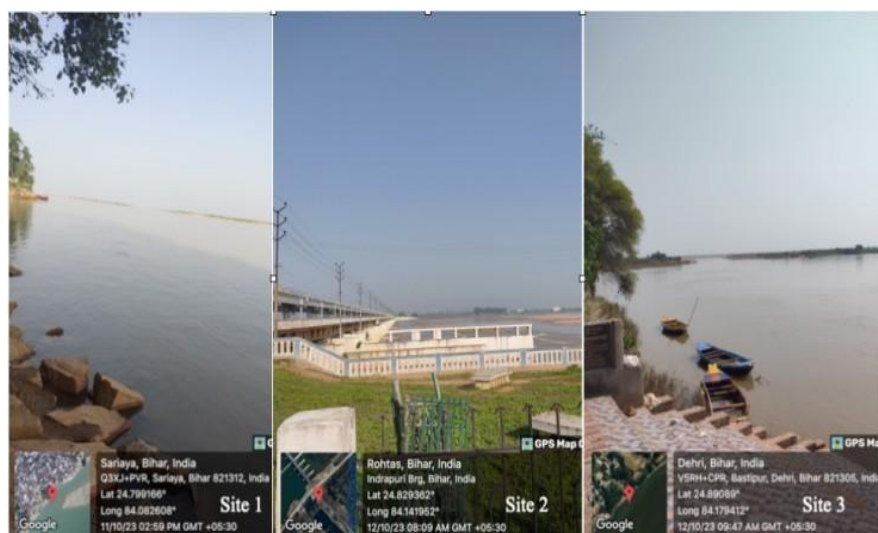
and Dehri. Co-ordinates of these locations are given in Figure 1. It is a significant water reservoir that plays crucial role in irrigation and water management of the region. It is 4th longest barrage in the world with a length of 1,407 meters and height of 44.94 meters [11] and is situated on river Son which is a major tributary of river Ganges [12], and is known for its contribution to agricultural activities and the overall socio-economics development of the area. Fishes *C. montana* and *C. garua* were caught by local fisherman of the above mentioned sites. The reason to study biodiversity of Indrapuri dam is driven by the scarcity of existing research conducted on this particular area. The dam is situated in a relatively undisturbed area with limited human interference, which allows undisturbed natural habitat for fish populations to thrive. We found both the fishes in the dam area but these two were not available in local markets of Patna.

### Sample collection

Fish species *C. montana* and *C. garua* were selected for this identification study. Sample collection was done with the help of local fishermen. Being a migratory fish these fishes are rare to find hence data collection was done in batches. 5 fishes of each *C. garua* and *C. montana* were used for this work. Guidelines for the identification were taken from book of K. C. Jayaram (1977) [13]. Methods explained in this book helped us in identifying the fishes based on their physical characteristics, such as body shape, coloration, fin structure, and other distinctive features. Limited data is available on biology, behavior, and ecological roles of these two fish species and therefore this information is crucial for understanding the ecological dynamics within their aquatic ecosystems. This study will help in developing effective conservation strategies for managing cultures of these fishes (Figure 2).



### Specimen 1

*Clupisoma garua*, often known as 'garua catfish,' is a potamodromous (migratory) fish species that lives in both fresh and brackish water. The species is found mostly in major



**Figure 1:** Sampling sites near Indrapuri Dam located in Rohtas district of Bihar on river Son. Site 1 is Sariaya, Site 2 is Rohtas Dam and Site 3 is Dehri, Bihar. Exact location of the site along with the co-ordinates is given in the pictures of each sampling site. Specimen of fishes were collected from the given three sites for identification of *Clupisoma* species with the help of local fishermen.

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Classification	<i>Clupisoma garua</i> and <i>Clupisoma montana</i>
Phylum-Chordata Class-Actinopterygii Order-Siluriformes Family-Scilbeidae Genus- <i>Clupisoma</i> Species- <i>garua</i>	
Class-Actinopterygii Order-Siluriformes Family-Scilbeidae Genus- <i>Clupisoma</i> Species- <i>montana</i>	

**Figure 2:** The figure shows the typical animals of order Siluriformes and genus *Clupisoma*. On the left is given the classification and on the right are the pictures of the *Clupisoma* species. Fish specimen on top is of *Clupisoma garua* whereas the lower one shows *Clupisoma montana*.

freshwater bodies found in parts of South and Southeast Asia. It is a bottom dwelling species often carried as shoals in fresh and brackish-water canals, rivers, streams, lakes, reservoirs and swamplands. It is omnivore by nature feeding on small invertebrates and plants along river borders [14].

### Specimen 2

*Clupisoma montana* also known as 'mountain river catfish' is primarily restricted to the upper and central regions of the Ganges and Brahmaputra basins, occurring primarily in India, Nepal, Bhutan, and Bangladesh. The body of *C. montana* is elongated and slender, with a silvery-gray coloration and a series of dark horizontal stripes along its sides. It possesses sensory barbels around its mouth. These barbels are used to detect food and navigate in its environment effectively. It is omnivorous and feeds on small invertebrates, aquatic insects and organic debris playing crucial role in the ecosystem as a detritivore [15].

### Classical methods of species identification

Following types of characters are important while studying a species for identification. Based on these characters one can identify a species that is of importance and needs conservation. Better identification also means better management and fish production (Table-1).

#### Morphological characters

It refers to the physical features of an organism that are related to its form, structure and appearance. These characteristics include aspects such as body shape, size, coloration, presence of appendages or organs and other observable physical attributes [16].

#### Morphometric characters

It refers to the quantitative measurements which are measured by various tools and techniques, such as calipers, rulers, or digital imaging software [17].

#### Meristic Characters

Meristic Characters are quantitative traits that describe the

countable features of an organism.

**Number of fin rays:** Different species have specific number of rays in their fins (dorsal fin, pectoral fins, and anal fin). These numbers can vary between individuals and populations, but they are typically consistent within a species.

**Number of vertebrae:** The number of vertebrae is another meristic characteristic used to differentiate between fish species. This count can vary between species and can be used as an identification feature.

**Number of gill rakers:** Different species have a specific number of gill rakers on their gill arches. These structures help filter food particles from the water.

**Number of scales:** The number of scales along the lateral line or on the body is another meristic character that can vary between individuals and populations. These meristic characteristics, along with the morphological characteristics mentioned earlier, help scientists and researchers differentiate between and understand the unique traits of each species.

#### Descriptive characters

These characters are used to describe the physical appearance, coloration, shape of the body, presence or absence of certain fins, color patterns, scales, and other distinctive features. Table given below explains all the types of characters that were used for identification of *C. garua* and *C. montana*.

### Results and Discussion

#### Morphological characters

Morphological characteristics refer to the physical traits and features of an organism that are related to its form, structure, and appearance. These characteristics can include aspects such as body shape, size, coloration, presence of appendages or organs, and other observable physical attributes. Morphologically, these species exhibit notable differences. *C. garua* possesses a slender body shape, which is elongated and laterally compressed; additionally it tends to display a bluish- gray coloration on its dorsal side. It has a pointed snout

and a relatively long, forked tail. Figure 3 explains the major morphological characters examined for this study [18].

In contrast, *Clupisoma montana* features a more robust body structure, with a rounded snout and a shorter, less forked tail and it often characterized by a brownish-gray hue. These differences contribute to the visual distinctiveness between the two species and aid in their taxonomic identification (Figure 4) [19].

### Morphometric characters

Size and shape of an organism's body or its specific parts [20]. These measurements are obtained through various

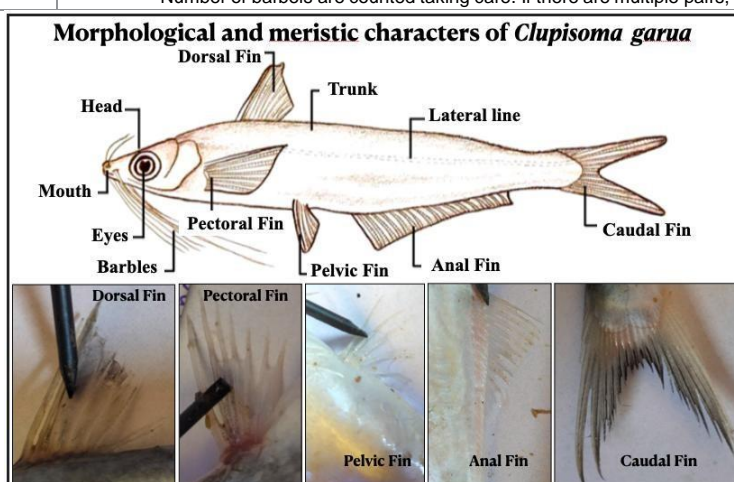
techniques, such as calipers, rulers, or digital imaging software. Morphometric analysis allows for the objective comparison and analysis of the variation in size and shape among individuals or populations. It can provide insights into population dynamics, evolutionary relationships, and ecological adaptations within a species or group of organisms (Table-2) [21].

### Meristic characters

Meristic characters are quantitative traits that are counted or enumerated and provide information about the number of specific features or structures in an organism. These characteristics include counts of features such as fin rays,

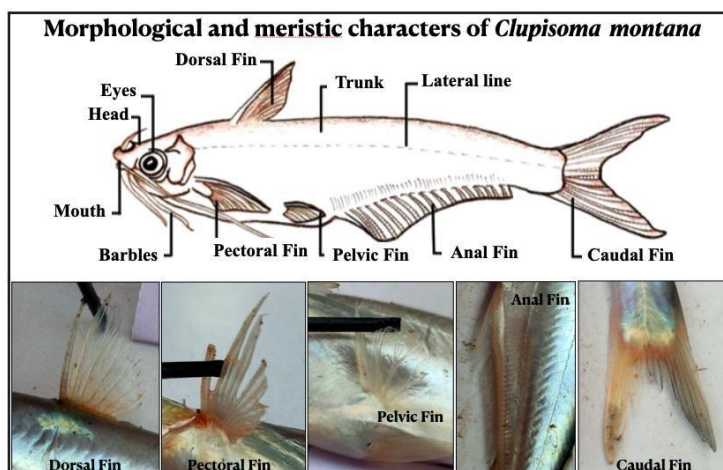
**Table 1:** This table represents different characters observed for the study of the *Clupisoma* fishes. Values given in column 1 are the characters that were used for identification. Column 2 shows standard abbreviations of the characters and Column 3 explains the definitions of the characters given in column 1. All the characters and their definitions are explained in the figure below pictorially.

S. No.	Characters	Abbreviation	Explanation
1	Total length of body	TL	It refers to the measurement of the fish from the tip of its snout or mouth to the end of its tail fin, including the caudal fin.
2	Standard length of body	SL	It refers to distance from the tip of the fish snout or mouth to the end of its vertebral column, excluding the caudal fin.
3	Depth of body	BD	It refers to the vertical measurement of the fish body from its ventral surface to its dorsal surface at its widest point.
4	Head length	HL	It refers to the measurement of fish head from tip of its snout or mouth to back of its gill cover or posterior margin of its eye socket.
5	Eye diameter	ED	It represents the distance from one side of the eye to the opposite side, passing through the center of the eyeball.
6	Dorsal fin length	DFL	It refers to the measurement of the dorsal fin from its base to the tip.
7	Pectoral fin length	P1FL	It refers to the measurement of the pectoral fin from its base to the outermost tip.
8	Anal fin length	AFL	It refers to the measurement of the anal fin from its base to its outermost tip.
9	Caudal fin length	CFL	It refers to the measurement of the caudal fin, measured from the base of the caudal fin, where it attaches to the body, to the outermost point of the fin.
10	Dorsal fin spines	DFS	It refers to the measurement of the length of each individual spine from its base to the tip.
11	Pectoral fin spines	P1FS	It refers to the measurement of the length of each individual spine from its base to the tip.
12	Ventral or Pelvic fin spine	P2FS	It refers to the measurement of the length of each individual spine from its base to the tip.
13	Anal fin- spines	AFS	The measurement usually taken along the axis of the spine, which corresponds to the straight line running from the point of attachment on fish's body to outermost tip of spine.
14	Soft rays	SR	Using a ruler or calipers each soft rays is measured from the base of the ray to the desired endpoint.
15	Barbels	B	Number of barbels are counted taking care. If there are multiple pairs, count each pair separately.



**Figure 3:** The sketch on top shows the morphological characters of fish *Clupisoma garua* representing different parts of the fish body- head, eyes, mouth, barbels, dorsal fin, pectoral fin, pelvic fin, anal fin, trunk, caudal fin. Given below are the actual pictures of the characters as observed during this study.

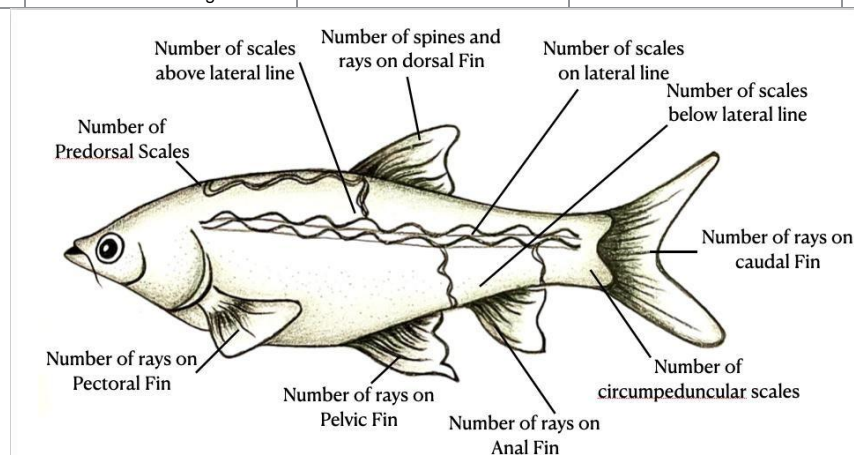




**Figure 4:** The sketch on top shows the morphological characters of fish *Clupisoma montana* representing different parts of the fish body-head, eyes, mouth, barbels, dorsal fin, pectoral fin, pelvic fin, anal fin, trunk, caudal fin. Given below the sketch are the actual pictures of the characters as observed and analyzed during this study.

**Table 2:** This table shows the different morphometric characters of the *Clupisoma* species as measured by the standard methods. The morphometric characters are – Total Length of the Body(TL), Standard Length of the Body(SL), Depth of body(bd), Head Length(HL), Eye Diameter(ED), Dorsal Fin Length(DFL), Pectoral Fin Length(P1FL), Pelvic Fin Length(P2FL), Anal Fin Length(AFL), Caudal Fin Length(CFL).

S. No	Morphometric characters	Abbreviation	<i>Clupisoma garua</i>	<i>Clupisoma montana</i>
1	Total length of body	TL	21.1 cm	19.00 cm
2	Standard length of body	SL	72.51 % of TL	73.68 % of TL
3	Depth of body	BD	27.01 % of TL	23.68 % of TL
4	Head length	HL	16.11 % of TL	16.31 % of TL
5	Eye diameter	ED	23.52 % of HL	22.58 % of HL
6	Dorsal fin length	DFL	11.84 % of TL	12.10 % of TL
7	Pectoral fin length	P1FL	12.79 % of TL	13.15 % of TL
8	Pelvic fin length	P2FL	7.58 % of TL	8.42 % of TL
9	Anal fin length	AFL	23.69 % of TL	28.94 % of TL
10	Caudal fin length	CFL	18.48 % of TL	22.63 % of TL



**Figure 5:** This sketch tells us about the standard meristic characters studied for fish species identification. Meristic characters include number of dorsal fin-spines, soft rays, anal fin-spines, caudal fin-soft rays, adipose fin, lateral line, pectoral fin-spine, ventral or pelvic fin-spine and barbels.

scales, vertebrae, or other segmented structures like myotomes. By analyzing meristic characters, we can compare and differentiate individuals or populations. Meristic characters vary in count in different species, which can help in species identification, population assessment and understanding genetic diversity of a species (Figure 5, Table-3) [22].

### Descriptive characters

Descriptive characters of fish refer to the qualitative traits or features used to describe the physical appearance, coloration, body shape, and other observable characteristics of fish species. These traits provide important information for species identification, taxonomy, and ecological studies. Descriptive

**Table 3:** Meristic characters of both *C. garua* and *C. montana* are shown in the table below. There are some differences in the numbers of dorsal fin-spines, soft rays, anal fin-spines, caudal fin-soft rays and no differences found in rest of the characters adipose fin, lateral line, pectoral fin-spine, ventral or pelvic fin-spine, barbels as shown in the table.

S.No.	Meristic characters	<i>Clupisoma garua</i>	<i>Clupisoma montana</i>
1	Adipose fin	Absent	Present, very small
2	Lateral line	Present	Present
3	Dorsal fin- spines	1-2 , slender	1
4	Soft rays	6-7 (4 branched)	7
5	Pectoral fin- spines	1, serrated internally	1
6	Soft rays	11	10
7	Ventral or Pelvic fin- spine	0	0
8	Soft rays	6	5
9	Anal fin- spines	3	1
10	Soft rays	27-29	30-34
11	Caudal fin- soft rays	16-18	19-20
12	Barbels	4 pairs (2 pair mandibular and 1 pair each of maxillary and nasal).	4 pairs (2 pair mandibular and 1 pair each of maxillary and nasal).

**Table 4:** Table presents the descriptive characters of *C. garua* and *C. montana* showing the body shape, mouth type, eyes, types of caudal fin, body color, and IUCN status of the fishes.

S.No.	Descriptive characters	<i>Clupisoma garua</i>	<i>Clupisoma montana</i>
1	Body shape	Elongated and laterally flattened	Robust body structure
2	Mouth	Wide and Sub terminal	Sub terminal
3	Eyes	Large, darker with circular adipose eyelids.	Small, little light color
4	Caudal fin	Deeply forked tail	Less forked tail
5	Body color	Silvery grey-green back and whitish or silvery on sides and belly. Light greenish on dorsal and caudal fin, light reddish on pectoral, pelvic, mouth and head. Silvery on anal fin.	Grayish above and whitish silvery on sides and belly. Light reddish on all fins and bluish on mouth and head.
6	IUCN status	Least concern. Threatened in West Bengal. Endangered in Bangladesh. Vulnerable in India.	Least concern

characters can include details about the shape of the body, presence or absence of certain fins, color patterns, scales, and other distinctive features (Table-4) [23-25].

## Conclusion

Freshwater ecosystems support a rich diversity of fish species, which contribute immensely to the ecological balance and provide vital resources for human consumption and recreational activities. The identification study of freshwater fish *C. garua* and *C. montana* using methods such as morphological, morphometric, meristic and descriptive characters near Indrapuri Dam area has provided valuable insights into the taxonomic classification and characteristics of these two species. It allowed us to differentiate between *C. garua* and *C. montana* based on distinct morphological traits. Meristic analysis that involved counting specific anatomical features such as the number of fin rays, scales, and vertebrae provided further supporting information. Similarly, morphometric analysis, which focused on quantitative measurements of various body parts, provided a more precise and objective means of identification. By examining measurements such as body length, head length, and fin dimensions, we were able to identify significant differences in size, counts and proportions between the two species. Lastly, the descriptive character analysis involved detailed descriptions of unique features, behavior, and habitat preferences which enhanced our understanding of the ecological niche and behavior of

these fish species, aiding in their accurate identification. Collectively, all these methods utilized in the identification study of *C. garua* and *C. montana* have contributed to our knowledge of their taxonomic classification and distinguishing characteristics. We are reporting detailed differences between the two species for the first time here. Such studies are crucial for effective conservation and management of freshwater fish populations, as well as for the overall ecological assessment of aquatic ecosystems. Future research can build upon these findings to explore further aspects of their biology and ecology, contributing to the preservation and sustainable management of freshwater fish species in similar habitats.

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## Conflict of interest

Authors declare no conflict of interest.

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