Icthyofaunal Diversity And Conservation Status Of Fish Under The Family Nemacheilidae In Kolodyne Drainage Of Mizoram, Northeastern India (Teleostei: Cypriniformes: Nemacheilidae)

Beihrosa Solo[1*]

[1*]Department of Zoology, Government Serchhip College, Serchhip-Mizoram, India, 796181. E-mail: beihrosasolo@yahoo.com

Abstract:
A survey on the fish diversity within the Nemacheilid family was conducted in selected rivers of the Kolodyne drainage in Mizoram, northeastern India, from January to December 2022. The survey identified a total of seven species across three genera: *Acanthocobitis*, *Physoschistura*, and *Schistura*. Among these, the genus *Schistura* was the most dominant, representing five species, while the genera *Acanthocobitis* and *Physoschistura* contributed only one species each. Certain species, such as *Acanthocobitis botia* and *Schistura andrewi*, were found to have very limited habitat distributions, being recorded only from the Mat River. Similarly, the *Physoschistura chhimtuipuiensis* species identified during the survey exhibited a restricted geographical range, being collected from only two rivers within the Kolodyne drainage.

Key words: Nemacheilidae, Kolodyne, Mizoram.

Introduction

Loaches of the family Nemacheilidae are a distinctive and significant component of the Eurasian ichthyofauna, inhabiting nearly all types of running waters across their distribution (Banarescu & Nalbant, 1973). This family comprises approximately 30 genera and 720 nominal species, with the majority found in South and Southeast Asia (Kottelat, 2012). Despite this diversity, many taxa within the family remain undescribed, indicating the potential for further discoveries and highlighting the need for more comprehensive research (Bohlen & Slechtova, 2011).

The Nemacheilidae family is among the largest within the order Cypriniformes (Conway *et al*., 2011) and is distributed widely across Asia, Europe, and parts of northeastern Africa, including Ethiopia (Kottelat, 1990). However, these fishes are poorly studied compared to other fish families. This lack of attention is largely due to their small size and limited distribution, which make them difficult to collect and study. Despite these challenges, nemacheilids hold ecological significance and are valued in the aquarium trade for their unique adaptations and attractive appearances (Kottelat, 1990).

Throughout their range, nemacheilids have been the focus of several taxonomic studies that aim to clarify their classification and evolutionary relationships. These efforts have significantly contributed to our understanding of the group, but much work remains to be done due to the high species richness and the presence of undescribed taxa.

Ecologically, loaches are commonly found in well-oxygenated hill streams, where they play a vital role in maintaining the health and stability of aquatic ecosystems (Kottelat, 1990). They often inhabit fast-flowing, clear waters and are particularly abundant in pristine environments with minimal human disturbance. Certain species of nemacheilids are confined to the upper reaches of river systems, where they are highly sensitive to environmental changes, including pollution and habitat degradation (Conway *et al*., 2011). This sensitivity underscores their importance as bio-indicators, as they can serve as early-warning systems for monitoring the impacts of human activities on freshwater ecosystems.

The ichthyofauna of Mizoram, located in northeastern India, remains largely underexplored. It is, therefore, unsurprising that recent studies focusing on the family Nemacheilidae have led to the discovery and description of several new species within the genus Schistura. These newly described species include *Schistura aizawlensis* (Lalramliana, 2012), *S. koladynensis* (Lokeshwor & Vishwanath, 2012), *S. maculosa* (Lalronunga, Lalnuntluanga & Lalramliana, 2013), *S. nebeshwari* and *S. scyphovecteta* (Lokeshwor & Vishwanath, 2013), *S. porocephala* (Lokeshwor & Vishwanath, 2012), *S. paucireticulata* (Lokeshwor, Vishwanath & Kosygin, 2013), and *S. andrewi* (Solo, B., Lalramliana, Lalronunga, S., & Lalnuntluanga, 2014).

Material and Methods

Specimens were collected from the Kolodyne River and six selected tributaries: Sala, Ngengpui, Tuisi, Tuichang, Mat, and Tiau Rivers, all part of the Kolodyne drainage in Mizoram from January to December, 2022. Field collections were conducted three times a year, spaced four months apart, to maximize fish diversity in the samples. Counts and measurements were performed following Kottelat (1990). Measurements were taken point-to-point on the left side of each specimen using digital callipers, accurate to 0.1 mm, while fin rays were counted under a stereomicroscope.

Specimens were initially preserved in 10% formalin solution in the field and subsequently transferred to the laboratory for detailed morphometric and meristic analyses. Photographs of each specimen were taken in fresh condition, capturing the left side of the fish.

Results & Discussion

The Nemacheiline loaches collected from the study area during the year 2022 comprises of 7 species belonging to 3 genera namely *Acanthocobitis*, *Physoschistura* and *Schistura*. Out of these, the genus *Schistura* turns out to be the most dominant by contributing 5 species whereas the genera such as *Acanthocobitis* and *Physoschistura c*ontributes only one species each. The different species collected under the family Nemacheilidae can be highlighted as follows:

1) *Acanthocobitis botia*

Diagnosis: *Acanthocobitis botia* is distinguished from its congeners by having the following combination of characters: presence of median interruption in lower lip; deep slit in cheek extending from base of rostral barbel to margin of eyes; dorsal fin with 3 simple, 12 branched rays, presence of 5oblique longitudinal lines or row narrow bands; Caudal fin with 9+8 principal rays, presence of 5 rows of transverse dark bars; Lateral line complete with 80 cephalic pores; axillary pelvic fin-lobe large.

Remark: This species of fish has been collected only from Mat River, a tributary of Kolodyne River of Mizoram so far among the specimen collected and it is not of common occurrence from the selected study areas. However, this species proved to be of common occurrence in abundance and distribution in other drainages and hence, according to IUCN criteria, it is put under the least concern category. *Acanthocobitis botia* from the Kolodyne River requires proper conservation due to its limited number and occurrence as is evident only from one study site. Without proper conservation measures, this species may likely face extinction from the Kolodyne drainage of Mizoram in the near future.

Figure 1. A) *Acanthocobitis botia* **B**) *Physochistura chhimtuipuiensis*

2) *Physoschistura chhimtuipuiensis*

Diagnosis: *Physoschistura chhimtuipuiensis* is distinguished from its congeners by having the following combination of characters: presence of two V-shaped dark brown bars across posterior part of caudal fin; dorsal and dorsolateral portion of head mottled dark brown; lateral line incomplete with 55-63 pores; 10-13 irregular dark brown saddles forming bars on the lateral side; large axillary pelvic-fin lobe; suborbital flap in males; dorsal with 3 simple 8 ½ branched rays, anal fin with 3 simple 5 ½ branched rays.

Remark: *Physoschistura chhimtuipuiensis* is collected only from 2 out of the 7 study sites which indicate that it is not of common occurrence in majority of the rivers of Kolodyne drainage, Mizoram. Due to lack of diversity study on this particular species, it is still put under not evaluated category according to IUCN criteria which raise concern over its conservation.

3) *Schistura andrewi*

Diagnosis: *Schistura andrewi* differs from other species of the genus from the Kaladan basin and its adjacent basins by having the combination of the following characters: long axillary pelvic lobe; complete lateral line with 82–95 pores; 2 unbranched dorsal and anal fin rays; 6–7 broad, wider than interspace, black bars on the body; 2 rows of black spots horizontally across the dorsal fin; a deeply emarginate caudal fin with 2 vertical rows of black spots across the fin, and 9 + 8 branched caudal fin rays; males with a sub-orbital flap; and intestine looped behind the stomach.

Remark: *Schistura andrewi* has been described as a new species from Mat River, a tributary of Kolodyne River from Mizoram, northeastern India (Solo *et al*., 2014).*Schistura andrewi* has been reported first and only from Mat River of Kolodyne drainage within Mizoram and the endemic status is yet to ascertain with more research. Since no specific IUCN criterion is available for this species, it is still put under not evaluated category.

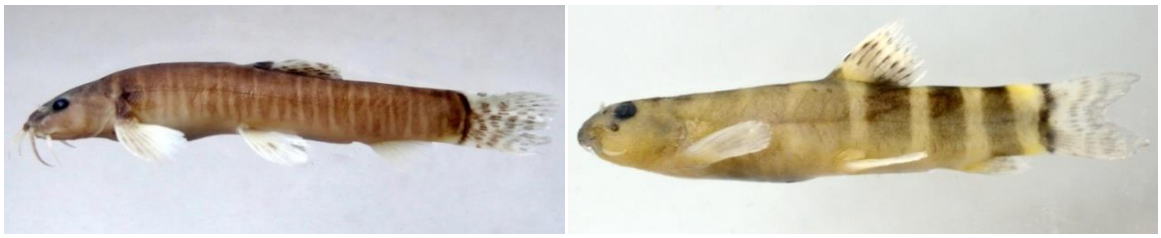

Figure 2. A) *Schistura porocephala* **B) *Schistura andrewi***

4) *Schistura porocephala*

Diagnosis: *Schistura porocephala* can be distinguish from its congeners by having the combination of the following characters: presence of cephalic lateral line system with prominent pores, incomplete lateral line with 28-37 pores,17-23 thin olivaceous dark bars on body against yellowish cream background; dorsal-fin with 3 simple, 7 ½ branched rays, 2-3 rows of black spots on dorsal fin; caudal fin with 10+9 principal rays (9+8 branched rays), slightly emarginate, subequal, upper lobe little longer than lower, presence of 5-6 rows of black spots; presence of elongated suborbital flap in males extending from anterior tubular nostril to anterior one third of eye.

Remark: *Schistura porocephala* has been described as a new species from a stream that drains into Mat River near Thualthu village (Kolodyne basin) of Mizoram (Lokeshwor & Vishwanath, 2012). This species has been collected from 4 study sites out of 7 and is of common occurrence and proved to be quite dominance in its habitat rivers. Since this species has been described recently in 2012 only, its IUCN criterion is still lacking due to lack of further research about its diversity from other drainages and hence, is still put under not evaluated category.

5) *Schistura koladynensis*

Diagnosis: *Schistura koladynensis* is distinguished from its congeners by the following combination of characters: lateral line system complete with 85-100 pores, presence of 9-11 dark brown saddles forming bars on the lateral side of the body, saddle often dissociate from bars on the caudal peduncle region, basicaudal dark bar present; caudal fin with 4-5 vertical rows of dark spots, two vertical rows of dark spots anterior to the fork and 2-3 radiating posterior from the fork.

Remark: *Schistura koladynensis* has been described as a new species from Kolodyne River at Kawlchaw Village, Lawngtlai District of Mizoram (Lokeshwor &Vishwanath, 2012). This species of *Schistura* is of common occurrence among the rivers of the study areas. As it is collected from all the different study sites at all seasons, it is proved to be the most dominant species among the Nemacheiline loaches. Due to lack of studies, its IUCN status is still under not evaluated category which requires its need for conservation.

Figure 3. A) *Schistura scyphovecteta* **B) *Schistura koladynensis***

6) *Schistura scyphovecteta*

Diagnosis: *Schistura scyphovecteta* is distinguished from its congeners by the combination of the following characters: complete lateral line system, 5-6 dark brown stripes, each continuing to the flank forming globular shaped bars, dorsal fin-base with two black spots, basicaudal bar incomplete, lower jaw without median notch,

Remark: *Schistura scyphovecteta* has been described as a new species from Ka-ao River near Serkawr Village, (Kolodyne basin) of Mizoram (Lokeshwor & Vishwanath, 2013).This species is of common occurrence as it is collected from majority of the study sites with the exception of one. However, dominant-wise, it is not a very dominant species as only few numbers were collected in each fish collection. *Schistura scyphovecteta* has been first reported and collected from the Kolodyne drainage of Mizoram only and its occurrence in other drainage is not yet known. But due to lack of studies on its diversity, its endemic status is not yet fully known. According to IUCN criteria, this species has been put under not evaluated category which proves its need for immediate and proper conservation to save the species from becoming extinct in the near future.

7) *Schistura nebeshwari*

Diagnosis: *Schistura nebeshwari* is distinguished from its congeners by the combination of the following characters: presence of dorsal adipose crest on the caudal peduncle, 11-16 dark olivaceous bars on the body, presence of numerous

small melanophores on ventral side of head, lateral line incomplete, dorsal fin-base with three black spots, dark prominent basicaudal bar, shallow median notch in lower jaw, absence of suborbital flap in males, inflated cheek, deep caudal peduncle.

Remark: *Schistura nebeshwari* has been described as a new species from a stream at Phura Village near Palak Lake (Kolodyne basin) of Mizoram (Lokeshwor & Vishwanath, 2013). *Schistura nebeshwari* has been collected from all the study sites and is proved to be quite dominant among the *Schistura* species collected from the Kolodyne drainage. This species is first reported from Kolodyne drainage of Mizoram only and its endemic status is yet to be ascertained with further research on its diversity. However, due to lack of study on its diversity, it is still put under not evaluated category according to IUCN criteria.

Figure 4. A) *Schistura nebeshwari*

Table 1. List of Nemacheiline loaches from Kolodyne drainage of Mizoram and IUCN (2023) status.

S.No	Name	Genus	IUCN
1	*Acanthocobitis botia*	*Acanthocobitis*	LC
2	*Physoschistura chhimtuipuiensis*	*Physoschistura*	NE
3	*Schistura koladynensis*	*Schistura*	NE
4	*Schistura porocephala*	*Schistura*	NE
5	*Schistura nebeshwari*	*Schistura*	NE
6	*Schistura scyphovecteta*	*Schistura*	NE
7	*Schistura andrewi*	*Schistura*	NE

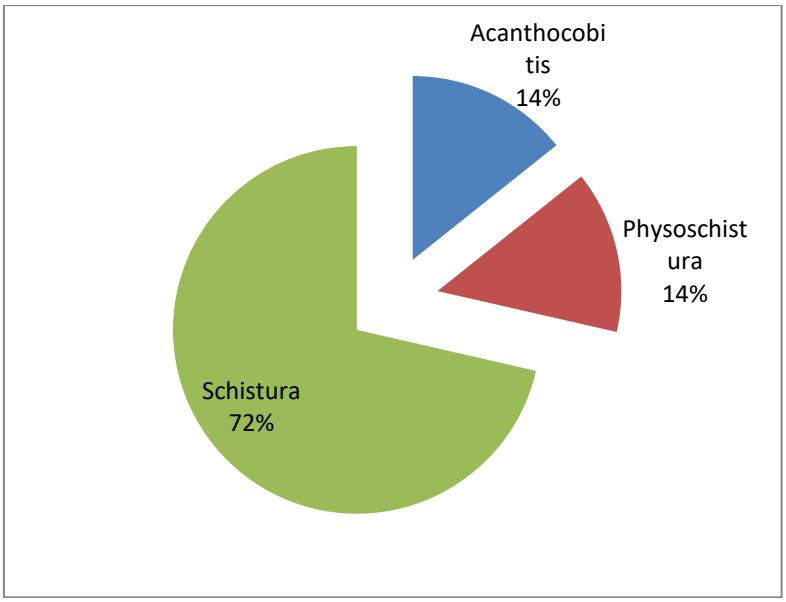

Figure 5. Genus-wise distribution of Nemacheiline loaches from Kolodyne drainage of Mizoram.

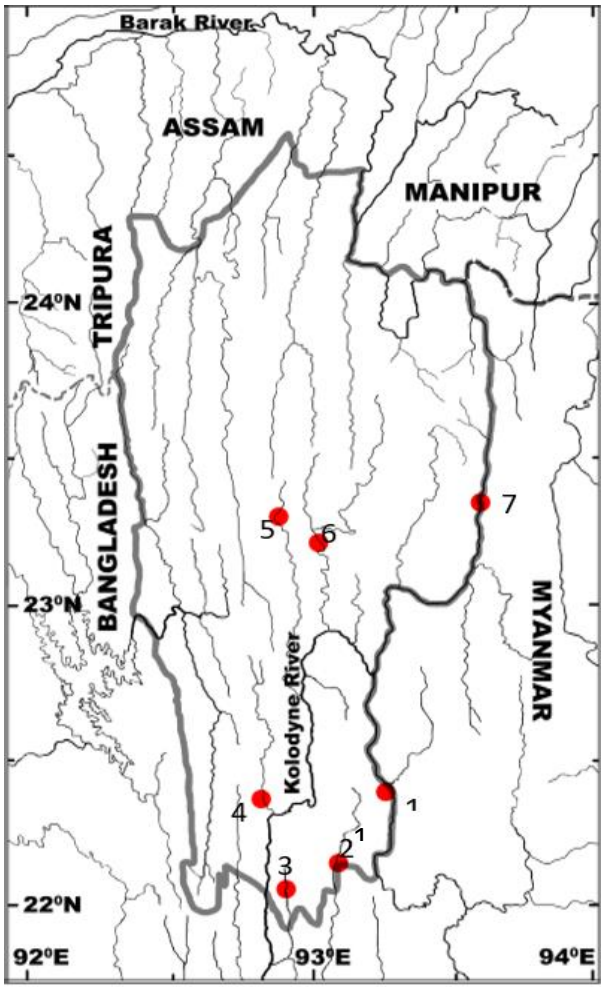

Figure 6.Study areas. 1) Kolodyne; 2)Tuisi; 3) Sala; 4) Ngengpui; 5) Mat; 6) Tuichang; 7) Tiau

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