BIODIVERSITAS
Volume 23, Number 5, May 2022
Pages: 2426-2432

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d230521

Biodiversity of nekton in the Barumun Watershed, South Labuhanbatu District, North Sumatra, Indonesia

DESRITA[1,♥], RIDAHATI RAMBEY[2], AHMAD MUHTADI[1], ONRIZAL ONRIZAL[2], VINDY RILANI MANURUNG[1], JULIA SYAHRIANI HASIBUAN[1], ISTEN SWENO TAMBA[3]

[1]Department of Aquatic Resources Management, Faculty of Agriculture, Universitas Sumatera Utara. Jl. Prof A. Sofyan No. 3, Medan 20155, North Sumatra, Indonesia. Tel./fax.: +62-61-8213236, ♥email: desrita@usu.ac.id
[2]Department of Forestry, Faculty of Forestry, Universitas Sumatera Utara. Jl. Tridarma, Medan 20155, North Sumatra, Indonesia
[3]Department of Aquaculture and Marine Resource Management, Wageningen University and Research. 6708 PB Wageningen, Netherlands

Manuscript received: 3 April 2022. Revision accepted: 21 April 2022.

Abstract. *Dersita, Rambey R, Muhtadi A, Onrizal O, Mamurung VR, Hasibuan JS, Tamba IS. 2022. Biodiversity of nekton in the Barumun Watershed, South Labuhanbatu District, Indonesia. Biodiversitas 23: 2426-2432.* Biodiversity is a very valuable source of germplasm for science and sustainable development. Therefore, research on freshwater biodiversity is very important to support the sustainability of this development. The research investigated three rivers in South Labuhanbatu District, North Sumatra, Indonesia: Barumun, Tasik, and Titi Kembar rivers. This investigation aims to ascertain the composition, distribution, and variety of nekton. From April to August 2020, the trial lasted five months. Nekton samples were collected with the aid of nets and fishing nets. While installed in the afternoon, the nets are removed the following day. Additionally, at each observation point, stocking nets were operated three times. The investigation discovered 38 fish species and one shrimp species. Two species of fish discovered, are protected by the government of the Republic of Indonesia. Both fish species are *Tenualosa* terubuk, a fish with little protection, and *Fluvitrygon signifer*, a ray fish with complete protection. The study site's sole shrimp species was the gigantic prawn *Macrobrachium rosenbergii* in the Barumun river. The index of nekton diversity discovered in the three rivers was not identical. Compared to other rivers, the Tasik river station has a high diversity. This makes the Tasik river rich in fish compared to the Barumun and Titi Kembar rivers. The Tasik river is recommended as water suitable for fish life from these results.

Keywords: Barumun, fish, *Fluvitrygon signifer*, Terubuk, torgamba

INTRODUCTION

The Barumun-Kualuh watershed is the largest river in North Sumatra. The size of the Barumun-Kualuh watershed reaches 1,721,334.93 ha. This watershed consists of the Kualuh watershed, the Bilah watershed, and the Barumun watershed. Barumun River is the dominant river in this basin, with a length of 440 km. The upstream of the Barumun river is located in Siraisan, Padang Lawas District in the southeast of North Sumatra Province, Indonesia. This river streams northward through North Padang Lawas, South Labuhanbatu, and Labuhanbatu districts and discharges into the Malacca Strait (Regulations in North Sumatra Number 2, 2017).

The Barumun River's existence and its watershed are crucial for the neighboring communities (Butorac et al. 2020). Historically, the Barumun watershed has been used for numerous needs, such as agricultural irrigation, family necessities, and fishing livelihood (Manalu 2020). In addition, the Barumun watershed is one of the essential habitats for endemic species in Indonesia, particularly the Terubuk fish (*Tenualosa ilisha*) (Lubis et al. 2016). *Tenualosa ilisha* is discovered to spread in India, Bangladesh, Pakistan, and Indonesia only in northern Sumatra (Lubis et al. 2016).

The Barumun watershed habitat is one of the vital ecosystems with ecological and economic importance and is an essential habitat for aquatic ichthyofauna (Desrita et al. 2021a). However, the publication of nekton in the Barumun watershed is still rarely reported. Publications relating to nekton in the Barumun watershed are still limited to Terubuk fish. The success of Terubuk fish conservation also lies in detecting and recognizing other varieties of nekton. Understanding the potential for fish diversity in a river affects sustainability and conservation efforts (Clavel et al. 2013; Brumm et al. 2021; Su et al. 2021; Miranda and Imanol 2021). In this research, three rivers were seen for their nekton diversity. The rivers are Barumun River, Titi Kembar and Tasik. Barumun river is the largest river compared to the Titi Kembar and Tasik rivers.

Barumun River every year experiences flood and low tide seasons. The low season is normally from March-May, and the flood season is June-December. If in flood conditions, the water will overflow into the area around the river. The region around the river was formerly forested, but recently along the Barumun river has been cultivated with oil palm and rubber. However, on the banks of the Barumun river, there are still numerous varieties of grass, such as reeds and other forms of flora. Tree vegetation near the Barumun river includes seri trees, gala-gala, kapok, bamboo, etc (Manalu 2020; Rambey et al. 2021).

The change of forest land into plantation crops and seasonal crops (change in habitat) (Cooke et al. 2021)

causes the vegetation around the Barumun River to be lost; as a result, some fish populations are disturbed because of the spawning ground, nursery ground and places to find food (feeding ground) are degraded (Odum 2009; Muhtadi et al. 2014). This research on biodiversity was carried out directly in three rivers in Torgamba Sub-district, namely Barumun, Titi Kembar, and Tasik. The new thing from this research is there has never been research on biodiversity in the three rivers in this Torgamba Sub-district before. Considering the importance of the Barumun watershed ecology for nekton, it is crucial to perform nekton studies throughout the Barumun watershed. It is hoped that the acquired data will be the initial data for research in the years to come, especially for the utilization and management of the Barumun watershed in the future.

MATERIAL AND METHODS

Study area

The research was conducted between April and August 2020 in three rivers in North Sumatra, Indonesia: Barumun, Titi Kembar, and Tasik rivers. Meanwhile, the sampling point is based on where fishers usually catch fish. The location can be seen in Figure 1. The nekton is identified at Universitas Sumatera Utara's Laboratory of Biology and Aquaculture as part of the Program of Aquatic Resources Management.

Procedures

Nets and fishing nets were used to collect nekton samples. The nets are installed in the afternoon and removed the next day, while the stocking nets are operated three times at each collection site. After photographing and preserving the nekton samples in a 10% formalin solution, they were labeled with the fish's indigenous name, location/station, collecting date, collector's name, and other relevant information. Then, nekton is identified using multiple databases, including Kottelat et al. (1993), fishbase.org, Wowor et al. (2004), and Wowor (2010).

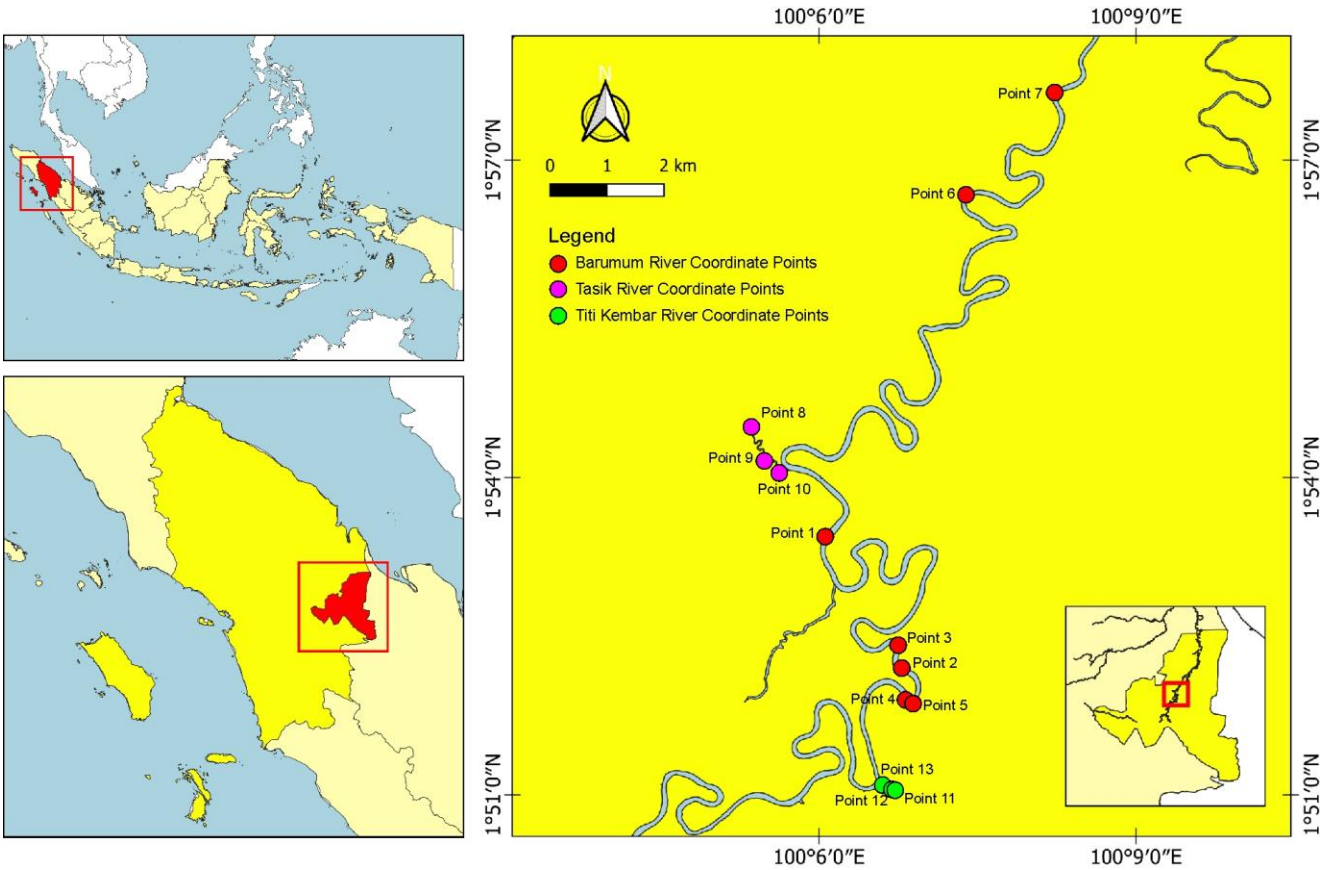

Figure 1. The research map of Barumun river: point 1 01°53′27.7″N 100°06′04.3″E; point 2 01°52′13.2″N 100°06′46.9″E; point 3 01°52′26.4″N 100°06′45.6″E; point 4 1°57'38.2"N 100°08'13.9"E; point 5 01°51′53.2″N 100°06′53.9″E; point 6 01°51′55.0″N 100°06′49.3″E; point 7 01°56′41.1″N 100°07′23.6″E; Sungai Titi Kembar: point 8 01°54′28.7″N 100°05′22.2″E; point 9 01°54′09.7″N 100°05′29.8″E; point 10 01°54′02.9″N 100°05′37.8″E; Sungai Tasik: point 11 01°51′03.9″N100°06′42.0″E; point 12 01°51′03.3″N 100°06′43.3″E; point 13 01°51′06.1″N 100°06′36.9″E

Data analysis

The diversity of the nekton community in aquatic is known through several attributes such as Shannon-Wiener diversity index (H') and evenness (E) (Krebs 1989). The diversity index (H') is used to get a mathematical description of the population of organisms. This can facilitate the analysis of information on the number of individuals of each species in a community (Odum 1996). Nekton diversity was calculated using the diversity index of Shannon and Wiener (1963) in Odum (1996); Dodds and While (2020) with the formula:

$$H' = - (-\sum pi \ln pi-)$$

Where:
H': Index of species diversity
ni: The number of individuals in each species
N: The number all of individual
Pi: The probability of species = ni/N

The evenness index is used to describe how much balance in an ecosystem. The evenness of individuals caught between species (equitability) was calculated by following the equation (Odum 1996; Dodds and While 2020).

$$E = H'/\ln S$$

Where:
E: Index of diversity Shannon-Wiener,
H: The balance of species,
H` max: Index of maximum diversity (lnS),
S: the number of species total

The Dominance index is calculated using the Simpson dominance index (Hossain et al. 2017; Guo et al. 2018).

$$C= \Sigma (ni/N)$$

Where:
C: dominance index
ni: number of individual species i,
N: total number of individuals of all species

RESULT AND DISCUSSION

Composition of nekton species

The nekton was discovered in Titi Kembar's Barumun River and Tasik comprised 39 species belonging to two major phyla (Chordata and Arthropoda), three orders (Actinopterygii, Elasmobranchii, and Crustacea). They were classified into 21 families: Anabantidae, Ariidae, Bagridae, Chandidae, Channidae, Claridge, Clupeidae, Cyprinidae, Eleotridae, Gobiidae, Helostomatidae, Loricariidae, Mastacembelidae, Notopteridae, Osphronemidae, Pangasiidae, Pristolepididae, Siluridae, Synbranchidae, Dasyatidae, and Palaemonidae. The family Cyprinidae dominates the fish community in the three rivers. This is backed by various research findings, which indicate that the Cyprinidae family is the most abundant in North Sumatra rivers (Muhtadi et al. 2017; Desrita et al. 2018; Wahyuningsih et al. 2019; Desrita et al. 2020). Additionally, the Cyprinidae family is the most numerous freshwater fish family in the world (Kottelat et al. 1993); Asia (Nguyen and de Silva 2006; Sarkar et al. 2012), Kalimantan (Nugroho et al. 2016); and Sumatra (Margasasmita 2002; Nugroho et al. 2016; Samitra and Rozi 2019).

The Cyprinidae family contained 13 species, followed by the Bagridae and Osphronemidae families, each containing three species, and the Siluridae and Claridae families, contained two species. For the remaining families, only a single species was discovered. Eleven Cyprinidae fish species were discovered in the Barumun River, nine in the Titi Kembar River, and five in the Tasik River. The family Cyprinidae's abundance is most likely attributable to the riverside environment (Sarkar et al. 2012; Nugroho et al. 2016; Saputra et al. 2018). The Barumun River is larger than the Titi Kembar and Tasik rivers, which results in a greater range of motion for the river's fish. The width of available space for fish allows them to forage freely, seek out acceptable microhabitats, and locate comfortable breeding sites (Desrita et al. 2018). Additionally, the ease with which fish adapt to their habitat promotes growth (Dodds and While 2020). Almost all Cyprinidae fish species are found in the Barumun River, except *Barbonymus schwanenfeldii*. The water conditions, specifically the flowing rivers, are ideal for the Cyprinidae fish family. Desrita et al. (2018) explained that the Cyprinidae family of huge fish inhabits rivers that flow to great depths. Cyprinidae is a family of fish with torpedo-shaped bodies that resemble solid currents (Kottelat et al. 1993). The yellow baung fish is another type of fish that prefers strong currents (Desrita et al. 2018).

According to the IUCN, the 39 species of nekton found in the Barumun watershed are classified as least concern (28 species), undefined (9 species), and data deficient (2 species) (International Union Conservation Nation). The interaction between ecological stress factors and biological traits and the use of sentinel species for the long-term monitoring of environmental status (Miranda and Miqueleiz 2021). The majority of nekton in the Barumun River are classified as being of minor concern (low risk). Certain fish are classified as having insufficient data (lack of information), and some species remain unclassified (not yet evaluated). Few researchers have focused exclusively on these common fish species, leaving fishery data in little supply.

Tabel 2. The composition and status of nekton IUCN redlist in Barumun, Titi Kembar and Tasik rivers

Phylum/Ordo/Familly	Synonym name	Indonesia name	Sungai			IUCN Red list
			Barumun	Titi Kembar	Tasik	
Chordata						
Actinopterygii						
Anabantidae						
Anabas testudineus	Climbing perch	Betok/betik	+	+	+	DD
Ariidae						
Nemapteryx caelata	Engraved catfish	Lundu			+	NE
Bagridae						
Hemibagrus nemurus	Asian redtail catfish	Baung	+	+	+	LC
Mystus singaringan	Bagrid catfish	Lambabiding	+		+	LC
Bagrichthys macracanthus	Lancer catfish	Baung tikus	+		+	LC
Chandidae						
Parambassis wolfii	Duskyfin glassy perchlet	Kaca	+		+	LC
Channidae						
Channa striata	Striped snakehead	Gabus	+		+	LC
Clariidae						
Clarias teijsmanni	Airbreathing catfishes	Lindi/Limbat	+		+	NE
Clarias batrachus	catfish	Lele	+		+	LC
Clupeidae						
Tenualosa ilisha	Hilsa shad	Terubuk	+			LC
Cyprinidae						
Barbonymus gonionotus	Silver barb	Tapelata	+	+	+	LC
Barbonymus schwanenfeldii	Tinfoil barb	Lemeduk			+	LC
Cyclocheleichtys enoplos		Dopang	+	+	+	LC
Cyclocheilichthys apogon	Beardless barb	Lapam	+		+	LC
Barbodes binotatus	swamp barb	Wader	+			LC
Luciosoma trinema		Kenyuar/Juar	+			NE
Mystacoleucus marginatus		Lamase/cencen	+		+	LC
Parachela hypophthalmus		Sulum pispis	+			LC
Rasbora dusonensis	Rosefin rasbora	Sulum	+	+	+	NE
Barbichthys laevis	Sucker barb	Betulu	+	+	+	LC
Hampala macrolepidota	Hampala barb	Kabaro	+		+	LC
Labiobarbus festivus	Signal barb	Kulare	+	+	+	DD
Osteochilus hasselti	Bonylip barb	Nilem	+			LC
Eleotridae						
Oxyeleotris marmorata	Marble goby	Butut			+	LC
Gobiidae						
Glossogobius giuris	Tank goby	Boto kuning			+	LC
Helostomatidae						
Helostoma temmincki	Kissing gourami	Tambakan		+	+	LC
Loricariidae						
Liposarcus pardalis	Amazon sailfin catfish	Sapu-sapu	+			NE
Mastacembelidae						
Mastacembelus unicolor	spiny eels	Tilan			+	NE
Notopteridae						
Notopterus notopterus	Bronze featherback	Belida		+	+	LC
Osphronemidae						
Trichopodus trichopterus	Three spot gourami	Sepat rawa	+			LC
Trichopodus pectoralis	Snakeskin gourami	Sepat siam		+		LC
Osphronemus goramy	Giant gourami	Gurami			+	LC
Pangasiidae						
Pangasius nasutus	Pangasid Catfish	Patin	+			LC
Pristolelepididae						
Pristolepis grootii	Indonesia leafish	katung	+	+	+	NE
Siluridae						
Kryptopterus apogon	-	Silais	+	+	+	LC
Wallago leerii	striped wallago catfish	Tapah	+			NE
Synbranchidae						
Monopterus albus	Asian swamp eel	Belut sawah			+	LC
Elasmobranch						
Dasyatidae						
Fluvitrygon signifer	White-rimmed stingray	Pari	+			NE
Arthropoda						
Crustacea						
Palaemonidae						
Macrobrachium rosenbergii	Giant river prawn	Udang galah air tawar	+			LC
Total			29	12	27	

Note: DD: Data Deficient, LC: Least Concern, NE: Not Evaluated, +: founded

Terubuk fish (*T. ilisha*) were also discovered in the Barumun River, according to the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia 2016. Along with terubuk fish, stingrays and enormous prawns have been discovered. The Tasik River is home to this species of stingray. The ray discovered was a *Fluvitrygon signifer*, a freshwater ray species. In Indonesia, *F. signifer* is a rare species, occurring only in the Kapuas watersheds of Kalimantan and Sumatra, along the Musi and Indragiri rivers (Setiawan et al. 2016). Stingrays will be easy to locate because the nekton sampling location is in the heart of the Barumun watershed. The stingrays are believed to migrate from the estuary to the river's lower reaches until they reach the Barumun River's center in search of food. According to the Decree of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia in 2021, the stingray type *F. signifier* has complete protection status.

Distribution

The three rivers are home to nine nekton species, including *Anabas testudineus, Hemibagrus nemurus, Barbonymus gonionotus, Cyclocheilichthys enoplos, Rasbora dusonensis, Barbichthys laevis, Labiobarbus festivus, Pristolepis grooti*, and *Kryptopterus apogon*. The types of fish above are white and blackfish, found in many rivers in Sumatra. Like the Barbonymus fish, they are scattered in rocky habitats with high currents. This nekton is dispersed among the three rivers; this is assumed because its strong current characteristics are favorable to its distribution. The most dominant of the three is the Cyprinidae family. This family is distributed in a wide area, including main rivers and tributaries, and even slightly found in flooded swamps (Sarkar et al. 2012; Muslim and Syaifudin 2022). The Barumun River has a high current of 5.1 m/s, the Titi Kembar River has a current of 19.95 m/s, and the Tasik River has a current of 0.16 m/s. The type of base can modify the current velocity differential between rivers, the river's width, and the existence of barriers to River currents (Djumanto et al. 2013). Similarly, these factors support a diverse array of fish species in the Wampu, Bahorok, and Batangtoru rivers (Muhtadi et al. 2017; Desrita et al. 2018; Desrita et al. 2020). Additionally, 18 species are found only in one location, namely the Tasik River, including *Nemapteryx caelata, Tenualosa ilisha, Barbonymus schwanenfeldii, Puntius brevis, Luciosoma trinema, Parachela hypophthalmus, Oxyeleotris marmorata, Glossogobius giuris, Liposarcus trichocereus, Trichogaster pectoralis, Osphronemus gouramy, Pangasius nasutus, Wallago leerii, Monopterus albus, Fluvitrygon signifer, and Macrobrachium rosenbergii*. While the Barumun River has the greatest species diversity, it is followed by the Tasik and Titi Kembar rivers.

Hemibagrus and *Kryptopterus* are bottom fish, which can be seen from the body shape, which is flat compressed (*Hemibagrus*), whereas *Anabas, Barbonymus* (Nurfadillah et al. 2019; Desrita et al. 2021c), and *Pristolepis* are mid-to deep-water fish, and Cyclocheleichtys, Rasbora, Barbichthys, and Labiobarbus are surface fish (Desrita et al. 2021b). The only shrimp found in Labuhanbatu rivers is the gigantic prawn (*M. rosenbergii*), located in the Barumun River. *Hemibagrus* is a carnivorous fish with zooplankton as the main food (Gupta and Banerjee 2014).

Diversity of nekton

The Tasik River has the greatest diversity index value among the three rivers at 2.21. Overall, the diversity index values for rivers are nearly identical, in the range of number 2, indicating that the river's fish diversity index is relatively high. It is claimed that the reason for the Tasik river's high diversity of fish is the river's elevation, particularly during heavy rains, when the river overflows and the fish are abundant (Bashar et al. 2020). The Barumun and Titi Kembar rivers, on the other hand, have a lower diversity index than the Tasik rivers. Environmental factors considerably impact the fluctuation of a river's fish variety. Reduced water levels and ecological diversity will result in the extinction of fish species in their habitat (Jorgensen et al. 2009).

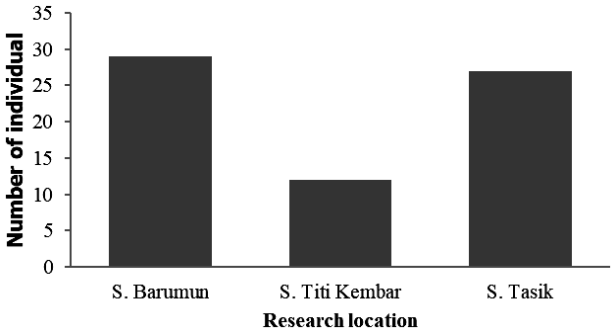

Figure 2. Distribution of nekton species in watershed Barumun

Table 3. Index of diversity and similarity of nekton in Barumum, Titi Kembar and Tasik rivers

Parameters	Rivers		
	Barumun	Titi Kembar	Tasik
Index diversity	2.094	2.056	2.208
Index evennes	0.628	0.827	0.663
Index dominance	0.171	0.18	0.182

The Titi Kembar River had the highest index of fish evenness, 0.83, indicating high uniformity. The Tasik River came in second at 0.66, and the Barumun River at third at 0.63. The Tasik and Barumun river's evenness indexes meet the moderate criterion (Ravanbakhsh et al. 2016). The uniformity of fish in the Barumun, Tasik, and Titi Kembar rivers implies a relatively even distribution of fish. This is because the habitat conditions of the three rivers are not uniform (Desrita et al. 2018). Additionally, it results from habitat destruction, primarily due to the river's densely packed oil palm plantations. More species, greater abundances, and larger individuals, also showed a higher number and densities of endangered fishes within the sanctuary area (Sarkar et al. 2012). This impacts habitat loss for certain fish populations in these rivers (Shaleh et al. 2020). Human activity is also a factor in the unequal distribution of fish in the Barumun, Tasik, and Titi Kembar rivers (Islam et al. 2017). Human activities such as farming generate garbage and organic substances that drain into rivers when it rains. The dominance index shows almost the same number in the three rivers ranging from 0.17 to 0.18. However, this figure aligns with the diversity and uniformity index in the three rivers. The dominance index in the three rivers is less than 1. This shows that there are no dominant fish species.

In conclusion the Barumun river had the most fish species, followed by the Tasik and Titi Kembar rivers. The Cyprinidae family largely dominated all fishing locations, followed by the Bagridae and Osphronemidae families, and the Siluridae and Claridae families. Nine fish species are found in each of the three rivers, whereas 18 are found exclusively in one. The Tasik river had the highest diversity index, followed by the Barumun and Titi Kembar rivers. The Titi Kembar, Tasik, and Barumun rivers have the highest to lowest homogeneity indexes, respectively.

ACKNOWLEDGEMENTS

We would thank Universitas Sumatera Utara for funding through the Talenta grant with number 63/UN5.2.3.1/PPM/SPP-TALENTA USU/2020. We will also thank Bella, Rahma, Harry, Fanny, Rahmad, and Fajri for the guide in the field and the fisherman in Asamjawa village, South Labuhanbatu.

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