Fish fauna in the Krueng Geumpang River, Indonesia

To cite this article: M Nasir et al 2018 IOP Conf. Ser.: Earth Environ. Sci. 139 012023

View the article online for updates and enhancements.
Fish fauna in the Krueng Geumpang River, Indonesia

M Nasir1*, M Munira2, Z A Muchlisin3

1 Departement of Biology, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia
2 Departement of Pharmacy, Health Politechnic Aceh, Banda Aceh 23352, Indonesia
3 Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia
*Email : muhd.nasir@fmipa.unsyiah.ac.id

Abstract. The objective of the present study was to examine the diversity and distribution of fishes in the Krueng Geumpang River. The survey was conducted from 1st to 22nd August 2015 with six sampling locations. Fish samples were caught using gillnets and fish traps. Data analyses performed in this study were the frequency of incidence (FOI), diversity index (H’), and dominance index (C). A total of 88 individual fishes belong to 12 species and six families. Tor soro is the dominant species in this river. There are two species of fish that widely distributed i.e. Tor soro (FOI = 66.7 %) and Neolissochilus thienemanni (FOI = 50.0 %). The Shannon-Wiener diversity index ranged from 0.00 to 2.05. The low value of the diversity index (H’) can be caused by factors such as river morphology, poisoning, mining, and overfishing.

1. Introduction

The Geumpang River is located in the Pidie Jaya District, Aceh Province, Indonesia. The watershed of the river is situated in the rain forest of Ulu Masen Ecosystem, Sumatra. Currently, the river condition is threatened by anthropogenic activities like illegal logging, traditional gold mining, and overfishing.

Riverine biota has undergone changes as a consequence of drastic land conversion. The rapid urban development threatens river biota and water quality. The use of detergents in households and fertilizers in crop fields enabled the flow of nutrients into surface waters. Moreover, many adverse changes in river ecosystems occurred due to a conversion of riparian land [1]. This condition is susceptible for aquatic organisms like fish. The pollution will disrupt the ecological balance of aquatic biota and produce negative impact for human being [2]. The waste discharge into waters has the potential to contaminate aquatic biota and disrupt food chain in the aquatic systems [3].

Fishing in the Aceh Province is mostly done in the sea, especially along the coast and continental shelf. Fishing also exists in lakes and rivers. The problems that arise in capture fisheries are overfishing and water pollution. A number of species experiences significant population decline and are under threat of extinction. This results the decline of in number of fish caught in the wild. The objective of present study is to examine the diversity and distribution of fish in the Geumpang River.

2. Materials and Methods

2.1. Time and location

Survey was conducted from August 1–22, 2015 at six sampling sites along the Geumpang River (figure 1). The sampling sites were determined purposively based on the characteristics of river (table 1). The fish was caught using gillnets (mesh size of 0.5 to 1.5 inches), fish traps, and hooks. Sampling activities were conducted for two days at each sampling site. The sampled fishes were counted and photographed.
prior to preservation with 10% formalin and then transported to the Basic Biology Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, University of Syiah Kuala, Banda Aceh Darussalam for further taxonomic identification by following [4].

| Locations   | Coordinates                  | Characteristics                                                                 |
|-------------|------------------------------|---------------------------------------------------------------------------------|
| Lhok Tarok  | 4°49'40.93"N; 96° 8'10.01"E | Bordering to the protected forest around the settlements and paddy fields additional |
| Lhok Kuala  | 4°49'52.66"N; 96° 8'3.95"E  | Water from a small river                                                          |
| Kuala Keunee| 4°51'29.97"N; 96° 6'46.27"E | Assembly between Kr. Geumpang and Kr. Keunee                                    |
| Lhok Tunggok| 4°52'51.43"N; 96° 5'43.34"E | Many activities taking Quarry                                                     |
| Alue Landong| 4°53'43.19"N; 96° 3'38.98"E | Bordered by natural forest and Alue Landong River                                |
| Tanjakan    | 4°55'12.66"N; 96° 1'18.89"E | Deeper river water and larger river                                               |

2.2. **Data analysis**

The frequency of incidence (FOI) was calculated to estimate the local distribution of fish by using the following formula:

\[ \text{FOI} = \frac{N_i \cdot S_t}{N \cdot S_t} \times 100\% \]  

where \(N_i \cdot S_t = \text{total number of locations where the species } i \text{ is found}\), \(N \cdot S_t = \text{total number of sampling locations}\).

The Shannon-Wiener diversity index was employed to evaluate the diversity of fish fauna in the Geumpang River.

\[ H' = -\sum p_i \ln p_i \]

where \(H' = \text{Shannon-Wiener Diversity Index, } p_i = \text{number of individuals of all species } i, \text{ and } N = \text{number of individuals of all species}\). The diversity index expresses the species richness in a community and shows the balance in individual proportion of every species. The Shannon Wiener diversity index is classified into three levels: low (\(H < 2\)), moderate (\(2 < H < 4\)), and high (\(H > 4\)) [5].

The Simpson dominance index was calculated to assess the dominance of the fish species in the community. The formula is as follows:

\[ C = \sum (\frac{n_i}{N})^2 \]

where, \(C = \text{Dominance Index, } n_i = \text{number of individuals of the species } to-i, \text{ and } N = \text{a total number of individuals}\). Type Dominance Index (C) ranges from 0 to 1, where value tends to 0 is an indication no predominant species. Value tends to 1 indicates the presence of predominant species in the community [6].
3. Results and Discussion
A total of 88 individuals of fish belongs to 12 species, 11 genera, and six families were recorded during the survey. The largest number of species was recorded in Lhok Tarok site (table 2). Cyprinidae was a predominant family of fish in the Geumpang River (figure 2). There are two species of fish that distributed widely, i.e. Tor soro (FOI = 66.7 %) and Neolissochilus thienemanni (FOI = 50.0 %) (table 3). Fish diversity index (H’) ranges from 0 to 2.05 indicating low degree of diversity. The dominance index (C) ranges from 0.15 to 1.

Figure 1. Map of sampling location in the Geumpang River.

Figure 2. Composition of fish family in the Krueng Geumpang River.
Tor soro and Neolissochilus thienemanni are two dominant species in the Krueng Geumpang River. Both species are caught in several locations with a considerable amount. Both fishes are in the family of Cyprinidae. The existence of Tor soro and Neolissochilus thienemanni is quite dominant because it has body shape that can survive in a strong current. The front body of Tor soro and Neolissochilus thienemanni are flat with pectoral fin and abdomen extended to the side [4].

The low value of the diversity index (H’) can be caused by factors such as river morphology, mining, and overfishing. Recent mining activities are postulated to induce mass mortality. Mass mortality of fish is a symptom of death of fish population. The main cause is poison. Poisoning due to water contamination is the major driver due to mining activities in the upper stream of the river.

The destruction of fish can be the first symptom of stress on the environmental quality. Various fish species have low tolerance for changes in environmental conditions and the mortality of fish in the region is an indicator of environmental problem in their habitat. The environment in which they live also has a direct or indirect relationship with the natural resources associated to human and is linked to the life of animals and other plants. Pollution and environmental damage may affect organisms at certain age levels, in particular fish larvae. Symptoms of dissolved oxygen deprivation tend to affect the big species have low to medium age levels, in particular fish larvae. Symptoms of harmful substances contamination can affect many species.

Among the freshwater fishes, Tor soro and Neolissochilus thienemanni are found in most sites. There are at least three species of mahseer (Tor tambra, T. soro and T. tambroides) found in Aceh [6]. However, only one species of mahseer was caught from sampling site in this study. The total number of fish in the river is probably higher than recorded in this study and further sampling using a greater diversity of sampling gears and sampling duration is required.

We found one introduction fish species in the study site, i.e. Oreochromis niloticus or known as tilapia. This fish presents in the Indonesia waters for long-term period. Oreochromis niloticus was introduced in 1969 by the Center of Research and Development for Freshwater Aquaculture, Ministry of Marine and Fisheries Affairs of the Republic of Indonesia. It is estimated that this species became established in the Aceh Province since 1990s [7].

| Location     | Genus | Species | Number of individuals | Dominance Index (C) | Diversity Index (H’) |
|--------------|-------|---------|-----------------------|---------------------|----------------------|
| Lhok Tarok   | 10    | 10      | 42                    | 0.15                | 2.05                 |
| Lhok Kuala   | 1     | 1       | 1                     | 1.00                | 0.00                 |
| Kuala Keune  | 1     | 1       | 12                    | 1.00                | 0.00                 |
| Lhok Tunggok | 1     | 1       | 7                     | 1.00                | 0.00                 |
| Alue Landong | 4     | 5       | 15                    | 0.37                | 1.23                 |
| Tanyakan     | 1     | 1       | 11                    | 1.00                | 0.00                 |
| Total        | 11    | 12      | 88                    | 0.19                | 1.97                 |

The negative impact of alien fish species on the indigenous fish community includes predation on local fishes, competition for food and habitat, interference with mate selection, and unexpected cross breeding with local fish. The results in a depressed genetic diversity and distinctiveness of local fishes and the transmission of disease [8]. However, the total number of alien fish species in the Krueng Geumpang River is lower than that recorded in other regions of Aceh Province.

Cyprinidae fish is widely distributed and predominant in the Krueng Geumpang River. Fish of the order Cypriniformes is the largest group of primary freshwater fish in the river system [9]. Cyprinidae is the largest group of freshwater fishes in the world and is the dominant family recorded in the Tripa
peat swamp, Aceh province. Moreover, Cyprinidae is dominant in many other freshwater habitats in Asia [9].

Table 3. List of species of fish and total individual, and distribution in the Geumpang Krueng River.

| Family          | Species                          | Local name | Locations | Total | FOI (%) |
|-----------------|----------------------------------|------------|-----------|-------|---------|
| Anabantidae     | *Anabas testudineus*             | Krup       | 1         | 1     | 16.7    |
| Balitoridae     | *Protomyzon griswoldi*           | Ilee       | 10        | 10    | 16.7    |
| Channidae       | *Channa striata*                 | Bace       | 4         | 4     | 16.7    |
| Cichlidae       | *Oreochromis mossambichus*       | Mujair     | 1         | 1     | 16.7    |
|                 | *Oreochromis niloticus*          | Nila       | 1         | 1     | 2       |
|                 |                                  |            |           |       | 33.3    |
| Cyprinidae      | *Anematichthys apogon*           | Ceperas    | 9         | 1     | 10      |
|                 | *Hampala macrolepidota*          | Palung     | 2         | 2     | 16.7    |
|                 | *Neolissochilus thienemanni*     | Kerling    | 1         | 4     | 11      |
|                 |                                  |            |           |       | 16      |
|                 |                                  |            |           |       | 50.0    |
|                 | *Puntius brevis*                 | Groe       | 3         | 3     | 16.7    |
|                 | *Rasbora sp.*                    | Depik      | 6         | 6     | 16.7    |
|                 | *Tor soro Valenciennes*          | Naleh      | 4         | 12    | 7       |
|                 |                                  |            |           |       | 31      |
|                 |                                  |            |           |       | 66.7    |
| Eleotridae      | *Ophiocarrassp*                  | Ntok       | 2         | 2     | 16.7    |

Number of Individual: 42 12 7 15 11 8
Number of species: 10 1 1 5 1 12

Note: * IUCN red list
A= Lhok Tarok,
B= Lhok Kuala
C= Kuala Keunee
D= Lhok Tunggok
E= Alue Landong
F= Tanyakan
FOI= Frequency of incidence

4. Conclusion
Cyprinidae fish is widely distributed and predominant in the Krueng Geumpang River. Among the freshwater fishes, *Tor soro* and *Neolissochilus thienemanni* are commonly found in most sites. *Tor soro* and *Neolissochilus thienemanni* are the two dominant species in the Krueng Geumpang River. The low value of the diversity index (**H**') can be caused by factors such as river morphology, mining, and overfishing.

Acknowledgements
The authors acknowledge the Syiah Kuala University for providing financial support for this project. The appreciation is also dedicated to the Department of Biology and DMAS Programme who have given permission and support for the implementation of this study and as well as to those who participate and help in the implementation of this research.

References
[1] Kruk A, Cieplucha M, Zieba G, Tybulczuk S, Tszydel M, Marszal L, Blonska D, Galicka W and Przybylski M 2016 Ecological Informatics. 33 109–118
[2] Lyons K, Carlisle A, Preti A, Mull C, Blasius M, O’Sullivan J and Lowe C G 2013 Marine Environmental Research 90 27–38
[3] Karrari P, Mehrpour O and Abdollahi M 2012 Daru: Journal of Faculty of Pharmacy, Tehran University of Medical Sciences 20(1) 2
[4] Kottelat M, Whitten S N, Kartikasari and Wirjoatmodjo S 1993 *Freshwater Fishes of Western Indonesia and Sulawesi* (Singapore: Periplus Edition)

[5] Muchlisin Z A and Siti-Azizah M N 2009 *International Journal of Zoological Research* 5(2) 62–79

[6] Odum E P and Barret G W 2004 *Fundamental of ecology* (Belmont: homson Brooks Cole Publishing) p 624

[7] Chen C H, Hsieh C H, Hwang D F 2012 *Food Control* 28 240–245

[8] Muchlisin Z A 2012 *Archives of Polish Fisheries*. 20 129–135

[9] Muchlisin Z, Akyun Q, Risika S, Fadli N, Sugianto S and Halim A 2015 *Check List the Journal of Biodiversity Data*. 11(2) 1–8