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**Abstracts
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Diversity and habitat condition of Tor Fish (*Tor* spp.) in the upstream of Wampu Waters, North Sumatra, Indonesia

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Abstract. The upstream of Wampu Waters is a habitat for various fish species including *Tor* spp fish. Fluctuating conditions of habitat will greatly affect the existence of fish as diversity, uniformity, dominance, and abundance of fish. This research was conducted to determine of the condition of habitat and diversity of *Tor* spp fish in the upstream of Wampu waters. Measurement of habitat conditions by measuring current velocity, depth, temperature, visibility, DO and pH. The method was used in this research is descriptive post facto with fishing using backpack electrofishing units, 12 volts and 9 amperes of battery with the multiple-pass depletion operation technique. Habitat conditions in both research locations are good and appropriate to support the life of fish of *Tor* spp. *Tor* fish species was found are *Tor soro* and *Tor tambroides* with low fish diversity index of *Tor* spp of 0.5 for the Bahorok River and 0.61 for the Berkail River, lowest evenness index of 0.09 was found in the Bahorok River and 0.11 in the Berkail River and lowest dominance index of 0.17 were found in the Bahorok River and 0.2 in the Berkail River.

1. Introduction

Tor fish is a local freshwater fish in Indonesia which is nearly endangered. Based on the red list of endangered fish published by the IUCN in 1990, 29 species of fish from Indonesia are listed, including all the Genus of *Tor*. The IUCN issued in 2012, 12 species of *Tor* Genus are endangered, including *Tor tambroides* and *Tor tambra* from Indonesia [1].

Tor fish (*Tor* spp.) was found in North Sumatra which has a large enough germplasm and can add the alternative source of animal protein needed. Some species of this genus *Tor*, was found in Indonesia, some of them in the island of Sumatra are *Tor douronensis*, *Tor tambroides*, *Tor tambra* and *Tor soro* [2] and become the dominant species in the upstream of Wampu waters with relative abundance of *Tor soro* fish of 28.5% and *Tor tambroides* of 7.5% relatively smaller size [3]. Unfortunately, the current number of *Tor* fish in North Sumatra, especially in the Bahorok and Berkail Rivers continues was decrease. According to [1], it is caused by unsustainable deforestation and overfishing such as using toxins and dynamite.

Conditions and characteristics of waters habitat including water quality greatly affected the pattern of distribution, diversity, the abundance of nekton [4]. Therefore, it is necessary to do research on the habitat of *Tor* spp. Fish in Wampu waters which will emphasize on the diversity condition, evenness and dominance of the fish in the upstream of Wampu waters, especially the Bahorok and Berkail Rivers.



2. Materials and methods

2.1. Study area

This research was conducted for three months, July to September 2017. The data collection was undertaken at the upstream of the Wampu Waters, Langkat District, North Sumatra Province, Indonesia, namely, the Bahorok River and the Berkail River (Figure 1). The identification of fish was done at the Laboratory of Biology and Aquaculture, Agriculture Faculty, the Universitas Sumatra Utara based on the result of sample identification by The Indonesian Institute of Science (LIPI), the identification keys in references such as [1] and [5].

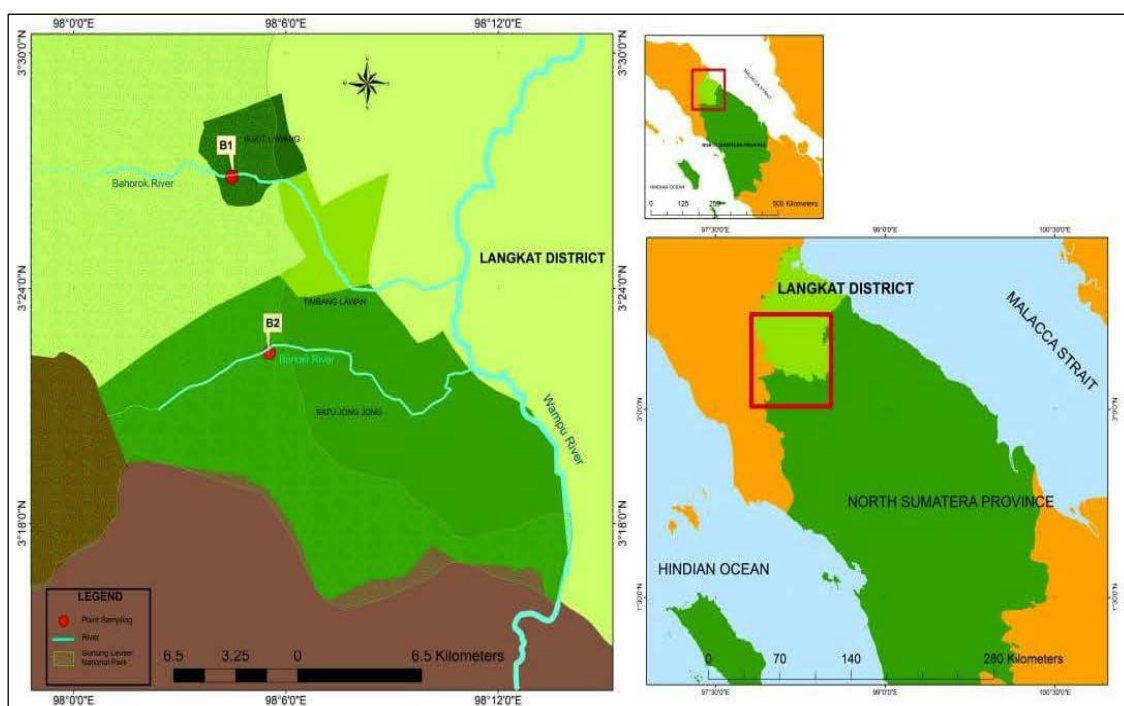


Figure 1. Research location: B1 ($03^{\circ}33'32.7''\text{N}$, $98^{\circ}05'57.4''\text{W}$), B2 ($03^{\circ}28'48.34''\text{N}$, $98^{\circ}07'56.75''\text{W}$); and the detected sites.

2.2. Description of sampling location

Location I (B1) is located in one of the upstream of Wampu Waters of Bahorok River located in Bukit Lawang Village, Langkat Regency and coordinates located at $03^{\circ}33'32.7''\text{N}$, $98^{\circ}05'57.4''\text{W}$. This location has a substrate with large rocks with a steady stream of water that is heavily influenced by activities such as tourism and high capture fisheries.

Location I (B2) is located in one of the upstream Wampu Waters, which is the Berkail River located in Batujong Village of Langkat Regency and coordinates located at $03^{\circ}28'48.34''\text{N}$, $98^{\circ}07'56.75''\text{W}$. The current velocity of this waters is fast to small, the substrate is dominated by large rocks, clear water, shallow waters and waters surrounded by trees of close intensity.

2.3. Procedures

Habitat conditions were determined by measuring the physics-chemical parameters of the waters and the measurements were carried out directly in the field. The temperature was measured by using a thermometer, the current velocity measured were using the estimated ball, the depth was determined with the scaled plank, Dissolved Oxygen (DO) was measured by using DO meter, the visibility was measured by using length measuring meter and the pH was determined using a pH meter.

Fishes were captured by a backpack of electrofishing units where the resulting electrical current was sourced from 12 volts and 9-ampere battery. This tool is very useful for shallow aquatic water such as a river and creek. The operation of this tool was carried out from each location along the rivers. Electrofishing operators moved in the opposite direction with river currents (moving upstream), and the fishes were captured by inserting them into plastic bags by using hand net [6]. The fishes were photographed and preserved in 10% formalin solution and labeled

2.4. Data analysis

Diversity Index analysis were using by Shanon-Wiener's diversity index is the value of H' when the value of $H' > 3$ = High diversity, $1 < H' < 3$ = Medium (moderate) and $H' < 1$ = Low diversity [4].

$$H' = - (\sum p_i \ln p_i) \quad (1)$$

Where:

H' = Index of species diversity

n_i = Individual quantity from each species

N = Community individual total

P_i = Necessary probability for each species (n_i/N)

The evenness of individuals caught (equitability) was analyzed by using the similarity index [4].

$$E = \frac{H'}{H'_{max}} \quad (2)$$

Where:

E = Index of similarity

H' = The balance of species

H'_{max} = Index of maximum diversity ($\ln S$)

S = Species total amount

Index of Dominance was used to know the abundance of individuals from species of fish in a community. If the value is: $C = 0$, if the value of C approaches 0 (zero), then the dominance is low. $C = 1$, if the value of C approaches 1 (one), then the dominance is high. The dominance analysis was used for dominance index [6].

$$C = \sum \left(\frac{n_i}{N} \right)^2 \quad (3)$$

Where:

C' = Index of dominance

n_i = Individual amount from each species

N = Community individual total

Relative abundance was calculated by using the Simpson formula [4]:

$$KR = \left(\frac{n_i}{\sum N} \right) \times 100\% \quad (4)$$

Where:

KR = Relative abundance

n_i = Individual amount from each species

N = Total of all individuals

3. Result and discussion

3.1. Diversity (H'), Evenness (E) and Dominance Index (C)

The values of Diversity (H'), Similarity (E) and Dominance Index (C) determined was shown in Table 1. Based on Table 1 Diversity Index (H') *Tor* spp. in the upstream of Wampu waters was found from 0.5 to 0.61 in the location I (Bahorok River), the value of 0.5 in a location II (River Berkail), and the value of 0.61. The diversity index is categorized as low. This is consistent with Hile (1963) referred to [7], stating that if the value of $H' < 1$ so the diversity is low.

Table 1. The values of Diversity (H'), Evenness (E) and Dominance (C) Index of *Tor* spp. fish in the upstream of Wampu Waters.

Index	Location	
	Bahorok River	Berkail River
H'	0.50	0.61
E	0.09	0.11
C	0.17	0.20

The evenness Index (E) of *Tor* spp. in the upstream of Wampu waters was found with ranges value from 0.09 to 0.11, and in location B1 (Bahorok) was found of 0.09 and location B2 (Berkail River) was found of 0.11. The evenness index will be categorized of lowest type sim. This value indicates the condition of the composition of *Tor* spp. fish do not spread evenly. If the value of E approaches 0 then there is an imbalance in the spread of the fish where is one of species fish dominates the waters. According to [8], when the value is near zero uniformity index implies the uneven distribution of the ecosystem and the predisposition of species dominance. The index category of uniformity ranges from 0 to 1 with the lowest uniformity index if the value was found of $E < 0.4$.

Table 1 shows that Dominance Index (C) *Tor* spp. in the upstream of the Wampu waters was found with ranges value from 0.17 to 0.2, in the location, I (Bahorok river) was found of 0.17 and of 0.2 in location II (Berkail river). Dominance index value of *Tor* spp. fish in the rivers will be categorized lowest dominance or no found dominating species. This is in accordance with [9], the criteria of dominance index and that is if the value of index dominance is between 0 to 0,5 then will be will be categorized no dominant type.

3.2. Relative abundance of *Tor* spp. in the upstream of Wampu waters

Relative abundance graph of *Tor* spp. in the upstream of Wampu waters (Bahorok and Berkail rivers) can be seen in Figure 2 below.

The relative abundance was found highest in *Tor* spp. fish and was found in Berkail River. The Berkail River in this part was found less tourism activity than other locations, and fishing activities tend to be lower than in other locations. The condition of waters is relatively good, high oxygen content, low current, and also many substrates were found in that parts. The condition of the water is relatively suitable for the habitat of fish. According to [10], small and medium fish size were found in that habitats and the characteristics of rock bottom with the value of < 50 cm in diameter, moderate to heavy water currents, crystal clear water, with a depth of < 1 m, of gravel and sand, canopy closure of 50-75%.

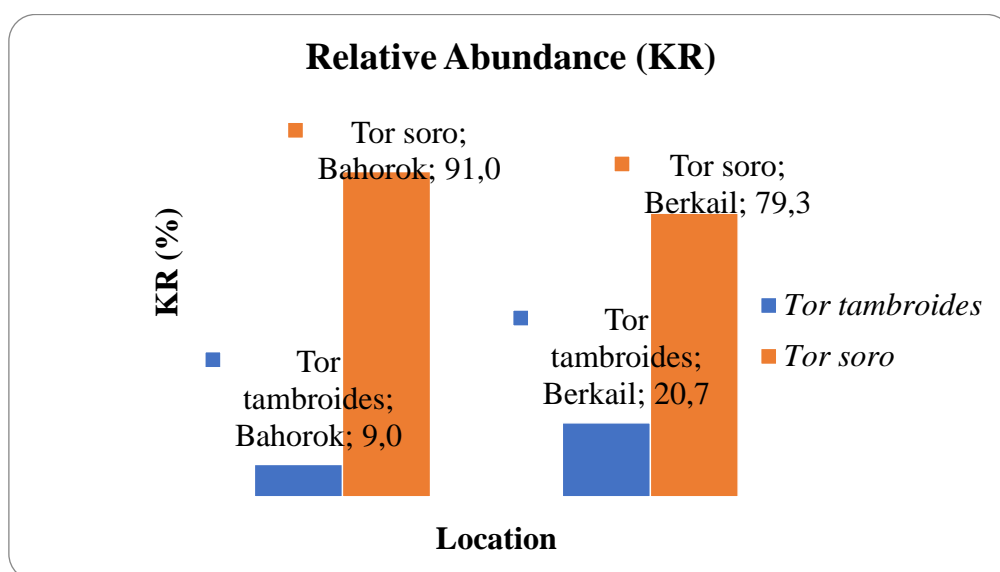


Figure 2. Relative abundance of *Tor* spp. fish in the upstream of Wampu waters.

3.3. Habitat condition of *Tor* spp. fish in the upstream of Wampu Waters

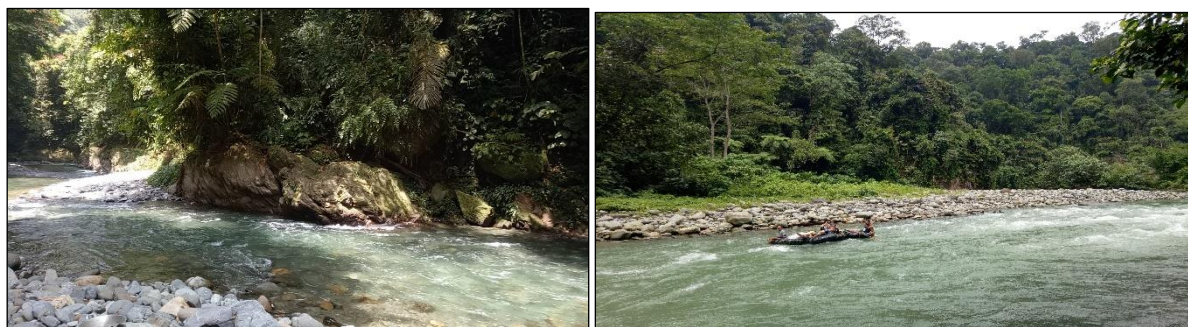
The quality parameters of the upstream of the Wampu waters especially Bahorok and Berkail rivers shown in Table 2 below. Based on table 2 that the general condition of the observation stations has a similar relative condition. Both stations have a heavy current of water and clean with substrate conditions, in the form of large rocks where the station I Bahorok River has a rock larger than the station II Berkail river. The thing that distinguishes these two stations are found in higher tourism activity at station I. However, the overall chemical physics factors of the two stations are in good condition with reference to Decree of the Minister of Environment Number 51 of 2004, with the observed aspects of current velocity, temperature, visibility, DO and pH.

Table 2. The quality parameters of the upstream of Wampu waters

Environmental Parameter	Unit	Stations	
		Bahorok River	Berkail River
Physics			
Current Velocity	ms ⁻¹	1.06	1.20
Depth	cm	62.04	86.31
Temperature	°C	25.53	24.73
Visibility	Cm	62.04	86.31
Chemistry			
DO	mgL ⁻¹	7.64	8.09
pH		6.86	8.40

Current velocities in this study sites ranged from 1.06 to 1.20 ms⁻¹. The highest current velocity is located in location II (Berkail River) of 1.20 ms⁻¹ and the lowest current velocity is located at the location I (Bahorok River) of 1.06 ms⁻¹. The speed of the water is very fast where the water speed exceeds 1 ms⁻¹ [11]. According to [10], the fish habitat of *Tor* spp. small to medium size is in waters with characteristics of medium to a heavy flow of water. The speed of the current is suitable to support the life of *Tor* spp. fish, which tend to like the heavy current waters [12].

The water depth of each location ranges from 62.04 to 86.31 cm. The highest depth location II (Berkail River) that is 86.31 cm while the lowest depth in location I (Bahorok River) that is 62.04 cm. This depth is appropriate to support the life of *Tor* spp. fish which is dominated by small fish with lengths ranging between 75-157.65 cm. This is in accordance with [10], the fish habitat of *Tor* spp. was found small to medium-sized and teenagers were living in the water depth of less than 1 m.



A

B

Figure 3. Condition around data sampling location at the upstream of Wampu Waters, Langkat District, North Sumatra Province, Indonesia. A. Berkail River, B. Bahorok River

Water temperature in each location ranged from 24.73 to 25.53°C. The highest temperature is located at Bahorok River which was 25.53°C while the lowest water temperature was found in location Berkail River that was 24.73°C. The lowest site temperature in location II caused by lower light penetration with leafy trees compared to location I. However, the temperature suitable to support the life of *Tor* spp. fish. This was in accordance with [12], the water temperature range which is good for Jurung Fish life (*Tor* spp.) is <30°C.

The dissolved oxygen content (DO) in each study site was in the range of 7.64-8.09 mgL⁻¹. The highest dissolved oxygen value was obtained at location II (Berkail River) of 8.09 mgL⁻¹ while the lowest value was obtained at a location I of 7.64 mgL⁻¹. Dissolved oxygen has shown from photosynthetic activity and also high water flow will be oxygen content in the water was high. The suitable value has been to support of *Tor* spp. fish life. This is similar in accordance with [12] which states that the dissolved oxygen content which is good for Jurung fish life (*Tor* spp.) with ranges of >5 mgL⁻¹.

Based on pH measurement results that have been done in each research location obtained pH value with the range value of 6.86-8.40. The highest pH value of 8.40 was found in location II (Berkail River) and lowest of 6.86 in the location I (Bahorok River). The pH value can make categorized is good for *Tor* spp. life. According to [12] with good pH range value will be good for the life of Fish *Tor* spp. and water biota between 6.5-8.5. Next, [13] stated that fish mortality point is common at pH 4 (acid) and pH 11 (base). Because of that, the pH in the waters of the Bahorok River and Berkail River were support for the life of *Tor* spp.

The water visibility each location ranges value was found from 62.04 to 86.31 cm. The highest visibility in location II (Berkail River) was obtained of 86.31 cm but lowest visibility was found in the location I (Bahorok River) that is 62.04 cm. The visibility of these waters is similar to have water depth. It shows the water is very clear where the light can penetrate to the bottom of the waters. The visibility is suitable to support the life of *Tor* spp. fish which love clear water. This is in accordance with [10], which state that the habitat of Fish *Tor* spp. small to medium size/teenagers are in the waters with clear water conditions. These conditions will facilitate the movement of fish in foraging [14].

4. Conclusions

Tor Fish species found in the research sites are *Tor soro* and *Tor tambroides*. Amount of *Tor* spp. Fishes located on the Berkail river which dominated by *Tor soro*. The condition of the fish habitat of *Tor* spp.

in the upstream of Wampu waters was good. The diversity, evenness and dominance index of *Tor* spp. was lowest on the Bahorok River and highest on Berkail River.

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