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Community structure of nekton in the upstream of Wampu Watershed, North Sumatra, Indonesia

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Abstract. *Desrita, Muhtadi A, Tamba IS, Ariyanti J, Sibagariang RD. 2018. Community structure of nekton in the upstream of Wampu Watershed, North Sumatra, Indonesia. Biodiversitas 19: 1366-1374.* River is a habitat for many aquatic organisms. Water quality is the main river characteristic that strongly influences distribution pattern, biodiversity, and abundance of aquatic organisms. Nekton is aquatic organism that swims and moves actively on their desire, for example, fish, shrimp, amphibian and also big aquatic insects. The purpose of this research was to know the habitat condition and biodiversity of nekton in the upstream of Wampu watershed. The habitat condition was measured by examining the temperature, visibility, flow velocity, depth of waters, dissolved oxygen, pH, kind of substrate, the width of the river, body width of river and rate of flow of the river. The type of nekton was determined by catching the nekton using a backpack of electrofishing unit with an electric flow of 12 Volt and 9 Ampere. The upstream habitat condition of Wampu watershed was characterized by big stone, pebble, sandy type of substrate with moderate to strong current flow, and the clear aquatic. Physical and chemical parameters in upstream of Wampu watershed were still sustainable and appropriate as habitat for fish and shrimp. The result of this research showed a variety of nekton collected, comprised of 27 species of fish, five species of shrimp of inland water. Two species of fish from *Tor genera,* i.e., *T. soro* and *T. tambroides* were also found in this study. The highest diversity (H′) in this research site was the Bahorok River (2.12), followed by Landak River (1.93) at the second, and the lowest was Berkail River with only about 1.50 diversity index.

Keywords: Biodiversity, freshwater fish, Bahorok River, Wampu Watershed

INTRODUCTION

River is dynamic open water because there is a fluctuated stream at any time (Gordon et al. 2004). Furthermore, Muhtadi et al. (2014) explained that rivers as open waters have the currents, the environmental gradient differences, and the land affection. A river is the habitat of various types of aquatic organisms such as plankton, benthos, and nekton (Gordon et al. 2004; Odum and Barrett 2004). Nekton is an organism that can swim and move actively on its own, such as fish and shrimp, amphibians and large water insects (Welch 1952; Odum and Barrett 2004). Kottelat et al. (1993) recorded that approximately 1300 species of freshwater fishes were discovered in Indonesia, most of which were found in river waters. Wowor (2010) identified about four types of freshwater crabs and 23 types of native crustaceans in the Cisadane River Basin (Wowor et al. 2009).

The conditions and characteristics of waters habitat including water quality were affected mostly by the pattern of distribution, diversity, and abundance of nekton (Muhtadi et al. 2017); fishes (Simanjuntak 2012a), shrimps and crabs (Eprilurahman et al. 2015; Trijoko et al. 2015). The ecological conditions of the habitat can affect the abundance of the shrimp in the river (Supriadi 2012). Gordon et al. (2004) and Winemiller et al. (2008) stated that fluctuations in water environment conditions either directly or indirectly will influence the composition of fish communities that inhabit the river. Hence, Gordon et al. (2004) and Higgins (2009) suggested that current velocity, habitat availability, and temperature affect the functional structure of fish communities, while the substrate and river width structures predispose the fish taxonomy structure.

Wampu watershed is one of the water resources in Langkat Districit in North Sumatra Province with a river length of approximately 105 km and a river width of 100 m. Hence, it has a normal volume of about 80 km^3 passing through Bahorok, Salapian, Kuala, Selesai, Stabat, Binjai, Secanggang and Tanjung Pura Districts (Center Bureau of Statistics 2013). The results of study on nekton in upstream of Wampu watershed in 2016 by Muhtadi et al. (2017) revealed that there were about 15 species of fish, one type of freshwater crabs and one type of freshwater shrimp. Furthermore, Muhtadi et al. (2017) found that the upper watershed of Wampu, especially the Bahorok and Berkail Rivers, was the primary habitat of the *Tor* fish. *Tor* fish is an economically important and socially valuable fish for Batak people in North Tapanuli and Mandailing, South Tapanuli. Hence, the Mandailing people must serve the *Tor* fish as a mandatory of the traditional Tapanuli wedding ceremony. Therefore, it is necessary to study the nekton in various currents (low, medium and large) in three rivers that flow into the Wampu watershed, namely the Bahorok, Berkail and Landak Rivers.

MATERIALS AND METHODS

Study area

This research was conducted in July-September 2017. Data collection was undertaken at the upstream of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia, namely, the Bahorok River, Landak River, and the Berkail River (Figure 1). Sampling was carried out on the segment of low, medium and large currents. The identification of nekton was done at the Laboratory of Biology and Aquaculture, Agriculture Faculty, the University of Sumatra Utara based on the identification keys in references such as Kottelat et al. (1993), Fishbase (2017), Wowor et al. (2004) and Wowor (2010).

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 was measured by using the estimated ball, the depth was determined with the scaled plank, DO was measured by using a DO meter, and the pH was determined using a pH meter. Meanwhile, the substrate type was observed directly with the senses of sight as well as the width and the body width of the river was measured by a length measuring meter.

Type of nekton was 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 waters such as river and creek. The operation of this tool was carried out for each location along the rivers. Electrofishing operators will move in the opposite direction with river currents (moving upstream), and the fishes were captured by inserting them into plastic bags by using a hand net. The nekton was photographed and preserved in 10% formalin solution, labeled with the local name of the fish, location, collection date, collector name, and other necessary information.

Data analysis

The diversity of nekton communities in aquatic is known through several attributes such as the diversity index of Shannon-Wiener (H'), Evenness (E) and Dominance (D) (Krebs 1989). The Diversity index (H') is used to obtain a mathematical picture of the organism's population. H' can facilitate the analysis of information on the number of individuals of each species within a community (Odum and Barrett 2004). Nekton diversity was calculated by the Diversity index of Odum (Odum and Barrett 2004) by the formula:

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

Where :
H' = Index of species diversity
ni = Individual quantity from each species
N = Quantity of individual
Pi = Necessary probability for each species = ni/N,

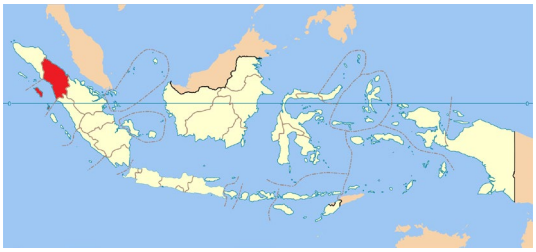


Figure 1. Research location at the upstream of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia: B1 (03º33'327"N, 98º05'574"W), B2 (03º28'48.34"N, 98º07'56.75"W), B3 (03º30'50.34"N, 98º07'56.75"W); and the detected sites

Index of Diversity is used to describe how much the balance in an ecosystem. The similarity of individuals caught (equitability) was calculated by following the equation:

$E = H'/H` max$

Where:
E = Index of similarity of Shannon-Wienner
H= The balance of species
H` max = Index of maximum diversity (lnS),
S = Species total amount

Index of Dominance was used to get information about fish species dominating a fish community at each habitat. Index of Dominance illustrates the species composition in the community. Index of Dominance was calculated following a method by Simpson in Krebs (1989).

$$C = \sum \left(\frac{ni}{N} \right)^2$$

Where :
C = Index of dominance
ni = Individual amount from each species
N = Community individual total

RESULTS AND DISCUSSION

Characteristics of aquatic habitat

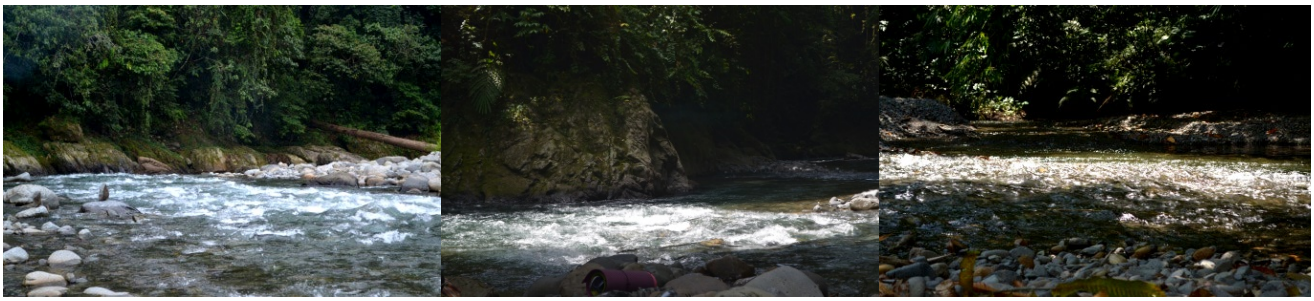
Based on survey results in the field, the land use around the sampling location in the upstream of Bahorok River (Bukit Lawang) and the Berkail River (Batujonjong Village) was an unspoiled area. This area is part of Gunung Leuser National Park area (TNGL). To reach this place, we had to trace the river and went through the TNGL forest. At the Landak River observation station (Timbang Lawan Village) is a community plantation area, around the rubber trees and other plantations. The condition around the observation location is shown in Figure 2. In Table 1, the results of measurement of several physical and chemical parameters of water in the upstream of Wampu aquatic in each station.

The substrate on the upstream of Wampu watershed was sandy and stone substrate type. On the Bahorok River and Berkail River, we found large rocks with the strong dominant flow. In the Landak River section, we discovered a pebble and sandy substrate with a middle-dominant flow. The segment of Berkail River was narrower in the river width and river body width. Furthermore, almost as long as two km of steeply rock cliffs were found in this study. The river width and river body width of Bahorok and Landak Rivers were broader than those of Berkail River. Flow velocity in the Bahorok River was higher than other rivers, reaching 5.83 m s^{-1}. The flow velocity of Landak River was relatively low to middle of about of 0.2-2.7 m s^{-1}. River debit of either the Bahorok or the Berkail River was higher than that of Landak River (46.67 m^3 s^{-1} and 31.54 m^3 s^{-1}, redepcyively). At a certain point, the flow velocity of Landak was recorded at 2.7 m s^{-1} but with a lower debit (7.54 m^3 s^{-1}), not more dangerous than Bahorok and Berkail Rivers.

Temperature changes significantly affect the physics, chemical and biological processes that happened in the water. The temperature range in upstream of Wampu was about 24.60-27.5°C. Temperatures in Landak River segment were warmer than Bahorok and Berkail Rivers (25.5-27.5) °C. This is because of coverage area in these rivers were more open access than Bahorok and Berkail River areas. In Landak River, the plantation area with tree closing level is much lower than the segment of Bahorok and Berkail Rivers that are overgrown by natural forest.

Species wealth of nekton

During the research, nekton caught were as many as 27 species of fish and five types of freshwater shrimp. In this study, we found two kinds of *Tor* fish namely *T. soro*, and *T. tambroides,* and one type of eel fish (*Anguilla* sp). Besides, around river Bahorok and Berkail Rivers, we also found a kind of freshwater turtle, i.e., *Heosemys spinosa*. The types of nekton found in upstream of Wampu are presented at Table 2. Sidat fish are migration fish from upstream to downstream (sea) or often called katadromous. Based on information from the society around the study site, Bahorok and Berkail Rivers are habitat of Jurung and Sidat fishes that can be found upstream of the two rivers flowing downstream to Aceh (Singkil). Both types of fish are the primary commodity caught by fish hunters from Medan, especially the Chinese community. For the Chinese community, consuming both types of fish will bring hockey to them.



A **B** **C**

Figure 2. Conditions around the data sampling location at the upstream of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia. A. Bahorok River, B. Berkail River, C. Landak River

Table 1. Condition of aquatic environment at the research location at the upstream of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia

Environmental parameter	Bahorok River			Landak River			Berkail River		
	High	Middle	Low	High	Middle	Low	High	Middle	Low
Substrate	Big rocks	Big rocks	Gravel, sandy	Small rocks	Gravel	Sandy	Big rocks	Big rocks	Gravel, sandy
Depth (m)	0.4-1.0	0.2-1.0	0.2-1.5	0.1-1.0	0.07-0.2	0.05-1.2	0.6-1.2	0.5-1.0	0.3-1.5
Width of river (m)	15-25	15-25	20-30	20-30	20-30	20-40	10-20	10-20	10-25
Body-width of river (m)	20-50	20-50	50-100	20-50	20-50	50-100	30-60	30-60	30-80
Flow (ms^{-1})	1.93-5.83	1.02-1.75	0.58-1.61	1.16-2.49	0.88-1.32	0.20-0.64	0.98-2.73	0.61-2.17	0.43-0.91
Rate of flow (m^3s^{-1})		22.41-46.67			4.55-7.35			18.84-31.54	
Temperature (°C)	25.20	25.30	25.20	25.5	26.0	27.5	24.65	24.60	25.25
DO (mg L^{-1})	8.50	7.70	7.70	7.45	7.4	7.1	8.45	8.35	7.70
pH	7.30	7.20	7.30	7.70	7.80	7.30	8.30	8.30	8.30

Table 2. Fish species caught in the upstream of of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia

Class, Family Species	Indonesian name	Local name	Common name	Bahorok River	Landak River	Berkail River
Pisces						
Anguilidae						
Anguilla sp.	Sidat	Dondong	Eel	√		
Bagridae						
Mystus nemurus	Baung	Baung	Asian redtail catfish	√	√	√
Mystus nigriceps	Baung	Keting	Twospot catfish		√	
Leiocassis micropogon	Baung	Baung Kuning	Bumble bee catfish	√	√	√
Channidae						
Channa striata	Gabus	Gabus	Snakehead		√	
Cyprinidae						
Barbodes schwanenfeldii	Lemeduk	Lemeduk	Tinfoil barb			√
Crossocheilus cobitis		Rabit	Carb	√		√
Hampala macrolepidota	Barau	Sebarau	Hampala barb	√	√	
Mystacoleucus marginatus		Cencen	Carps	√	√	
Osteochilus hasseltii	Nilem	Paweh	Hard lipped barb	√	√	
O. microcephalus	Paitan	Paitan	Bonylip barb		√	
Puntius brevis		Wader	Swamp barb	√	√	√
Puntius lateristriga		Wader Belang	Spanner barb	√	√	√
Rasbora haru	Pantau	Siluang	Rasbora	√	√	√
Rasbora spp.	Pantau	Siluang	Rasbora	√	√	√
Tor soro	Jurung	Gemo	Tor barb	√	√	√
Tor tambroides	Jurung	Jurung	Tor barb	√	√	√
Siluridae						
Ompok bimaculatus	Lais	Ompok	Butter catfish	√	√	
O. leiacanthus	Lais	Ompok	Catfish		√	
Silurichthys hasseltii	Lais	Selais	Catfish	√		
Sisoridae						
Glyptothorax platypogon	Lele Gunung	Baung layau	Sisorid catfish	√	√	√
G. *platypogonoides*	Lele Gunung	Baung Layau	Sisoridcatfish	√	√	√
Mastacembelidae						
Mastacembelus unicolor	Tilan	Mirik	Spiny eels		√	
M. notophthalmus	Tilan	Mirik	Spiny eels		√	
Hemirhampidae						
Hemirhamphodon tengah	Julung-julung		Halfbeaks		√	
Kuhlidae						
Kuhlia marginata	-	-	Spotted flagtail	√		
Syngnathidae						
Doryichthys martensii	-	-	Longsnouted pipefish		√	
Crustacea						
Atyidae						
Atyopsis moluccensis	Udang Bambu	Udang	Bamboo shrimp	√		
Palaemonidae						
Caridina gracillirostris	Udang beras		Rhino shrimp		√	
Macrobrachium equidens	Udang		Rough river prawn	√	√	√
Macrobrachium spp.	Udang		Freshwater prawn	√		
Solenoceridae						
Solenocera crassicornis	Udang		Red prawn	√	√	
Total				22	25	13

Spatially, there were differences in the number and distribution of nekton in three segments of upstream of Wampu watershed. Species wealth in Sungai Landak was higher (25 species) as compared to that in Bahorok River (22 species) and Berkail River (13 species). However, the total number of fish found on Baharok River (240 fish) was higher than that in Berkail River (184 fish) and Landak River (135 fish). The number of fish species found in Berkail River was fewer due to the river topography that was deeper and narrower. It was very rare to find segments of low-flow shallow streams and pebbles in this river. In the Bahorok River segment, however, we still discovered many grooves river and low flow velocity with sandy/gravel substrate. This indicates that flow is one of limiting factors for the spread of nekton in the river.

Table 3. Distribution of fish caught spatially and temporally in the upstream of Wampu Watershed, Langkat District, North Sumatra Province, Indonesia

Class, Family Species	Bahorok River			Landak River			Berkail River		
	Jul	Aug	Sep	Jul	Aug	Sep	Jul	Aug	Sep
Pisces									
Anguilidae									
Anguilla sp.	1								
Bagridae									
Mystus nemurus			4	2	1	3	8		4
Mystus nigriceps				3	1				
Leiocassis micropogon	5			5	1				1
Channidae									
Channa striata					3				
Cyprinidae									
Barbodes schwanenfeldii									1
Crossocheilus cobitis	2		4						8
Hampala macrolepidota	2			2					
Mystacoleucus marginatus		13			2				
Osteochilus hasseltii		1		2					
O. microcephalus				1					
Puntius brevis	6	4			15	3	3		
Puntius lateristriga		2		3	6	4		3	8
Rasbora haru	7	15		19	2		3	10	
Rasbora spp.		1		3	1	7	1		1
Tor soro	23	14	72	2		4	14	28	54
Tor tambroides	3	1	11			2	1	14	10
Siluridae									
Ompok bimaculatus				2					
O. leiacanthus									
Silurichthys hasseltii		1							
Sisoridae									
Glyptothorax platypogon				2	1	1			
G. *platypogonoides*					1				
Mastacembelidae									
Mastacembelus unicolor	2			2					
M. notophthalmus				3	1				
Hemirhampidae	1		1						
Hemirhamphodon tengah									
Kuhlidae	3	2	4	5	5		2	1	
Kuhlia marginata	2	1	14		3	2	2		5
Syngnathidae									
Doryichthys martensii				1	1				
Crustacea									
Atyidae									
Atyopsis moluccensis		1	1						
Palaemonidae									
Caridina gracillirostris				1	1				
Macrobrachium equidens			11	2	2				2
Macrobrachium spp.	1		1						
Solenoceridae									
Solenocera crassicornis			3	1	1				
Total	58	56	126	64	48	26	34	56	94

Diversity, evenness, dominance of fish at wampu watershed

The diversity index is used to obtain a description of the population of organisms; evenness is used to describe how much balance in an ecosystem and dominance index is to get information on the dominant fish species. Although a higher number of fish species was found in Landak River (25 species), the highest nekton diversity index (H') was found in Bahorok River segment (22 species) (H'=2.12), followed by Landak River (1.93) and Berkail River (1.50). Likewise, the evenness index (E) was highest in Bahorok River (0.69) and lowest in Berkail River (0.59). This indicates that the number of species is not the main diversity indicator of species in aquatic, but proportion between species found in these waters. This is also seen in the dominance index that was higher in Bahorok River even though the value of H 'and E was the highest of these rivers. However, the dominance value was still low (below 0.5), so it can be said that there were not dominant species in this aquatic area. Dominance value obtained was about 0.02-0.23 with the highest value found in Bahorok River, followed by Berkail River, and Landak River.

Discussion

Characteristic of aquatic habitat

Rocky cliffs were found in the segment of Bahorok and Berkail Rivers. The sloping areas in the segment of Bahorok and Berkail River were steeper than Landak River section. The slope and the narrow width of the river were the main factors causing the higher flow in Bahorok and Berkail Rivers. The average depth of Bahorok River and Berkail River were about 30-200 cm and that of Landak river was about 30-150 cm. The rocky and high flow substrate conditions signify upstream river segment, as revealed by research by Pasisingi et al. (2014) who found that the upstream segment of the Cileungsi River were rapid flow and rocky substrate. Gordon (2004) and Mihow et al. (2011), mentioned that rivers in the upland segment (upstream) are characterized by large rock substrate, rapid current, and narrow river width. Furthermore Muhtadi et al. (2014, 2017) suggested that the upstreams are also characterized by large slopes and narrow river width.

The temperature in upstream of Wampu Watershed was in the normal ranged and was still suitable for aquatic biota life. Of course, the optimal temperature for the growth of aquatic biota is specific for a particular biota type. Low temperatures in the upstream were due to their higher

altitude from the sea level. Effendi (2003) said that temperature is influenced by season, measurement time and height/latitude. The temperature range found in this study is not much different from that of Pasisingi et al. (2014) of about 23-29°C and Muhtadi et al. (2017) with a temperature range of 23-29°C.

Tabel 4. Amount of nekton caught based on the flow condition

Class, Family Species	Bahorok River			Landak River			Berkail River		
	High	Middle	Low	High	Middle	Low	High	Middle	Low
Pisces									
Anguilidae									
Anguilla sp.		1							
Bagridae									
Mystus nemurus			9		5				9
Mystus nigriceps					2				
Leiocassis micropogon		5			5			4	
Channidae									
Channa striata						3			
Cyprinidae									
Barbodes schwanenfeldii								1	
Crossocheilus cobitis		4	2				5	1	1
Hampala macrolepidota			2		2				
Mystacoleucus marginatus		13		5	10				
Osteochilus hasseltii			1			2			
O. microcephalus						1			
Puntius brevis			6			8			2
Puntius lateristriga			2			10			11
Rasbora haru		1			21			13	
Rasbora spp.		7			10			2	
Tor soro	23	38	13	4			13	10	12
Tor tambroides	5	5	2	2			10	4	2
Siluridae									
Ompok bimaculatus					2				
O. leiacanthus									
Silurichthys hasseltii		2							
Sisoridae									
Glyptothorax platypogon						3			
G. *platypogonoides*						1			
Mastacembelidae									
Mastacembelus unicolor		2				2			
M. notophthalmus						4			
Hemirhampidae									
Hemirhamphodon tengah									
Kuhlidae		9			10			3	
Kuhlia marginata		17			5			7	
Syngnathidae									
Doryichthys martensii						2			
Crustacea									
Atyidae									
Atyopsis moluccensis			2						
Palaemonidae									
Caridina gracillirostris						2			
Macrobrachium equidens			11			2			2
Macrobrachium spp.			2						
Solenoceridae									
Solenocera crassicornis			3			2			
Total	11	28	104	55	11	72	42	28	45

On the upstream part of Wampu, we obtained visibility value to the bottom of the waters of 100%. Visibility is very closely related to turbidity because it can inhibit the entry of light into the aquatic area. High turbidity can cause the decrease of visibility. This is in line with the statement of Effendi (2003) that high turbidity disruption can lead of osmoregulation system, such as respiration ability of aquatic organisms, and can inhibit the penetration of light into the aquatic region.

The H value in the upstream of Wampu watershed ranged about 7.2-8.3. The pH level of the upstream aquatic tends to be alkaline due to the low organic matter so that the organic decomposition rate becomes low. Thus, the dissolved oxygen is always higher, and CO_2 is depressed causing the pH tends to be alkaline. In general, the observed pH was still in the standard quality. According to Odum and Barrett (2004), pH range of 6-9 is suitable for the life of fish and other aquatic biotas. The value of pH and dissolved oxygen is a parameter of water quality as an indicator of aquatic ecosystem health (Goudey 2003).

Dissolved oxygen indicates the volume of oxygen contained in water. Oxygen can get into the aquatic through photosynthesis and diffusion from the air. The concentration of dissolved oxygen in upstream of Wampu ranged from 7.1-8.5 mg L^{-1}. High level of dissolved oxygen was due to the strong flow velocity in this area. Flowing waters tend to have high dissolved oxygen content compared to stagnant waters since water movement allows oxygen diffusion from air to water to occur (Radwan et al. 2003; Gordon 2004). This can be seen in Table 1, where sampling location with high flow showed a high DO value on each segment of data collection. Haryono (2004) explained that oxygen content of > 6 ppm, pH> 6, and the temperature range between 25°C to 30°C is a suitable water condition supporting the life of fish.

Species wealth of nekton

Freshwater shrimp found in the upstream of Wampu was five types. Giant shrimps (*Macrobrachium equidens*) were found to be most numerous as compared to other shrimp species. In the same year and the same location, only one type of shrimp was found, i.e., *Macrobrachium* (Muhtadi et al. 2017). *Macrobrachium* is a crustacean inhabitant of freshwater. The most common freshwater shrimp found in Indonesia are members of the family of Palaemonidae and Atyidae (Holthuis 1980; Chan 1998). The most common member of the Palaemonidae family in Indonesia is the genus *Macrobrachium*. Members of this genus can be found in flowing and stagnant aquatic waters, and the entire life cycle is in fresh water (Supriadi 2012). Taufik (2011) suggested that *M. sintangense* and *M. lanchesteri* have the most widespread distribution members of the genus Macrobrachium. *M. lanchesteri* species were widespread in Thailand, Malaysia, Myanmar, Singapore, Sumatra, Borneo, and Java; *M. sintangense* was widespread in Thailand, Sumatra, Java, and Borneo (Chong et al. 1988; Wowor et al. 2009); while *M. empulipke* spread in West Java and southern Sumatra (Wowor 2010). Gonawi (2009) found two types of shrimp in Cihideung watershed, Bogor, while Supriadi (2012) found three species of genus

Macrobrachium in the river that headed from Mount Salak, namely *M. lanchesteri*, *M. sintangense*, and *M. empulipke*. According Wowor et al. (2009) and Taufik (2011), freshwater prawns have an essential role in the ecological system in maintaining the balance of ecological systems in aquatic. One of them serves as a component of the food chain. The existence of various types of freshwater shrimp in a river can be used as an indicator of the quality of water and can improve the quality of the river water environment conditions (Trijoko et al. 2015).

Fish from Cyprinidae family are dominant families found in this study as compared to other families (Table 2). Even, the fish from the Cyprinidae family reached up to 86.41% in Berkail River, 75.42% in Bahorok River, and 57.78% in Landak River. When explored further, the research locations were dominated by *Tor* fish which reached 51.67% (Bahorok River) and 65.76% (Berkail River). Meanwhile, the Landak River was dominated by Wader and Siluang Fishes (80.77%). Cyprinidae is a family of freshwater fish that has the most species in the world, except in Australia, Madagascar, New Zealand and South America (Kottelat et al. 1993). Zakaria et al. (1994) stated that Cyprinidae is the largest freshwater fish group in Southeast Asia, and including in the inland water of Sumatra Island (Margasasmita 2002). Nguyen et al. (2006) confirmed that freshwater fish species in the Asian region are dominated by the Cyprinidae fish group (approximate 1000 species), followed by the Loaches (Balitoridae and Cobitiidae) family group (approximately 400 species), Gobiidae (300 species), Bagridae (100 species), and Osphronemidae (85 species). Fish from the Bagridae and Siluridae group became the second largest after Cyprinidae (Table 2). There were three species found, i.e., *Mystus nemurus*, *Mystus nigriceps* and *Leiocassis micropogon* from Bagridae Family and *Ompok bimaculatus*, *O. leiacanthus* and *Silurichthys hasseltii* from the family of Siluridae. The Siluridae and Bagridae groups live in the bottom aquatic regions in rivers and lakes (Kottelat et al. 1993).

Results of previous research in several rivers in Sumatra Island revealed almost similar findings, for instance, in Bukit Tigapuluh Siberida, the aquatic organism found was the Cyprinidae family as the largest population followed by Catfish group (Bagridae, Clariidae, Pangasidae) (Siregar et al. 1993). In Enim River, South Sumatra, number of fish species found was 28 species of 11 families, and the fish was dominated by Cyprinidae (14 species), Cobiitidae (4 species) and Balitoridae (2 species) (Hamidah 2004). Muchlisin et al. (2009) reported that there were 114-711 fish species, with 69 genera, and 41 families found in Aceh aquatic region. Similarly, in Asahan River, North Sumatra, Cyprinidae (14 species), Balitoridae (three species) were found to be most diverse, followed by Clariidae family and Bagridae family (three species) (Simanjuntak 2012a) and 16 species of 10 genera and eight families in Sopokomil River, Dairi, North Sumatra (Simanjuntak 2012a). Sagala (2014) found Cyprinidae (six species), Bagridae (two species), Eleotridae (two species), Cichlidae (one species), Loricaridae (one species), Notopteridae (one species), Ariidae (one species) in Belumai River, North Sumatra.

In a high flowing river condition, only four fish species were found, i.e., Jurung, Gemo, Rabit, and Cencen. There were 67 fish (15.80%) caught in the strong flow condition. The four types of fish are fast swimmers who love swifting water flow. Even, Jurung and Gemo fish (usually > 12 cm) are more common in very strong river currents (>2.5 m s^{-1}) (Table 4). Medium-size Jurung fish were found in medium and low current flow. Kottelat et al. (1993) mentioned that fish group of *Tor* is the fish which likes strong currents with torpedo body shape. Other types of fish that inclined to like strong currents are Baung Kuning and Cencen fishes found in Landak River. Baung Kuning fish can survive in strong currents of big rocks while Cencen fish likes heavy currents with small rocks or gravel substrate. In moderate currents conditions, 17 species were found. Baung and Siluang fishes were mostly found in moderate current conditions. There were 221 (52.12%) fish caught during research in the moderate currents conditions. In the low current flow condition, as many as 136 (32.08%) fish was found from 20 fish species. Wader, Siluang, Mirik and Shrimp are fish species that prefer low currents on the river banks, or on rivers with gravel or sand substrates. Fishes were often found in the groove (very small rivers that boils down to the main river).

There were ten fish species always found on all research in the rivers. Fish from Cyprinidae and Sisoridae families as well as *Macrobrachium equidens* family have a wide distribution in the upstream of Wampu. Furthermore, *T. soro* and *T. tambroides* were the fish species mostly found in large quantities, either in strong currents, medium or low currents depending on fish size (up to 86%). This indicates that upstream of Wampu River is suitable as habitat for Jurung fish (*Tor*). Simanjuntak (2012a) stated that this fish is the same as *N. sumatranus* fish who likes bright, rocky, shallow waters, high dissolved oxygen, and low turbidity. This condition gives an idea that the upstream of Asahan River is the primary habitat of Jurung fish. The results of Wahyuningsih et al. (2016) provide information that upstream of Wampu River is one of the fish habitats of *Tor* in Sumatra. Although *Tor* fish were mainly found in small sizes, this fact encourages the need for protection and conservation of *Tor* species.

Nine types of fish and shrimps spread limitedly in specific river segments. Sidat, Selais, and *Kuhlia marginata* were found only in the Bahorok River. Based on information from local fishermen, Bahorok River is a habitat where Sidat fish is often found. Gabus, Mirik, Julung-julung and *Doryichthys martensii* fish as well as *Caridina gracillirostris* shrimp were found only in Landak River while Lemeduk fish was only found in the Berkail River in September, and was not found in other rivers.

Temporally, Jurung fish was always caught in large quantities on each observation (27.74-62.45%). Sidat fish was only caught in the first observation (July). Even, research carried out a year earlier by Muhtadi et al. (2017) found no Sidat fish although, in the previous study, the authors found types of freshwater crabs in Landak River. In this study, the number of species found was higher (32 species) than that discovered one year earlier (17 species).

In the previous year, Lemeduk fish was not caught in July and August but later was captured in September. This might have occurred due to the high water debit at the time of research so that Lemeduk fish went up to the upstream. The same thing happened in the second sampling where Cencen fish was found on Bahorok River where at that time, the water discharge increased (water was somewhat turbid), when in fact, Lemeduk and Cencen fish like strong currents with somewhat muddy waters.

Differences in spatial distribution is shown, each research location provides different niches (habitats and foods) so that species composition is different; while differences in species composition are temporally more affected by changes in water quality such as increased turbidity and water mass debit (Simanjuntak 2012a). Thus, the composition of species found were spatially and temporally different, especially in Landak River that was quite different from other two rivers. Some researchers pointed out that spatial distribution of species richness is related to habitat differences and the presence of microhabitat, substrate composition and depth of waters (Gordon et al. 2004), diversion of water masses for irrigation/hydroelectricity and destruction of vegetation around the river (Adams et al. 2004; Simanjuntak 2012a). Meanwhile, fish distribution is temporally more affected by changes of water quality for example temperature, pH, dissolved oxygen, turbidity, water discharge (Jenkins et al. 2011; Li et al. 2012), and spawning migration to the river upstream (Rodriguez et al. 1992). Especially for *Tor* fish, Wahyuningsih et al. (2016) found the genetic variation of fish and morphology of *Tor* fish along with different fish habitat *Tor*.

Diversity, evenness, dominance of fish at wampu watershed

The most dominant fish was Tor. This fish is a fish family of Cyprinidae that likes deep, fast flowing, and clear river current (Simanjuntak 2012a; Wahyuningsih et al. 2016), which is different from that found by Simanjuntak (2012a) in Asahan River where the D value was about 0.21 to 1 because the sampling site was upstream in the main and the minor river. Dominance index was close to 1 if a particular species dominate the community and if the dominance index is close to 0, there are no dominant species (Odum and Barrett 2004).

Based on the three indexes, Bahorok River is better than Berkail River. This finding is related to the previous discussion that microhabitat of Bahorok River is more varied than Berkail and Landak Rivers. Thus, there is a chance for fish that do not like strong flow (especially Bahorok River) to live on low flowing river, which is less available on Berkail River segment. Therefore, the Berkail River was more dominated by Jurung and Baung fishes that can survive and like low-fast/strong flowing river. Diversity and evenness are directly proportional to environmental conditions. One of the things that cause higher diversity in Bahorok River was the condition of the river that was still good, and the river flow conditions were favored by big and small fish types. Big fish was found in high currents parts, while small-sized fish in low currents was mainly found in grooves along Bahorok River. This can be seen from index of diversity and evenness fish at low current conditions (2.48) that were higher than those of the moderate currents (2.3) and high currents (1.04). At low flows, the dominance index was very low (0.11) as compared to that of the high currents (0.43).

Fish diversity in upstream of Wampu was higher than nekton diversity of other rivers in Indonesia. The results of Gonawi (2009) showed that diversity index (H') in Cihideung River in each station was about 1.2-2.3. Djumanto et al. (2011) determined the fish diversity in the upstream of Opak River, Yogyakarta of about 1.4-1.9. Haryono (2004) obtained the fish diversity of a river in Muller Mountain, Central Kalimantan that ranged between 0.80-2.17. Simanjuntak (2012a) also found a low diversity of fish in upstream Asahan River of 0-1.75. These suggest that although many species are found in a habitat, it does not mean that the index of diversity is high because there is a factor of the proportion of each species that affect the index of biodiversity (Odum and Barrett 2004).

Temporally, the highest diversity of fish occurred in July as compared to other months. Diversity index (H') in July was 2.62 while that in August was 2.32, and that in September went down to 1.76. This indicates that in the dry season (July), the conditions of the river flow and discharge are lower than that in the rainy season (September). Normally, fishes are distributed on each river segment as well as currents segment. While entering the rainy season with massive discharges, small fish tends to search the bottom of the river to avoid heavy currents. Meanwhile, fish that likes strong currents will be more in the main river. Besides, the fishes found in downstream (Wampu River) will go to the upstream for spawning and feeding. Simanjuntak (2012a) found that fish caught in the rainy season in upstream of Asahan River was dominated by fish entering the mature level of gonads. Higgins (2009) stated that flow velocity, habitat availability, and temperature affected the functional structure of fish communities; while substrate structure and river width affected the taxonomic composition of fish (Simanjuntak 2012a).

To conclude, the highest number of nekton species found in the study sites was Cyprinidae family, and the lowest was Anguilidae, Channidae, Hemirhampidae, Kuhlidae and Syngnathidae families. The richest fish species was found in Landak River, and the poorest was in Berkail River, while the highest number of fish was found in Bahorok River, and at the lowest number was in Landak River. Based on the river currents, the highest fish total counts were found in the medium currents and the lowest were in the strong currents. The highest diversity index and evenness index was found in Bahorok River, and the lowest was in Berkail River. The highest dominance index was found in Bahorok River, and the lowest was in Landak River where Tor was the most dominant fish. The highest diversity and evenness index was found at low currents, and the lowest was in strong currents. The highest dominance was at low currents, and the lowest was at strong currents. The highest fish diversity occurred in July, and the lowest did occur in September.

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