Biodiversity of Ichthyofauna In Mainland Waters of Muara Bulian District Jambi Province and Its New Record

Apriliawati[1*], *Tedjo* Sukomono[1], and *Anggit* Nugraha[1]

[1]Biology, Faculty of Science and Technology, University of Jambi Street. Jambi – Muara Bulian No.KM. 15, Mendalo Darat, District. Jambi Outher City, Muaro Jambi, Jambi

Abstract. Sumatra Island has 589 species of freshwater fish with 58 of them being endemic. Jambi Province ranks second as the highest endemic province and has the longest river in Sumatra passing through six districts, one of which is Batanghari Regency. Muara Bulian District is the only sub-district in Batanghari Regency whose entire village is traversed by the Batanghari River. This research aims to reveal the biodiversity of ichthyofauna in the mainland water of Muara Bulian. The four research stations represent different habitats, namely Batanghari River, Bulian River, Letang's Lake, and Teratai's Swamp. Sampling was carried out using various fishing gear and bait, to obtain different samples. The results of this study showed the diversity of fish from 523 individuals, there were 51 species, 32 genera, 18 families, 8 orders included 2 species (*C. kapuasensis* and *C. pseudoleiacanthus*) as New Record in Jambi Province, included 1 species protected by government, and the other is introduction or native species. Research data in the form of fish specimens have been deposited at the Zoologicum Bogoriens Museum (MZB) belonging to the Bogor National Research and Innovation Agency (BRIN) with numbers MZB 26811 to MZB 26834.

1 Introduction

Sumatra Island is one of Indonesia's largest islands, covering 50,630,931 km^2 and home to over 150 districts and cities with rivers, lakes, and swamps [1]. This diverse ecosystem provides ample potential for freshwater fish, with [2] identifying 589 species of freshwater fish on the island, 58 of which are native to Sumatra. Unfortunately, many of these species, such as lais kaca (*Kryptoperus minor*), sepat mutiara (*Trichopodus leerii*), ridiangus (*Balantiocheilos melanopterus*), belida (*Chitala borneensis*), and silver Arowana (*Schlerophages formosus*) have experienced significant population declines and are difficult to find in the wild [3]. The highest endemicity is found in West Sumatra and Jambi provinces. Jambi Province has the Longest River in Sumatra passing through six districts, one of which is Batanghari Regency. Muara Bulian District is the only sub-district in Batanghari Regency

* Corresponding author: tedjo_sukmono@unja.ac.id

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whose entire village is traversed by the Batanghari River and has inland waters in the form of tributaries, lakes, and swamps.

Muara Bulian District is one of the eight sub-districts in Batang Hari Regency and it serves as the capital of Batanghari Regency. The area of the district is 417.97 km^2 and it is situated along the Batanghari River, which has various types of inland waters. These include the Bulian River, Letang's Lake, and Teratai's Swamp, these various types of habitats are inhabited by different species of fish. For instance, fish with barbels are commonly found in river habitats, whereas those that can swim fast in open water and search for food at the bottom of the water are usually found in lake waters. Additionally, fish without scales and with a pocket-like room under the gills are more common in swamp waters [4]. Although the ichthyofauna in the mainland of Muara Bulian District is expected to be diverse, there is no available data yet on the biodiversity of ichthyofauna across these four habitats. In various forms, waters that are on land are referred to as mainland waters. These can be in the form of rivers, lakes, or swamps. Inland waters can be further categorized into two types: stagnant surface (lentic) and flowing surface (lotic). Muara Bulian District, which covers an area of 417.97 km^2, is the capital of Batanghari Regency. Geographically, it is located between 1˚40' south latitude to 139' south latitude and between 1˚39' east longitude to 103˚09' east longitude. Therefore, it is important to explore the freshwater ichthyofauna's biodiversity in the mainland of the district.

2 Materials and Methods

The study was carried out in the mainland waters of the Muara Bulian District, which included the Batang Hari River, Bulian River, Letang's Lake, and Teratai's Swamp. These locations featured three substations that were selected using purposive sampling. Purposive Sampling was based on the presence of upstream, middle, and downstream. The investigation also considers the presence of inlets and outlets, anthropogenic activities, the presence of hollows, and the presence of vegetation [4]. Tools and materials in this study consisted of various types of fishing gear because different fish are caught with different tools and different types of bait.

2.1 Tools and materials

Captions Gill nets with mesh diameters of 1 inch, 2 inches, and 3 inches, traditional trap (bubu) sized at 2.5 x 1.5 x 1.5 meters, hooks in sizes 0.6, 6, 3, 4, 5, 6, 11, and 12, mesh size of 1 inch, traditional trap (tangkul) mesh size 0.5 inches, cameras, aquariums sized at 35 x 15 centimeters, red velvet base cloth, cloth meters, stationeries, trays, identification books, DO meters, pH meters, thermometers, laser rangefinders, Secchi disks, GPS devices, bottle jars, lup/magnifying glasses, dissecting sets, alcohol at 70%, formalin at 10%, and fish samples.

2.2 Sampling

The sampling has been adjusted to match the activity level of the fish. Fish activity can be classified into two categories based on their sensitivity to light. Diurnal fish, which are sensitive to light, are active during the day, while nocturnal fish, which are not sensitive to light, are active at night. [5] Each station uses different combinations of fishing gear and bait, these are explained in table 1.

Table 1. Gear and Bait used at four stations

No	Gear/bait	Station 1 Batanghari River	Station 2 Bulian River	Station 3 Letang's Lake	Station 4 Teratai's Swamp
	Gear				
1	Gill Net	-	√	√	√
2	Jala	√	-	-	-
3	Fishing rod	√	√	√	√
4	Tangkul	√	-	-	-
5	Bubu	√	√	√	√
6	Scooping net	-	-	√	√
	Bait				
7	Worm	√	√	√	√
8	Frog	√			√
9	Ants	√	√	√	-
10	Cricket	-	√	√	√
11	Pellets	-	-	√	-
12	Chicken offal	√	-	-	-
13	Shrimp	√	-	-	-

2.3 Identification Samples

Identification samples used in the identification books authored by [6], [7], [8], and reference www.fishbase.org also provide valuable information on identification. The process was based on analyzing the morphology and meristics of the fish, which includes features such as body shape, mouth type, tail type, number of scales on the lateral line, and number of fin rays. This process measured morphometric and meristic characters. According to [9], morphometrics refers to the physical attributes of fish, specifically their body size and outer shape. Meanwhile, Meristic characters refer to the number of external body parts of a fish, such as the number of Dorsal fin rays (D), Pectoral fin rays (P), Pelvic fin rays (Pv), Anal fin rays (A), and scales on Lateral Line (Li).

2.4 Samples Preserved

To preserve fish samples larger than 15 cm, 70% alcohol is injected into their internal organs through the anal canal. These samples are then stored in a container with 10% formalin. However, small fish do not require internal organ injections. This preparation is necessary to create a voucher specimen. After treatment with formalin, the fish are rinsed with distilled water and dried with a tissue. They are then stored in a jar filled with 70% alcohol to ensure proper preservation.

2.5 Sample Deposits

Data in the form of specimens were deposited at the Zoologicum Bogoriens Museum (MZB), National Research and Innovation Agency (BRIN). The fish deposited in the MZB are representatives of Jambi fish that have not been in the MZB before. To deposit the samples, the following steps were taken: 1.) Filling out the fish deposit form 2.) Preparing the bottles of specimen vouchers and alcohol needed according to the number of fish to be deposited. 3.) Preservation of the specimen voucher into the specimen bottle 4.) Writing the voucher,

and filling in the catalog number. Then, MZB code is given if the specimen is already done to all procedures of deposit. In this research, MZB code is given at MZB 26811 to MZB 26834.

3 Results and Discussion

3.1 Biodiversity of Ichtiofauna in Mainland Water of Muara Bulian

According to the research conducted, 51 species, 32 genera, 18 families, and 8 orders were obtained. Each species was found in the same or different stations, this shown the distribution of the ichthyofauna based on four different habitats Table 2.

Table 2. Biodiversity of Ichthyofauna in Mainland Water of Muara Bulian

No	Family/Species	Local name	Station				MZB Code	IUCN/KKP
			I	II	III	IV		
	Anabantidae							
1	*Anabas testudineus*	Betok	0	0	0	3	-	LC
	Aplocheilidae							
2	*Aplocheilus panchax*	Kapi-kapi	0	0	0	1	MZB 26818	-
	Bagridae							
3	*Bagroides melapterus*	Baung kembang	1	0	0	0	MZB 26823	LC
4	*Hemibagrus nemurus*	Baung	0	1	0	0	MZB 26829	LC
5	*Hemibagrus planiceps*	Baung	1	0	0	4		-
6	*Mystus castaneus*	Senggiring	0	0	0	2	MZB 26812	LC
7	*Mystus nigriceps*	Senggiring	4	4	0	41	-	LC
	Channidae							
8	*Channa lucius*	Bujuk	0	0	1	0	-	LC
9	*Channa micropeltes*	Toman	1	0	1	0	-	LC
10	*Channa striata*	Gabus	0	0	0	2	-	LC
	Chiclidae							
11	*Oreochromis niloticus*	Nila	29	0	0	5	-	LC
	Clariidae							
12	*Clarias kapuasensis**	Lele	0	0	0	1	MZB 26820	LC
13	*Clarias pseudoleiacanthus**	Lele	0	0	0	1	-	CR
	Cyprinidae							
14	*Barbonymus schwanenfeldii*	Lampam	2	1	0	6	MZB 26813	LC
15	*Barbichthys laevis*	Bentulu	0	0	0	4	MZB 26814	LC
16	*Cyclocheilichthys apogon*	Puyou	1	2	20	5	-	LC

No	Family/Species	Local name	Station				MZB Code	IUCN/KKP
			I	II	III	IV		
17	*Hampala ampalong*	Sebarau	0	1	7	7	MZB 26833	LC
18	*Labiobarbus festivus*	Umbut-Umbut	0	0	0	1	-	DD
19	*Labiobarbus sabanus*	Umbut-Umbut	1	0	0	0	MZB 26824	LC
20	*Labiobarbus sp*	Umbut-Umbut	0	0	0	4	-	-
21	*Labeo chrysophekadion*	Sitam	1	0	0	0	-	-
22	*Osteochilus kelabau*	Terpadi	0	1	0	0	MZB 26828	DD
23	*Osteochilus schlegelii*	Puyou	0	0	0	1	-	-
24	*Osteochilus vittatus*	Nilem	1	3	11	3	MZB 26815	-
25	*Osteochilus waandersii*	Puyou	0	1	0	0	-	-
26	*Parachela hypophthalmus*	Seluang ping-ping	0	0	0	0	MZB 26817	LC
27	*Parachela oxygastroides*	Seluang ping-ping	0	0	0	2	-	LC
28	*Puntigrus tetrazona*	Aji-Aji	0	7	189	1	-	
29	*Striuntius lineatus*	Seluang kuring	0	1	4	2	-	LC
30	*Puntioplites bulu*	Kepa	1	0	0	0	MZB 26827	LC
31	*Thynnichthys polylepis*	Lambak	2	0	0	0	MZB 26821	LC
	Danionidae							
32	*Rabora argyrotaenia*	Seluang	1	7	5	7	MZB 26832	-
33	*Rasbora trilineata*	Seluang	0	1	36	1	MZB 26816	LC
	Helostomatidae							
34	*Helostoma temmninckii*	Sapil/Biawan	0	0	0	2	-	-
	Leptobarbidae							
35	*Leptobarbus hoevenii*	Jelawat	1	1	2	0	-	LC
	Notopteridae							
36	*Chitala borneensis*	Belida	1	0	0	0	-	Protected
	Osphronemidae							
37	*Betta picta*	Tempalo	0	0	1	0	MZB 26831	-
38	*Belontia haselti*	Selincah	0	0	0	1	-	-
39	*Luciocephalus pulcher*	Tumbuk benur	0	0	0	2	-	LC
40	*Trichopodus leerii*	Sepat mutiara	0	0	0	1	-	NT
41	*Trichopodus pectoralis*	Sepat siam	0	0	2	0	MZB 26834	LC
42	*Trichopodus trichopterus*	Sepat Swamp	2	0	2	1	-	LC
	Pristolepidiae							
43	*Pristolepis fasciata*	Sepatung	0	0	1	1	-	LC

No	Family/Species	Local name	Station				MZB Code	IUCN/KKP
			I	II	III	IV		
44	*Pristolepis grootii*	Sepatung	0	6	37	0	-	LC
	Pangasiidae							
45	*Pangasius polyuranodon*	Juaro	1	0	0	0	MZB 26825	LC
	Polynemidae							
46	*Polynemus multifiliis*	Ikan Jenggot	1	0	0	0	MZB 26826	-
	Siluridae							LC
47	*Belodontichthys dinema*	Sengarat	0	1	0	0	-	LC
48	*Hemisilurus heterorhynchus*	Lais bungkuk	1	0	0	0	MZB 26822	LC
49	*Kryptopterus limpok*	Lais	1	0	0	1	MZB 26811	-
	Tetraodontidae							
50	*Pao palembangensis*	Buntal	0	0	0	2	MZB 26819	LC
	Xenocyprididae							
51	*Macrochirichthys macrochirus*	Parang-Parang bengkok	1	0	0	0	-	LC

3.2 Distribution of Each Station as a Different Habitat

Cyprinidae and Danionidae are the dominant families found in all stations. Teratai's swamp has the highest number of Cyprinidae species, while Bulian River has the most Danionidae species. Bagridae and Siluridae are absent in Letang's lake, and Pristolepidae in Batanghari River. Families Helostomatidae, Tetraodontidae, Belontidae, Aplocheilidae, and Anabantidae are only in the Teratai's Swamp, while Notopteridae, Polynemidae, and Pangasiidae are only in Batanghari River. Channidae and Osphronemidae are exclusive to Letang's Lake and Teratai's Swamp, while Xenocyprinidae are only in Batanghari River and Teratai's Swamp.

At all stations except Letang's Lake, a variety of fish species were found, including *Bagroides melapterus, Hemibagrus nemurus, Hemibagrus planiceps, Mystus castaneus,* and *Mystus nigriceps*, all of which belong to the Bagridae family. Bagridae can be found in various aquatic habitats, from estuary waters to upstream water and standing water resources [9]. Additionally, *Osteochilus vittatus*, a member of Cyprinidae, *Rasbora argyrotaenia*, a member of Danionidae, and *Cyclocheilichthys apogon*, also a member of Cyprinidae, were discovered at all stations. R. *argyrotaenia* is capable of adapting to various environmental conditions, increasing its blood's oxygen affinity when DO levels are low, and taking cover behind rocks in fast-moving currents [10].

3.3 Conservations status and Jambi Province Fishes New Record Founded

Conservation status refers to the IUCN red list for international scope and the Decree of the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia (KKP) which regulates the protection of several local fish species. Overall, the conservation status of Indonesian fish on an international scale is 33 species categorized as Least Concern, 2 data deficient species,

1 Critically Endangered species, 1 Near Threatened species, and 14 other species not yet recorded on the IUCN Red list. Apart from the conservation status reviewed by the IUCN, locally several species of freshwater fish have been protected by the KKP. In this study, it was found that Chitala borneensis was nationally protected by the KKP through the issuance of the KKP Ministerial Decree No. 1 of 2021 concerning protected fish species with full protection status.

The origin of the 51 species obtained, there were 50 species native species and 2 introduced, or 96% native and 4% introduced, which was the introduction namely *Oreochromis niloticus*, and Aplocheilus panchax. Apart from introductions, both are also invasive species that have high colonization power and the ability to occupy habitats with a wide range of salinity and water temperature, thereby winning in competition for food and habitat with other species [10]. The presence of introduced species in the natural habitat of native species is an indicator of poor aquatic health [11].

In Indonesia, there are 9 species of Clarias, namely *C. batrachus, C. gariepinus, C. leiacanthus, C. meladerma, C. nieuhofii, C. teijsmanni, C. tapeinopterus, C. pseudoleiacanthus* and a new species from Indonesia, namely *C. kapuasensis* in 2003 by [13] in Kalimantan. Based on data from previous ichthyofauna biodiversity research conducted in the Batanghari watershed, *C. kapuasensis* species have never been found [13, 14]. This species was first discovered in 2003 in Kalimantan [13].

Based on meristic calculations and morphological observations, *C. kapuasensis* found in this study corresponds to the holotype in MZB 2003, with the key character being the length of the Occipital process which is 5-6% of the total head length, as evidenced by the species found in this study has a total head length of 5 cm, 5% of 5 cm is 2.5 cm which is the length of the Occipital process. Another key character is the distance between the tip of the Occipital process and the base of the dorsal fin, which is 6-8% of the PS. The species found had a PS of 17 cm, 6% of 17 cm is 1.02 cm which is that distance.

Based on meristic calculations and morphological observations, the *C. pseudoleiacanthus* found in this study also matches the holotype in MZB 2003, with the key character being the length of the Occipital process which is 5.7-8% of the total head length, as evidenced by the species found in this study has a total head length of 4.5 cm, 5.7% of 4.5 cm is 0.26 cm which is the length of the Occipital process. Another key character is the distance between the tip of the Occipital process and the base of the dorsal fin, which is 4.5-5.6% of the PS. The species found had a PS of 25.5 cm, 5.6% of 25.5 cm is 1.4 cm which is that distance.

3.4 Five Largest Families Found in This Mainland

The five largest families found were Cyprinidae 48%, Bagridae 17%, Oshphronemidae 17%, Channidae 9%, and Siluridae 9% (Figure 1) with only two to one species of other families. This is consistent with previous research by [14] and [15] which found that the Cyprinidae family dominates fish species in Sumatra, Java, and Kalimantan, with over 1,058 species. Cyprinidae is also the largest group of freshwater fish worldwide, except in Australia, Madagascar, New Zealand, and South America, according to [16] and [17]. The high adaptive ability of Cyprinidae allows them to diversify rapidly from their ancestral species into many new forms through adaptive radiation, a process by which organisms diversify rapidly when environmental changes make new resources available, alter biotic interactions, or create new environmental niches. This adaptive ability causes speciation to occur without geographical isolation [16]. Cyprinidae members have a variety of food preferences, ranging from detritus eaters (*Lebiobarbus festivus*) to smaller fish eaters (*Thynnichthys polylepis*).

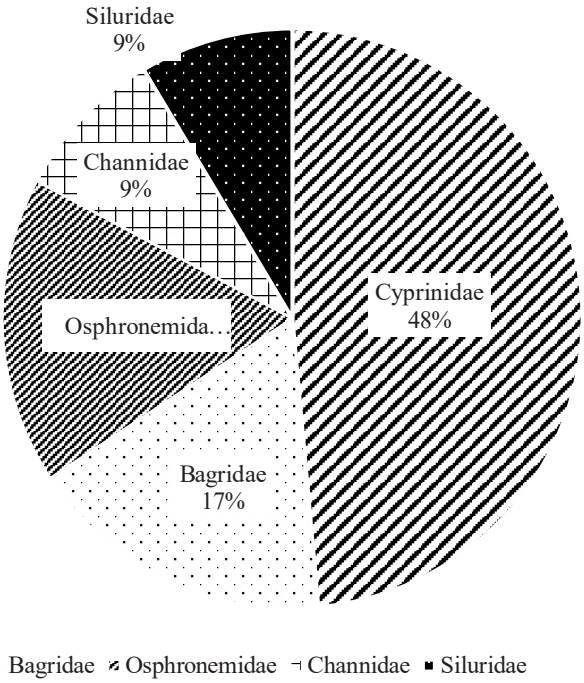

Fig. 1. Percentage Diagram of the 5 Largest Families Found

The second largest family is Bagridae and Osphronemide because Bagridae is a family that is spread both in estuarine waters, upstream water, and standing water resources [17] and can be found in Batanghari River in the upstream area, the upstream part generally has heavy air currents [18]. One of the survival abilities of Bagridae comes from the morphological adaptation to the difference in size between males and females. This difference in size between males and females can explain the adaptive process of intrasexual selection, selecting partners, and reproductive methods [19] This is also because Bagridae is a *Carnivorous europhagus* feeder, which has broad and varied eating preferences, Bagridae can eat crabs, shrimp, small fish, polychaete, worms, algae, detritus zooplankton, and mud [20] another ability is that Bagridae has 4 pairs of barbels (Maxillarry barbel, Nassal barbel, Outer mandibular barbel, and Inner mandibular barbell) which functions as a location sensor and mechanoreceptor, thereby helping to adapt in muddy environments in deep waters [21], while the Oshphronemidae, can adapt to environmental stress, such as *Trichopodus trichopterus* which can survive in poor environmental conditions [22].

The lowest family among the other five is Channidae and Siluridae, which is only 9%. This is because not all Channidae can adapt to all environments, such as C. *lucius* and C. *micropeltes* only inhabit calm waters with a pH of 5-7 and only eat meat or [23]. The Siluridae only have 2 pairs of barbels (Maxillary barbels and mandibular barbels) and are included in the blackfish, which spend most of their life in waters that are characterized by dark brown to blackish water colors such as lakes and swamps [24].

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