

SHORT COMMUNICATION

First Report of Ichthyofaunal Composition in the River of Madauo, Maco, Davao de Oro, Philippines

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ABSTRACT

Studies on freshwater fishes in Davao Region, Mindanao, Philippines, remain limited and are only conducted in a few areas. To help address this deficiency, the researchers conducted a rapid assessment of freshwater fishes in the river of Madauo, Maco, Davao de Oro, Philippines, in August 2022. A total of 429 individuals representing 12 species from eight families were collected. The Families Eleotridae and Gobiidae were the most represented, with three species each. Five of these species were identified as native, and three were introduced. The most abundant species was *Barbodes binotatus* of Family Cyprinidae. Two species reported in this study, *Bunaka gyrinoides* and *Giuris tolsoni*, were added to the list of known freshwater fishes in the Davao Region. The results of this study not only serve as a baseline for future research but can be a valuable input in crafting policies to protect the river and conserve its biodiversity.

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Freshwater ecosystems cover less than one percent of the Earth's surface and are home to an extraordinary diversity of life (Strayer and Dudgeon 2010). Unfortunately, freshwater biodiversity has declined rapidly over the past years (Loh et al. 2002, as cited by Jenkins 2003). The number of freshwater species around the globe has declined by 83% since 1970 (WWF 2018). One of the freshwater organisms threatened with extinction is fish (WWF 2021), and the significant loss of freshwater fish diversity observed in the past decades could be attributed to the combined effects of several factors, such as acidification, eutrophication, introduction of invasive species and climate change (MEA 2005).

There are at least 13,000 freshwater fish species worldwide belonging to 2513 genera of some 170 families (Levêque et al. 2008). However, a more recent report revealed that there are 18,075 freshwater fishes which account for more than half of all known fish (WWF 2021). Even with this number of discovered species, inventories or assessments remain incomplete in some parts of the world (Levêque et al. 2008). Pelayo-Villamil et al. (2014) revealed that many

freshwater fish species remain to be discovered. The importance of freshwater fishes in their respective ecosystems cannot be downplayed as they deliver various provisioning (e.g., aquaculture, bioindicator, genetic pool), regulating (e.g., decomposition, seed dispersal) and supporting (e.g., habitat quality, nutrient cycling) services (Pellicice et al. 2023).

As of February 2023, 360 freshwater fishes in the Philippines are listed (Froese and Pauly 2022). Inventories were already done to ascertain the ichthyofaunal composition and diversity of various freshwater systems of Luzon (e.g., Corpuz et al. 2016; Cui et al. 2022; Labatos and Briones 2014; Tauli et al. 2022), Visayas (e.g., Denusta et al. 2020; Guzman and Capaque 2014) and Mindanao (e.g., Cudal et al. 2019; Ojao et al. 2021; Vedra et al. 2022; Yagos et al. 2022). Even so, data on freshwater fishes remains scarce, especially in Davao Region. Despite having at least 40 river bodies (DENR-EMB 2018), records were only available for the Mt. Hamiguitan Range Wildlife Sanctuary River systems in Davao Oriental (Dapar et al. 2021; Quimpang et al. 2015, 2016). To help address this deficiency, the researchers conducted a rapid

assessment of freshwater fishes in the unstudied river of Maduao, Maco, Davao de Oro, Philippines. This study sought to classify the fish and to determine the relative abundance of identified species. The result of this baseline study will enable a better understanding of ichthyofaunal composition in the said river system.

This study was done along the 2.16-km river segment in Maduao, Concepcion, Maco, Davao de Oro, Philippines (Figure 1). From Barangay Concepcion, the river passes through barangays Lumatab, Binuangan, and Bucana and drains into Davao Gulf. This medium-type river reaches up to 10–20 m wide and 2 m deep. It originates from a waterfall, and the stretch presents mountain stream characteristics. It has a curved shape and clear waters with slow water flows and steep rocky slopes surrounded by trees. Ferns and perennial weeds line some areas of the riverbanks. The site includes a portion of agroforestry near and within civilized settlements with crops such as *Cocos nucifera*, *Theobroma cacao*, and *Musa* spp. present.

Three stations with approximately 300–400-m intervals were established in the river for sampling (Figure 2). Station 1 (upstream: 7.396242°N 125.887475°E) features a maximum depth of 1.10 m,

limited sunlight due to dense riparian vegetation offering sufficient shade to the water, coarse grain substrates, boulder-rich riverbeds contributing to turbulent water flow, and noticeable extensive rock formations on both riversides. Further, station 2 (midstream: 7.396675°N 125.885108°E) exhibits a laminar water flow, reaching a maximum depth of about 0.70 m, and has a riverbed with coarse sand and pebbles. Station 3 (downstream: 7.399795°N, 125.883798°E), on the other hand, has a maximum water depth of about 1.00 m and a pebbly riverbed. To its side, human settlements and cultivated crops like coconut, banana, and bamboo were observed. Each station was surveyed for 40 minutes for four days (Corpuz et al. 2016) and was done between 10:00 and 15:00 (Labatos and Briones 2014) last August 2022. Fish samples were collected using various fishing gears (Figure 3) and methods, such as seine netting (1.5 x 1.5 cm mesh), scoop netting, and low-voltage electrofishing. The collection of samples was permitted by the Department of Agriculture-Bureau of Fisheries and Aquatic Resources Region XI (Gratuitous Permit No. R11-GP-001-22). All fish caught were counted and initially identified.

Identification was made by examining morphometric characteristics. Previous publications (Cudal et al. 2019; Dapar et al. 2021; Quimpang et al. 2015, 2016, 2020; Ojao et al. 2021) were also consulted. Specimens of each species were preserved in a 10% formaldehyde solution and were temporarily stored for further documentation. Verification of species was mainly carried out with FishBase. Advice from an expert was also sought.

In this first account of ichthyofaunal composition in the river of Maduao, Maco, Davao de Oro, a total of 429 individuals of freshwater fish

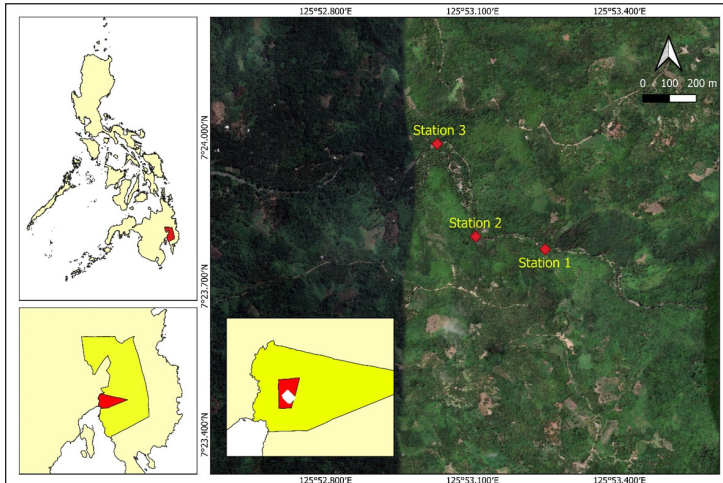


Figure 1. Study area in the river of Maduao, Maco, Davao de Oro, Philippines.

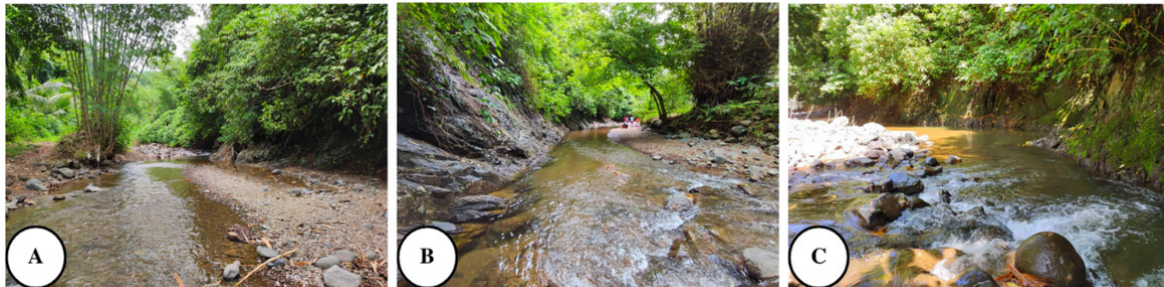


Figure 2. Sampling sites in the river of Maduao, Maco, Davao de Oro, Philippines. A) Station 1; B) Station 2; C) Station 3.

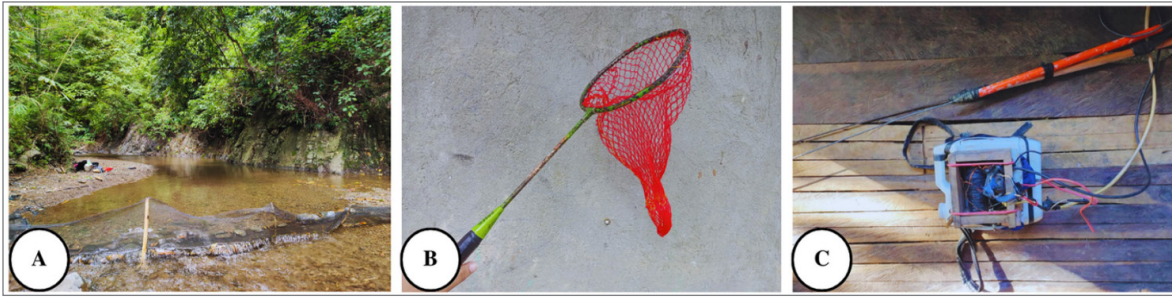


Figure 3. Fishing gears used during sampling. A) seine net; B) scoop net; C) electrofishing apparatus.

comprising 12 species representing eight families were recorded (Table 1). Families Eleotridae and Gobiidae were the most represented, with three species each, while other families were represented by one species each. The species richness revealed in this study is lower than the previous studies conducted in several freshwater systems in Mindanao, Philippines: 19 in Sibugay River, Zamboanga del Sur (Yagos et al. 2022), 23 in Ihawan Spring Community Watershed, Surigao del Sur (Ojao et al. 2021), 25 in the river systems of

Mt. Hamiguitan Range Wildlife Sanctuary, Davao Oriental (Dapar et al. 2021), and 27 in Iligan River, Iligan City (Requieron and Demayo 2015). Even so, it is comparable to the record in Mount Timolan Protected Landscape, Zamboanga del Sur (n = 12; Cudal et al. 2019), and higher than the Matingao and Marbel rivers, Mt. Apo Natural Park (n = 6; Quimpang et al. 2020) and Talabaan River, Misamis Oriental (n = 11, Vedra et al. 2022). The lower species richness accounted for in this study may be attributed to limited

Table 1. Freshwater fishes in the river of Maduao, Maco, Davao de Oro, Philippines

Species name	Common name	Local name	Endemism	IUCN Status	Stations			Total	Relative Abundance (%)
					1	2	3		
ANGUILLIDAE									
<i>Anguilla marmorata</i>	Giant Mottled Eel	kasili	Native	Least concern	1	1	2	4	0.93
CHANNIDAE									
<i>Channa striata</i>	Snakehead Mudfish	haluan	Introduced	Least concern	-	2	-	2	0.47
CLARIIDAE									
<i>Clarias batrachus</i>	Walking Catfish	pantat	Introduced	Least concern	1	-	-	1	0.23
CYPRINIDAE									
<i>Barbodes binotatus</i>	Spotted Barb	paitan	Native	Least concern	193	133	36	362	84.38
ELEOTRIDAE									
<i>Bunaka gyrinoides</i>	Greenback Gauvina	bibangon	Native	Least concern	-	2	-	2	0.47
<i>Eleotris</i> sp.	-	bibangon	For further ID		5	2	2	9	2.10
<i>Giuris tolsoni</i>	-	bibangon	No data	No data	8	6	4	18	4.20
GOBIIDAE									
<i>Awaous ocellaris</i>	Spotfin River Goby	burod	Native	Least concern	1	4	2	7	1.63
<i>Sicyopterus</i> sp. 1	-	hipon	For further ID		5	6	4	15	3.50
<i>Sicyopterus</i> sp. 2	-	hipon	For further ID		1	-	-	1	0.23
OSPHRONEMIDAE									
<i>Trichopodus trichopterus</i>	Three Spot Gourami	gurami	Introduced	Least concern	-	1	-	1	0.23
RHYACICHTHYIDAE									
<i>Rhyacichthys aspro</i>	Loach Goby	darupingan	Native	Data deficient	4	3	-	7	1.63
Total					219	160	50	429	100

fishing gear used, time, effort, and site coverage during sampling.

Among the species documented in this study (Figure 4), five are native, three have been introduced, three are pending further identification, and one remains uncategorized (Table 1). The status of *Giuris tolsoni* (Figure 4G) in the Philippines remains to be determined as it is not listed in FishBase for freshwater fishes in the country, despite specimens having been collected from Panay Island (Keith and Mennesson 2020). Further, IUCN (2023) data showed that none of the identified species was threatened at the global level. Of all the species caught, *Barbodes binotatus* (Figure 4D), a native species, was found to be the most

abundant constituting 84.38% of the total population. The dominance of native species may indicate a healthy state of the river (Ojao et al. 2021). However, the presence of introduced species could pose a threat to the stability of the native ecosystem as they, though not always, could become invasive and have negative impacts such as loss of genetic integrity, reduced species richness, and higher mortality rates of native species (Britton 2023). In fact, two species found in the study site, *Channa striata* (Figure 4B) and *Clarias batrachus* (Figure 4C), have become invasive in the country (Guerrero 2014). To et al. (2022) classified *C. batrachus* to have a high risk of becoming invasive even with consideration of future climatic conditions. On a

positive note, only a few individual counts of introduced species were documented in the river of Maduao.

Regarding the relative abundance per site, station 1 had the highest abundance (51.04%). It is followed by stations 2 (31.15%) and 3 (11.66%). These varying abundances across sites may be attributed to food availability, habitat type, and anthropogenic activities (Vedra et al. 2013). Furthermore, this study found that the upstream and midstream stations had higher species richness, with nine and ten species, respectively. Low abundance and richness downstream may be due to water quality affected by water uses and surrounding land uses (Gebrekiros 2016). During fieldwork, domestic activities were observed in the river. A denser settlement area was also noted near the downstream sampling station.

While this study only accounted for 12 species, two of which, *Bunaka gyrinoides* and *G. tolsoni* of Family Eleotridae, were added to the current list of known freshwater fishes for the Davao Region. These species have not been previously reported in the region (cf. Dapar et al. 2021; Escote and Jumawan 2017; Quimpang et al. 2015, 2016).

Overall, the inventoried river in Maduao, Maco, Davao de Oro, shelters various fish species. The presence and dominance of native

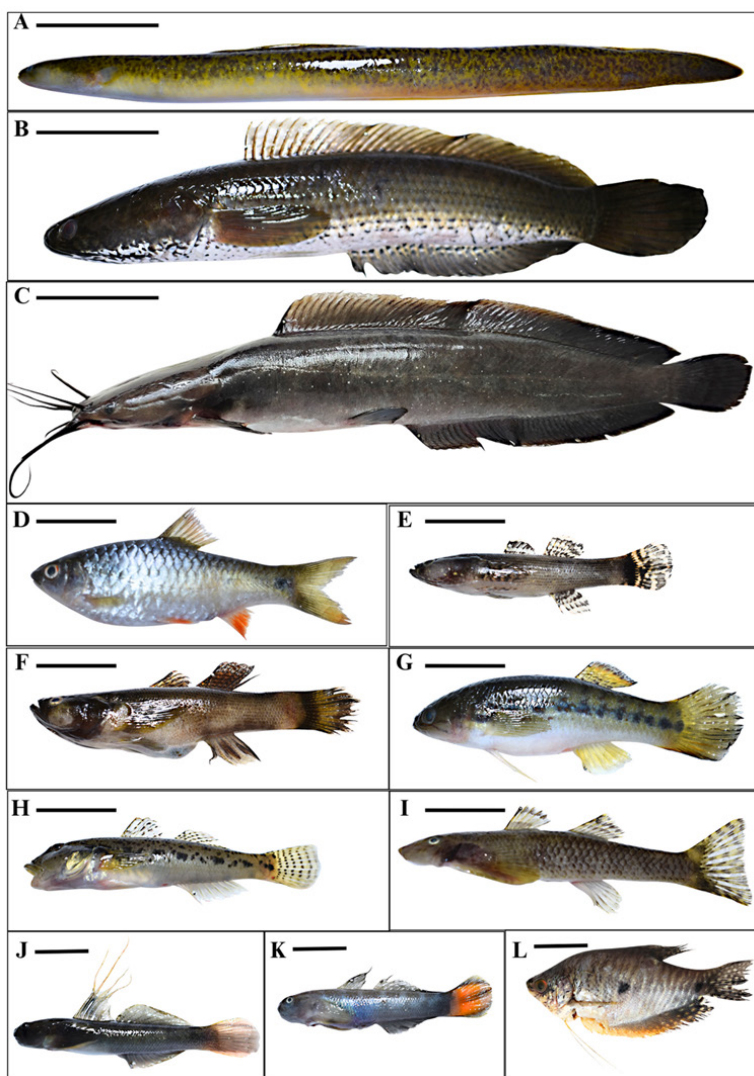


Figure 4. Fish samples collected and identified from the river of Maduao, Maco, Davao de Oro, Philippines. A) *Anguilla marmorata*; B) *Channa striata*; C) *Clarias batrachus*; D) *Barbodes binotatus*; E) *Bunaka gyrinoides*; F) *Eleotris* sp.; G) *Giuris tolsoni*; H) *Awaous ocellaris*; I) *Rhyacichthys aspro*; J) *Sicyopterus* sp. 1; K) *Sicyopterus* sp. 2; and L) *Trichopodus trichopterus*. Scale bars: A, B, and C = 5 cm; E, D, F, G, H, and I = 3 cm; and J, K, and L = 2 cm.

species may signify their healthy state. However, the presence of introduced species necessitates constant monitoring to ensure that they do not negatively impact the native species or become invasive over time. Future surveys are recommended to be extensive by increasing sampling efforts and establishing more sites downstream until near the estuary to provide a better perspective about its ichthyofaunal composition and diversity. This account can also be a valuable input in crafting policies to protect the river and conserve its diversity. Efforts to protect the site should be made to ensure the continued existence of these species, especially the upstream area that has been gaining visitors due to its waterfall's recreational value.

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AUTHOR CONTRIBUTIONS

Alonzo CSP: Conceptualization, Methodology, Investigation, Data curation, Visualization, Writing-Original Draft. **Diamante EJY:** Conceptualization, Methodology, Investigation, Data curation, Visualization, Writing-Original Draft. **Vitor-Maluya KCA:** Methodology, Investigation, Writing-Review and Editing. **Alimbon JA:** Conceptualization, Investigation, Formal Analysis, Writing-Review and Editing, Supervision.

CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICS STATEMENT

The researchers followed all institutional and national guidelines for the care and use of laboratory animals.

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