Fish Diversity in Peusangan River, Aceh Tengah Regency, Indonesia

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Abstract: Information upon fish diversity in Peusangan river, Aceh Tengah regency is still limited in addition to its surrounding physicochemical factors which may indicate the health status of natural habitat. This study aims to obtain the ecological parameters and biodiversity of fish in study sites based on different characteristics of sampling sites. Data analysis included the Shannon's diversity index (H') and evenness index (E) and water parameters, e.g. velocity, temperature, pH, light intensity, light penetration, dissolved oxygen, biochemical oxygen demand, nitrate and phosphate content. Ten species of fishes sampled from study sites were classified into 4 orders (Perciformes, Cypriniformes, Cyprinodontiformes, Siluriformes) and 6 families (Cichilidae, Channida, Cyprinidae, Poecilidae, Clariidae, Loricariidae). The highest population was *Xiphophorus hellerii* (1 ind.m^{-2}) while the highest and lowest H' was found in Station 2 and Station 4 with 1.89 and 1.52, respectively. Stream velocity and phosphate content were strongly correlated to the diversity of fishes in Peusangan river based on Pearson's product-moment correlation analysis.

1   INTRODUCTION

Fish is one of the biodiversity which construct the river ecosystem. Biodiversity acts as a stable ecosystem, source of germplasm and economic source. Fish in tropical rivers have the characteristic of being able to adapt to fast river currents and low dissolved oxygen during the dry season. Freshwater fish are very vulnerable to be disturbed considering freshwater fish as a need to meet the nutritional value for humans. The presence of freshwater fish in Indonesia's rivers is increasingly threatened because of over-exploitation, habitat destruction and invasion of foreign species.

Peusangan River is one of the rivers in the province of Aceh with a length of 128 km flowing through 4 districts / cities (Khasanah et al., 2010). At present, the Peusangan River experiences mild to moderate degradation due to community activities such as agriculture, bathing, washing and toilet as well as the construction of the Peusangan Hydroelectric Power Plant which causes disturbed water conditions and affects the stability of aquatic ecosystems. Therefore, research is needed on the diversity of fish in the Peusangan River to see the condition of the waters in the Peusangan River. The purpose of this study was to analyze the diversity of fish and their relationship with physical factors of chemical waters in the Peusangan River, Central Aceh District.

2   MATERIALS AND METHODS

This research was conducted from September to October 2018 in Sungai Peusangan, Central Aceh District, Aceh Province. Samples were taken based on the activities around the station twice as many replications which are located in Bale Atu Village, Kayu Kul Village, Lenga Village, and Semelit Mutiara Village. Identification and determination were conducted at the Biology Laboratory of the Faculty of Mathematics and Natural Sciences, University of North Sumatra.

This study uses a purposive sampling method by determining 4 research stations. Fish are taken using a 5×1 m net with 1 inch mesh size. The net is stocked at 17:00 WIB until 06.00 WIB and 07.00 WIB until 16.00 WIB. The fish obtained are documented and put in containers containing 70% alcohol. The physical chemistry factors were measured including temperature, light intensity, light penetration, velocity, pH, DO, BOD_5, NO_3 and PO_4.

The fish obtained were identified by reference to Kottelat et al. (1993).

3 RESULTS AND DISCUSSION

The number of fish individuals sampled in this study was 398 ind during two capture efforts. Fish species are grouped into 4 orders (Cypriniformes, Silluriformes, Cyprinodontiformes, Perciformes), 6 families (Cyprinidae, Clariidae, Loricariidae, Poeciliidae, Channidae, Cichilidae), 10 species of fish (Table 1 and Figure 1). The most abundant fish species are from the Cyprinidae family with 4 species namely *Osteochillus vittatus, Osteochillus kappenii, Rasbora sumatrana,* and *Poropuntius tawarensis*. Cyprinidae is a large freshwater fish spreaded in almost all freshwater region (Kottelat et al., 1993). Cyprinids inhabit both strong and weak streams characterized with good water quality, making their presence as generalists.

Guppy fish (*Poecilia reticulata*) was found at all research stations because these fish are easy to breed and adapt to their environmental conditions. According to Panjaitan et al. (2015) Guppies are easy to breed by mating at the age of 3 months. A Guppy can produce up to hundreds of chicks during its lifetime. Guppies are a group of fish that are able to survive in an unfavorable environment, and do not require a special location to breed.

Green Swordtail (*Xiphophorus hellerii*) is an ornamental fish species that has a unique shape. The male fish will develop a sword at the bottom of the tail fin. This fish was not found at stations 3 and 4 due to unfavorable environmental conditions such as lower light penetration, more turbid water and faster water currents. According to Maddern et al. (2011) Swordtail can live at temperatures of 18-25°C but can still survive at lower temperatures in subtropical areas. This fish likes clear waters and should be calm. The population of Swordtail will be lower if predator fish such as tilapia and cork fish are found.

Poropuntius tawarensis is a species that generally lives in tap waters such as lakes and can only be occasionally found in slow-flowing rivers. The number of fish species found at each station is different, this depends on the ability of fish to adapt to the physical chemical factors of the waters. According to Muchlisin et al. (2010) Kawan fish (*Poropuntius tawarensis*) is an endemic fish of Lake Laut Tawar. This fish lives in the sub-pelagic zone to the demersal zone. Most of these fish are found around aquatic plants near the lake shores.

Relo fish (*Rasbora sumatrana*) are only found at station 1. This fish has a relatively small body size. The absence of *Relo* Fish in other research stations is due to the presence of predators that prey on *Relo* fish. According to Idris et al. (2017) at least Rasbora sumatrana fish were found due to predatory Channa striata fish which prey on small fish, insects, and various other aquatic animals.

Snakehead fish is a species of freshwater carnivorous fish. Snakehead fish has a rather flat head and snakehead shape. Snakehead were not found at station 1 and station 2 because of the unfavorable environmental conditions for fish habitat. Snakehead prefers shallow and muddy areas. According to Listyanto and Andriyanto, (2009), snakehead generally live in shallow waters such as rivers and swamps, tend to choose dark, muddy places. This fish prey on a variety of small fish, insects, and various aquatic animals including tadpoles and frogs.

Table 1: Fish taxa and occurrence in Peusangan river.

Order	Family	Species	Station			
			I	II	III	IV
Cypriniformes	Cyprinidae	*Osteochillus vittatus*	+	+	-	-
		Osteochillus kappenii	-	+	+	+
		Poropuntius tawarensis	+	+	-	-
		Rasbora sumatrana	+	-	-	-
Siluriformes	Clariidae	*Clarias batrachus*	-	+	+	+
	Loricariidae	*Liposarcus pardalis*	-	+	+	-
Cyprinodontiformes	Poecilidae	*Poecilia reticulata*	+	+	+	+
		Xiphophorus hellerii	+	+	-	-
Perciformes	Channidae	*Channa striata*	-	-	+	+
	Cichilidae	*Oreochromis niloticus*	+	-	+	+

1. *Osteochillus vittatus*

2. *Osteochillus kappenii*

3. *Poropuntius tawarensis*

4. *Rasbora Sumatrana*

5. *Poecilia reticulata*

6. *Xiphophorus hellerii*

7. *Liposarcus pardalis*

8. *Clarias batrachus*

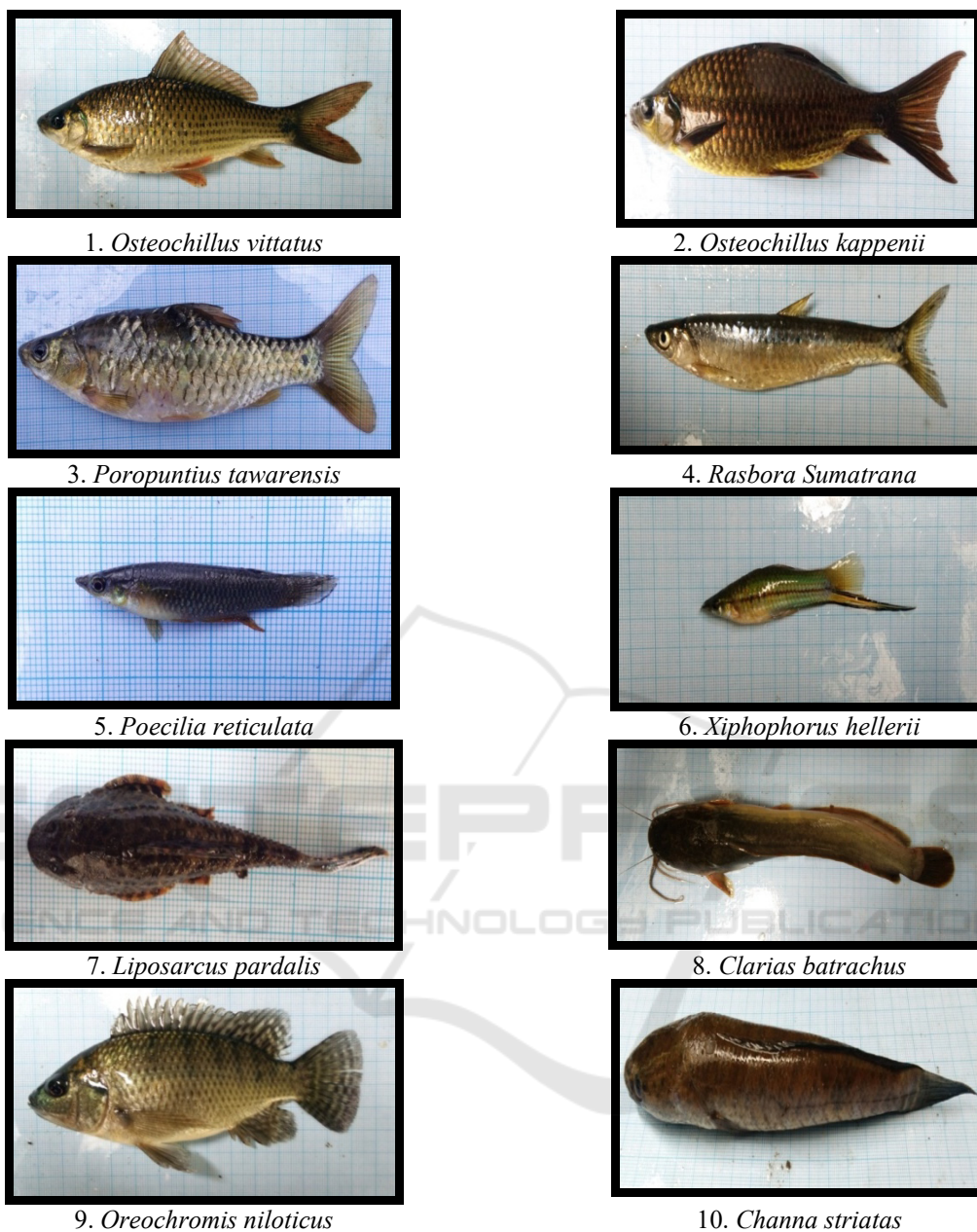9. *Oreochromis niloticus*

10. *Channa striatas*

Figure 1: Documentation of fish diversity in Peusangan river.

Sapu-sapu is one of the invasive species. Invasive species can be predators and competitors of native species. *Sapu-sapu* are more commonly found at station 2 because the high phosphate content at station 2 causes significant growth of algae which is the main food of the broom. According to Wu et al. (2011) *Sapu-sapu* fish live on the bottom of the waters as algae eaters. This fish can be a competitor of algae-eating local fish. The fish also prey on fish eggs, thereby reducing the number of local fish populations.

Peres (*Osteochillus* sp) is a freshwater fish inhabiting the benthopelagic zone with sandy substrate and muds. *Peres* were found at each research station due to the availability of sufficient food in the waters. According to Setiawan et al. (2018) The genus *Osteochillus* is a herbivorous fish that in the larval to adult phase utilizes plankton as its food source in *O. hasselti* and 48% of stomach contents are identified as plants in *O. vittatus*.

Shannon's diversity index values ranged from 1.52 to 1.89. According to Krebs (1985), the

diversity index value (H ') below 2.302 is classified as low diversity. According to Wahy Wahyuni and Zakaria (2018), the high and low value of the diversity index depends on the variation in the number of individuals per fish species that was successfully caught. The greater the number of fish species and the variation in the number of individuals per species, the greater the diversity of fish in an aquatic ecosystem.

Uniformity index values at each station are relatively the same. Uniformity index (E) values ranged from 0.94 to 0.98. According to Krebs, (1985), the uniformity index value close to 1 states that the distribution of individuals is very uniform and evenly distributed. This causes the absence of a species that dominates in these waters.

Table 2: Shannon's diversity and evenness index.

Station	Shannon's diversity index (H')	Evenness index (E)
I	1.67	0.94
II	1.89	0.97
III	1.76	0.98
IV	1.52	0.95

The temperature at each research station ranged from 23.7-25.3°C. The highest temperature obtained at station 3 was 25.3°C, while the lowest temperature obtained at station 2 was 23.7°C. The difference in temperature at each station is influenced by the intensity of light, current, and depth. According to Barus (2004), temperature can be influenced by season, altitude from sea level, air circulation, currents, light intensity and depth.

Dissolved oxygen (DO) at each station ranged from 5.8 to 6.6 mg / L. The highest DO is at station 2 and the lowest is station 3. The difference in oxygen solubility can be caused by several factors including the temperature difference at the two stations. At station 2 the water temperature is lower so DO is higher. Oxygen is a very important compound for the life of organisms, especially for the process of breathing, metabolism, and photosynthesis. The presence of dissolved oxygen in the waters is an important factor for the survival of all organisms. According to Kenconojati et al. (2016) DO levels that are good for fish growth are above 5 mg / L.

The highest BOD5 value is at station 3 of 2.8 mg/L and the lowest BOD5 is at station 1 of 1.4 mg/L. This difference is due to the content of organic compounds derived from domestic and agricultural waste. According to Kristanto (2002) the value of BOD that can still support the life of aquatic organisms ranges from 1-3 ppm.

The highest PO4 (Phosphate) level is at station 2 at 4.87 mg/L and the lowest at station 4 is 0.03 mg/L. The very high phosphate value at station 2 is caused by domestic waste from households, markets, and livestock that are dumped directly into the waters. According to Mustofa (2015), high phosphate levels indicate an eutrophic (fertile) waters.

Table 3: Physicochemical characteristics of Peusangan river.

Parameters	Units	Station			
		I	II	III	IV
Temperature	°C	24.10	23.70	25.30	24.90
Light intensity	Cd	314	344	325	380
Light penetration	meter	1.80	1.50	1.20	1.40
Velocity	m/s	0.31	0.24	0.42	0.47
pH	-	7.57	7.31	7.21	7.19
DO	mg/L	6.20	6.60	5.80	6.40
BOD5	mg/L	1.40	2.20	2.80	1.80
O_2 Saturation	%	75.33	79.61	71.87	78.72
Nitrate	mg/L	0.17	0.15	0.44	0.37
Phosphate	mg/L	0.04	4.87	0.11	0.03

The value of phosphate correlation and current velocity to diversity index (H ') is quite strong. Correlation values for temperature, light intensity, and nitrate are moderate and correlation values for pH, light penetration, DO, BOD, and oxygen saturation are relatively weak. The highest correlation value is the current speed of -0,814. High correlation values indicate the speed of the flow is very influential on the diversity index. A negative correlation value (-) shows the opposite correlation. The higher the current velocity, the lower the diversity index of fish. According to Barus (2004) currents that are too swift can wash away fish, so fish will avoid by hiding behind rocks.

Table 4: Correlation between H' and physicochemical characteristics of Peusangan river.

Parameters	Correlation (r)
Temperature	-0.529
Light intensity	0.177
Light penetration	-0.539
Velocity	0.013
pH	-0.814
DO	0.095
BOD5	-0.255
O_2 Saturation	-0.031
Nitrate	-0.482
Phosphate	0.768

The value of the phosphate correlation to the diversity index of 0.768 indicates a strong correlation. A positive value, indicating the higher the value of the phosphate, the greater the diversity index. Phosphate in the waters is an important nutrient for the growth and metabolism of aquatic organisms, especially phytoplankton. According to Patty et al. (2015) phytoplankton is an indicator of fertility in waters. The more presence of phytoplankton in the waters, indicating the more fertile waters so that more aquatic biota. However, if the phosphate concentration is too large in waters, eutrophication can occur which causes death in aquatic biota.

4   CONCLUSIONS

Fish species obtained at four research stations in Peusangan river, Central Aceh regency, Aceh province consisted of 4 orders, 6 families, and 10 species. The diversity (H') is classified as low within range of 1.52-1.89. Distribution of fishes in the water are relatively uniform and evenly distributed with E value of 0.94-0.98. Phosphate and stream velocity show a strong correlation to fish diversity index in the Peusangan river.

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