

## Short Communication: Fish fauna of Lake Lauik Tawar and Lake Lauulo, Simeulue Island, Indonesia

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**Abstract.** Muchlisin ZA, Nurfadillah N, Arisa II, Rahmah A, Putra DF, Nazir M, Zulham A. 2017. Short Communication: Fish fauna of Lake Lauik Tawar and Lake Lauulo, Simeulue Island, Indonesia. *Biodiversitas* 18: 752-757. The objectives of the present study were to evaluate the species composition and diversity index of fishes in Lake Lauik Tawar and Lake Lauulo, Simeulue Island, Aceh Province, Indonesia. The survey was conducted from 17<sup>th</sup> to 21<sup>st</sup> of November 2015. The fishes were sampled using gillnets with mesh size 1-3 inches. The representative of each species was photographed and then preserved in 10% formalin and transported for taxonomic identification in the Laboratory of Ichthyology, Syiah Kuala University, Banda Aceh, Indonesia. The study showed that there were 11 species of fish recorded during the survey; where eight species were found in Lake Lauik Tawar and six species were found in Lake Lauulo. Two species of alien fish were recorded in Lake Lauik Tawar, i.e. *Osphronemus gouramy* and *Oreochromis niloticus* and one species in Lake Lauulo i.e. *O. niloticus*. In addition, *Ambassis miops* and *Clarias batrachus* were predominant species in Lake Lauik Tawar and Lake Lauulo, respectively. In general, the two lakes were categorized as a low degree of fish diversity.

**Keywords:** Diversity, endemic, Indian Ocean, inland fisheries, outer-most island of Indonesia

### INTRODUCTION

Indonesia is known as a megadiversity country in the world just after Brazil. Vida and Kotai (2006) estimated that about 50,000 species of fish occurred worldwide. Of these, about 22000-25000 species have been identified and described (Allen 2000; Gilbert and Williams 2002). In addition, Nelson (1994) predicted that approximately 200 new species per year are recorded and 40% of them are freshwater fish. Djajadiredja et al. (1977) estimated that there are 4000 species of freshwater fishes found in the waters of Indonesia and Kottelat et al. (1993) reported that more than 964 species of freshwater or brackish water were recorded in the western region of Indonesia and Sulawesi (Muchlisin and Siti-Azizah 2009) reported that at least 114 freshwater and brackish fishes are found in Aceh waters, and according to Muchlisin et al. (2015) 73 species of those are recorded from the Tripa peat swamp forest. However, Muchlisin and Siti-Azizah (2009) and Muchlisin et al. (2015) noted that the report of the fish communities from the outermost islands of Indonesia like Simeulue Island was scanty.

Simeulue Island has situated in the Indian Ocean approximately 150 km from the mainland of Sumatra

Island. Simeulue has big potency on the fishery, for example, the island had 400 km coastline with fishery production about 13,966 tons a year in 2015 (Rahmantya et al. 2016). Besides of being rich in a marine fishery, the island also has the potency of inland waters resource, for example, the Simeulue Island has 26 watersheds where the main watersheds are Sangiran (26,534.64 ha) and Devayan (14,659.02 ha). It has four lakes, namely, Lake Lauik Tawar (56.95 ha), Lake Lauulo (169.6 ha), Lake Tirama (18.72 ha), and Lake Luan Buoyo (10.45 ha) (RPJMD 2012).

Other than as an isolated area, Simeulue Island also has a unique hydrology condition, for example, marshes and estuaries, short and shallow rivers and small lakes. It is very likely that the new fish species or endemic species are found. This is the first report of ichthyofauna from the outermost island of Aceh Province, Indonesia, and the survey is focused on the two bigger lakes in Simeulue Island, i.e. Lake Lauulo and Lake Lauik Tawar. The objective of the present study was to explore the fish fauna of Lake Lauik Tawar and Lake Lauulo in relation to providing the comprehensive database of freshwater fishes of Aceh Province, Indonesia.

## MATERIALS AND METHODS

### Study area

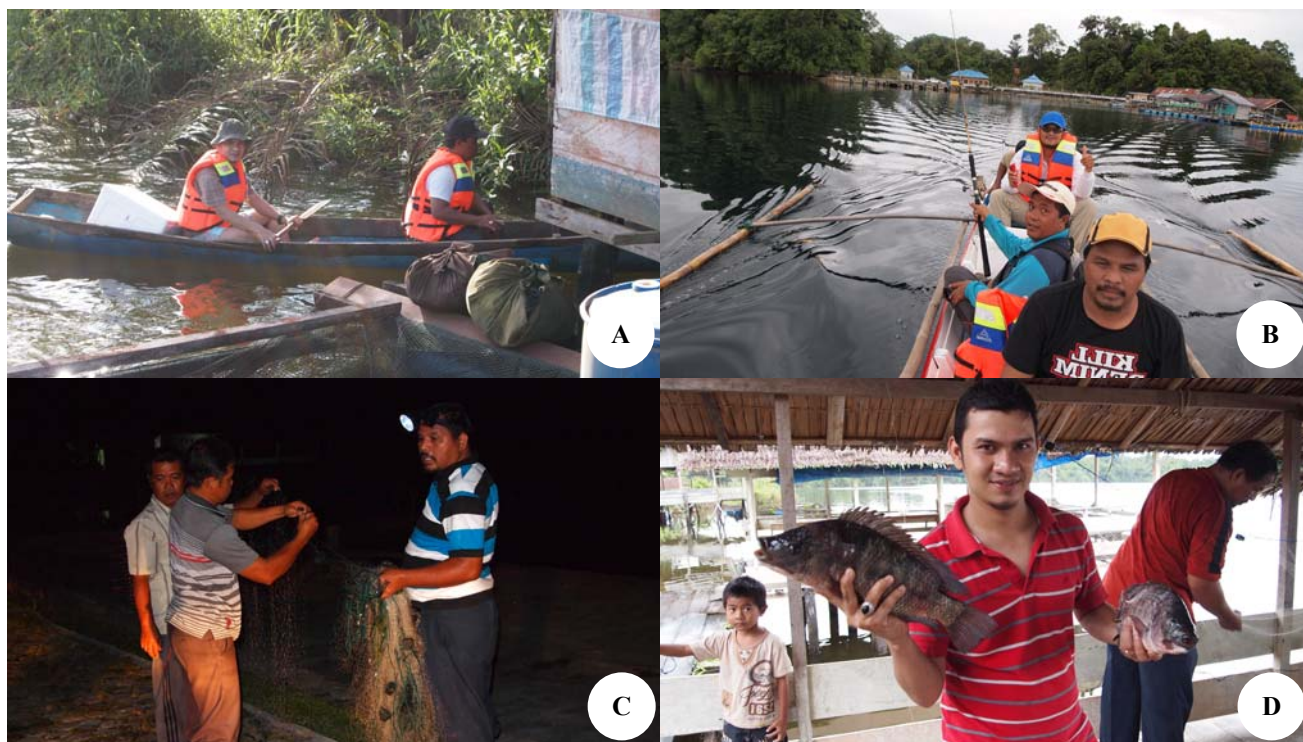
The survey was conducted from November to December 2015 in Lake Laulo (2°.83' 06' 57", 95°.81' 97' 67" E) and Lake Lauik Tawar (2°.37' 25.47" N, 96°.6' 8.48"E) of Simeuleu District, Aceh Province, Indonesia (Figure 1). Lake Lauik Tawar is situated in Bulu Hadek Village, Teluk Dalam Subdistrict, at 100 meters above sea level. The lake has 800-meter length and 500-meter width and the maximum depth is 15 meters. The estimated water's volume was about 6.83 million m<sup>3</sup>. Lake Lauik Tawar has four inlets and two outlets. The lake is surrounded by scrub and dense forests. The lake has been utilized for ecotourism and recreational fishing activities. In situ measurement of the main water quality parameters during the study showed that surface water temperature

ranged between 30.0 and 32.4°C, pH ranged between 7.3 and 8.8, dissolved oxygen ranged between 3.5 and 4.2 ppm, and water visibility ranged between 72 cm and 75 cm. While, Lake Laulo is located in the Village of Amabaan, Subdistrict of Simeulue Barat, at approximately 100 above sea level. The lake has an area of 169.6 ha with the maximum depth of 20 meters. The estimated water's volume was about 20.352 million m<sup>3</sup>. Lake Laulo has three inlets and one outlet that have been surrounded by clove plantation, nypa, sago palm, and shrubs. The artisanal capture fishery is the main activity in the lake with the dominant fish target is working catfish (*Clarias batrachus*). The direct measurement of water quality parameters showed that surface temperatures ranged from 30.3 to 31.3 °C, the average pH was 6.73, dissolved oxygen ranged from 4.1 ppm to 4.3 ppm, and the average water visibility was 57.5 cm.



**Figure 1.** The map of Indonesia archipelago showing Simeulue Island of Aceh, Indonesia and sampling sites. 1. Lake Laulo, 2. Lake Lauik Tawar





**Figure 2.** Field study in Lake Lauik Tawar and Lake Lauulo, Simeulue Island, Aceh Province, Indonesia. A. Sampling activity in the Lake Lauik Tawar, B. Sampling activity in the Danau Lauulo, C. The evening monitoring of gillnets at the Lake Danau Lauulo, D. The fish samples from Lake Lauik Tawar

### Fish sampling and identification

The fish sampling was conducted on 17<sup>th</sup> to 21<sup>st</sup> of November 2015 at Lake Lauulo and Lake Lauik Tawar using nine gillnets (mesh size 1.0-3.0 inches). The sampling was conducted purposively at the sites allegedly; there are fishes based on information from local fishermen. The gillnets were settled up for 24 hours and the catches were monitored every 6-hour. The sampling activity was presented in Figure 2. The samples were recorded as well their local name and the number of individuals of each species. The representatives of every species from each location were photographed and then preserved in 10% formalin. The samples were transported to the Ichthyology Laboratory of the Faculty of Marine and Fisheries, University of Syiah Kuala, Banda Aceh, Indonesia for further taxonomic identification based on Kottelat et al (1993), Saanin (1988), Nelson (1994), Gilbert and Williams (2002), and Vida and Kotai (2006).

### Data analysis

#### Shannon-Wiener diversity index, $H'$

The Shannon-Wiener index ( $H'$ ) was used to calculate the fish diversity as follows:  $H' = \sum (P_i \times \log(P_i))$ , where  $P_i = N_i/N$  ( $N_i$  is a total number of individuals in a species  $i$ ;  $N$  is total number of individuals for all species). The diversity index expresses the species richness in a community and shows the balance in the individual proportion of every species (Muchlisin and Siti-Azizah 2009). This value will increase as total species increased and total individual of

every species was proportional or even (Kreb 1985). According to Odum (1971), the diversity index is classified into three levels, that is, low ( $H < 2$ ), moderate ( $2 < H < 4$ ), and high ( $H > 4$ ).

#### Margalef species richness index, $d$

The species richness was calculated as follows:  $d = (S - 1) / \log N$ , where  $S$  is a total number of species and  $N$  is the total number of individuals for all species. According to Magurran (1988) the  $d$  value is classified into three levels; low degree of species richness ( $d < 3.5$ ), a moderate degree of species richness ( $3.5 - 5.0$ ), and a high degree of species richness ( $d > 5.0$ ).

#### Pielou evenness index, $J'$

The evenness index was examined as follows:  $J' = H' / \log(S)$ , where  $H'$  is diversity index and  $S$  is a total number of species. The evenness index ranges between 0 and 1. Values that tend towards 0 (lower) indicate that the total abundance was not equally distributed, whereas values that tend towards 1 (higher) indicate that the total abundance was spread equally amongst the observed species (Clarke and Warwick 2001). The data were presented in the tables and figures and then analysis was presented descriptively.

## RESULTS AND DISCUSSION

A total of 528 individual fishes belong to 11 species were recorded during the survey (Figure 3). Of these, 8

species were found in Lake Lauik Tawar and 6 species were found in Lake Lauo. *Ambassis miops* was predominant species in Lake Lauik Tawar, while *Clarias batrachus* was predominant in Lake Lauo (Table 1). *C. batrachus* is a commercial freshwater fish and it has potency as a species target for aquaculture (Muchlisin 2013). Currently, the fishermen of Lake Lauo have initiated culturing this species extensively where the juveniles were caught from the lake and grow them in aquaculture ponds.

The species richness ranged between 1.09 and 1.52 where Lake Lauik Tawar had higher species richness compared to Lake Lauo. However, the higher diversity and evenness indices were recorded in Lake Lauo (Table 2, Figure 3). In general, the diversity indices of Lake Lauik Tawar and Lake Lauo were categorized as a low degree of diversity. The low degree of fish diversity was also reported by other researchers on several lakes in Indonesia, for example, Lake Laut Tawar, Aceh Tengah District, with the diversity index 1.88 (Muchlisin and Siti-Azizah 2009), Lake Aneuk Laot, Sabang City, with the diversity index ranged between 0.24 and 1.53 (Defira and Nasir 2007), and Lake Toba, North Sumatra, ranged between 1.12 and 1.37 (Siagian 2009). Although falling into the similar category, the diversity index of fish in Lake Lauo and Lake Lauik Tawar were lower compared to Lake Laut Tawar, Lake Toba, and even Lake Aneuk Laot. The presence of alien fish species was probably one cause of the decline in biodiversity of fish in several lakes in Indonesia (Wargasasmita 2005; Muchlisin 2011; Muchlisin 2012).

Two species of alien fishes were recorded in Lake Lauik Tawar during the survey, namely, gourami (*Osphronemus gouramy*) and tilapia (*Oreochromis niloticus*). The tilapia also occurred in Lake Lauo. However, in terms of invasiveness of alien fish species, the condition of these two lakes of Simeulue Island was better than Lake Laut Tawar, Aceh Tengah District, and Lake Toba where the lakes have been invaded by 6 and 9 species of alien fish species, respectively (Siagian 2009; Muchlisin

2012). The worse condition in Lake Laut Tawar that depict (*Rasbora tawarensis*) the dominant fish population in the lake nowadays has been replaced by tilapia (*O. niloticus*). Tilapia is one of the alien fish species that spread broadly in Aceh waters including in the Lake Lauo and Lake Lauik Tawar Simeulue Island as recorded in this study thus threaten the existence of indigenous fish species (Muchlisin 2012).

With an interesting finding that there were one species of small fish probably within the genus *Rasbora* (Cyprinidae) recorded during the study, it had approximately less than 11 mm length and matured (Figure 3.B). Allegedly this species is endemic in Lake Lauik Tawar and possibly as one of the smaller fishes in Indonesia. Currently, six endemic freshwaters fishes were reported in the waters of Aceh Province, Indonesia, and mostly from the genus of *Rasbora* (Muchlisin et al. 2010; Lumbantobing 2010). Therefore, further intensive and precise taxonomic identification is needed to clarify the taxonomic status of this cryptic species. Presently, the smallest fish was *Paedocypris progenetica* recorded from Sumatra, Indonesia, with the maximum length of 7.9 mm. This is an endemic species to Sumatra (Kottelat et al. 2006).

**Table 2.** The species richness, diversity and evenness indices of fish in Lake Lauik Tawar and Lake Lauo, Simeulue Island, Aceh Province, Indonesia

Parameters	Lake Lauik Tawar	Lake Lauo
Total species	8	6
Total individual	409	119
Margalef species richness (d)	1.52	1.09
Pielou's evenness index (J')	0.13	0.29
Shannon-Winner diversity index (H')	0.27	0.51

**Table 1.** The list of fish species from Lake Lauik Tawar and Lake Lauo, Simeulue Island, Aceh Province, Indonesia caught during the survey

Scientific name	Family	Local name	Lake Lauik Tawar	Lake Lauo
<i>Ambassis miops</i> Günther, 1872	Ambassidae	Sariding	390	5
<i>Osphronemus gouramy</i> Lacepède, 1801	Osphronemidae	Gurami	3	-
<i>Oreochromis niloticus</i> Linnaeus, 1758	Cichlidae	Nila	2	2
<i>Caranx ignobilis</i> Forsskål, 1775	Carangidae	Gabui	7	-
<i>Gerres filamentosus</i> Cuvier, 1829	Gerreidae	Kapas-kapas	3	-
<i>Bunaka gyrinoides</i> Bleeker, 1853	Eleotridae	Lontok	2	-
<i>Channa striata</i> Bloch, 1793	Channidae	Gabus	1	2
<i>Anabas testudineus</i> Bloch, 1792	Anabantidae	Betok	-	2
<i>Megalops cyprinoides</i> Broussonet, 1982	Megalopidae	Ikan bulan	-	2
<i>Clarias batrachus</i> Linnaeus, 1758	Clariidae	Ikan limbat	-	106
<i>Rasbora</i> sp. (Cryptic species)	Cyprinidae	Bilis	1	-
Total			409	119



**Figure 3.** The photograph of fish from Lake Lauik Tawar and Lake Lauulo of Simeuleu, Aceh, Indonesia; A. *Ambassis miops*, B. *Rasbora* sp. C. *Osphronemus gouramy*, D. *Oreochromis niloticus*, E. *Caranx ignobilis*, F. *Channa striata*, G. *Gerres filamentosus*, H. *Anabas testudineus*, I. *Bunaka gyrinoides*, J. *Megalops cyprinoides*, K. *Clarias batrachus*.



In conclusions, a total of 11 species of fishes were recorded during the survey; of these 8 species were found in Lake Lauik Tawar and 6 species were found in Lake Lauo. Two species of alien fish i.e. *O. niloticus* and *O. gouramy* were recorded in Lake Lauik Tawar and one species in Lake Lauo. *Ambassis miops* and *Clarias batrachus* were predominant species in Lake Lauik Tawar and Lake Lauo, respectively. In general, the two lakes were categorized as a low degree of fish diversity.

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### REFERENCES

- Allen GR. 2000. Marine Fishes. A Field Guide for Angler and Diver. Periplus, Singapore
- Clarke KR, Warwick RM. 2001. Change in marine communities: An approach to statistical analysis and interpretation, 2nd ed. Plymouth Marine Laboratory, UK.
- Defira CN, Nasir M. 2007. Fish Community Evaluation due to Sedimentation Process and Increased Population Utilization of Aneuk Laot Lake, Sabang, Nanggroe Aceh Darussalam. Syiah Kuala University Press, Banda Aceh. [Indonesian]
- Djajadiredja R, Fatimah S, Arifin Z. 1977. The important commercial fishes. Ditjen Perikanan, Departemen Pertanian, Jakarta. [Indonesian]
- Gilbert CR, Williams JD. 2002. Field Guide to Fishes (Revised edition). Alfred a Knopf Inc., New York.
- Kottelat M, Whitten AJ, Kartikasari SN, Wirjoatmodjo S. 1993. Freshwater Fishes of Western Indonesia and Sulawesi. Periplus, Singapore.
- Kottelat M, Britz R, Hui TH, Witte K. 2006. *Paedocypris*, a new genus of Southeast Asian cyprinid fish with a remarkable sexual dimorphism, comprises the world's smallest vertebrate. Proc R Soc Society B Biol Sci 273: 895-899.
- Krebs CJ. 1985. Ecology Experimental Analysis of Distribution and Abundance. Harper and Row Publisher, Philadelphia.
- Lumbantobing DN. 2010. Four new species of the *Rasbora trifasciata*-Group (Teleostei: Cyprinidae) from Northwestern Sumatra, Indonesia. Copeia 2010 (4): 644-670.
- Magurran AE. 1988. Ecological Diversity and its Measurement. Chapman and Hall, New York.
- Muchlisin ZA, Siti-Azizah MN. 2009. Diversity and distribution of freshwaters fish in Aceh waters Northern Sumatera Indonesia. Intl J Zool Res 5 (2): 62-79.
- Muchlisin ZA, Musman M, Siti-Azizah MN. 2010. Length-weight relationships and condition factors of two threatened fishes, *Rasbora tawarensis* and *Poropuntius tawarensis*, endemic to Lake Laut Tawar, Aceh Province, Indonesia. J Appl Ichthyol 26: 949-953.
- Muchlisin ZA. 2011. Analysis of introduction of alien fish species policy in inland waters of Aceh Province. Jurnal Kebijakan Sosial Ekonomi Kelautan dan Perikanan 1 (1): 79-89. [Indonesian]
- Muchlisin ZA. 2012. The first report on the introduced freshwater fishes in Aceh waters, Indonesia. Arch Polish Fish 20 (2): 129-135.
- Muchlisin ZA. 2013. Study on potency of freshwater fishes in Aceh waters as a basis for aquaculture and conservation development programs. Jurnal Iktiologi Indonesia 13 (1): 91-96.
- Muchlisin ZA, Akyun Q, Rizka S, Fadli N, Siti-Aziza MN. 2015. Ichthyofauna of Tripa Peat Swamp Forest, Aceh Province, Indonesia. CheckList 11 (2): 1560.
- Nelson JS. 1994. Fishes of the World. 3th ed. John Wiley & Sons, Inc., New York.
- Odum EP. 1971. Fundamentals of Ecology. 3rd ed. W.B. Saunders Company, Philadelphia.
- Rahmantya KF, Wibowo D, Somad WA, Nainggolan H, Asianto AD, Nugroho U. 2016. Profile of marine and fishery resources of Simeulue District. Pusat Data, Statistik dan Informasi Kementerian Kelautan dan Perikanan, Jakarta. [Indonesian]
- RPJMD. 2012. Simeulue 2012-2017 DKP Aceh 2015. Geospasial, BNPB, Jakarta.
- Saanin H. 1988. Taxonomy and Key Identification of Fish. Volume I and II. Bina Cipta, Jakarta. [Indonesian]
- Siagian C. 2009. The Diversity and Abundance of Fish and its Relation to Water Quality in Lake Toba, Balige, North Sumatra. Universitas Sumatera Utara, Medan. [Indonesian]
- Vida A, Kotai T. 2006. 365 fish. Koneman Vince Books, China.
- Wargasasmita S. 2005. Invasion, threats of exotic fish species to diversity of indigenous fish species. Jurnal Iktiologi Indonesia 5 (1): 5-10.