


## RESEARCH ARTICLE

# Ichthyofauna of the Rasian and Asahan Rivers in the South Coast of Aceh Province, Indonesia

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### ABSTRACT

The Rasian and Asahan rivers are located in the South Aceh District, Aceh Province, Indonesia, and are affected by the development of the cement industrial area and ports due to their proximity to the area. Therefore, this study aims to analyze and document the fish species diversity in the Rasian and Asahan Rivers as baseline and comparative data for the aquatic resource management plans and environmental impact monitoring programs, respectively. Sampling locations are determined purposively by dividing the river into upstream, midstream, and estuary. Furthermore, the fish was caught using gill nets and casting nets. The results show that a total of 16 species belonging to 12 families are obtained from the Rasian River. Meanwhile, 13 species belonging to 11 families were discovered in the Asahan River. These make a total of 24 species belonging to 18 families. One of the species recorded in the Asahan River is the alien fish (*Trichogaster pectoralis*). The diversity index in these two rivers falls within the moderate category, while the uniformity and dominant indices are in the high category.

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## 1. INTRODUCTION

Indonesia is known as a mega-biodiverse country after Brazil. One of its provinces with high biodiversity is Aceh (Muchlisin and Siti-Azizah 2009), which is located at the northern tip of Sumatra Island and is bordered by the Malacca Strait and the Indian Ocean. It has potential marine waters resources covering an area of 42,665.67 km<sup>2</sup> with 2,817.9 km of coastline and 335 islands (Maulina and Astra 2011). Additionally, Aceh province has inland water resources, including approximately 38,546 ha, 1,502 ha, 19,335 ha, 3,365 ha, and 331 ha of main rivers, lakes, reservoirs, swamps, and other waters bodies, respectively (Gadeng et al. 2020). One of the important potential aquatic resources in this province is marine and freshwater fishes.

Previous studies reported the diversity of Indonesian freshwater fish, especially on Sumatra Island. For example, in the research of Simanjuntak et al. (2006), fish fauna in the Kampar Kiri River, Riau Province, was studied, recording 86 species of freshwater fish consisting of 21 families and 44 genera. Nurdawati and Prasetyo (2007) studied swamp fish in South Sumatra, and the results showed 75 species, 45 genera, 20 families, and 7 orders. Iqbal (2011) reported that 57 species belong to 44 genera and 24 families of freshwater fish from the Merang-Kepayang Peat Swamp Forest of South Sumatra. Meanwhile, studies were conducted in the province of Aceh, namely Muchlisin and Azizah (2009), which reported 114 species, 69 genera, and 41 families of fishes in several rivers within this region. Muchlisin et al. (2015) recorded 34 families, 47 genera, and 73 species of fish

in the Tripa peat swamp waters (Muchlisin et al. 2015). Dekar et al. (2018) reported 44 species, 34 genera, and 25 families in the Aceh River. A total of 32 species belonging to 21 families of fish were discovered from the Meurebo River, Aceh Barat district (Irhami et al. 2018 ). Timorya et al. (2018) reported 12 species belonging to 7 genera and 9 families from the Krueng Sabee River in Aceh Jaya district. Muchlisin et al. (2017) reported 11 fish species in Lake Lauik Tawar and Lauo in the Simuelue, the outermost island of Indonesia, and Razi et al. (2023) reported 39 species belonging to 31 genera and 26 families of fish from Singkil peat swamp waters of Aceh. However, to date, there has been no report from the southern region of Aceh.

The development of the South Aceh district is quite rapid, as the local government cooperated with a private company to develop an area for the cement industry and built a special port for the export-import of the products from this region. According to the initial survey, the two main rivers adjacent to this area were the Rasian and the Asahan Rivers, which are short and small but play a significant role as water resources for domestic, agricultural, and fishery purposes. The Rasian River is approximately 4.13 km long, while the Asahan is approximately 5.12 km long. A total of 17 species of macrozoobenthos have been reported from

these rivers (Ramadhaniaty et al. 2023). However, the fish fauna in these rivers has not been explored. The information on fish diversity is essential as initial or baseline data for monitoring environmental impacts, especially in the future, for well preparation of proper and sustainable management plans. Therefore, this study aims to explore and document the fish community in the Rasian and Asahan Rivers, South Aceh district, Indonesia.

## 2. MATERIALS AND METHODS

### 2.1 Time and site

The research was conducted in July 2022 at the Rasian and Asahan rivers, South Aceh District, Aceh Province, Indonesia. The sampling area was determined purposively by dividing the river into three zones, including (a) the upstream with the characteristics of protected forests and hills, (b) the middle zone with the characteristics of oil palm plantations and rice fields, (d) the downstream zone, which is the estuary part of the river overgrown with mangroves especially *Rhizophora* and *Nipa* (Figure 1). In these zones, three random or selected sampling points were determined based on accessibility and the likelihood of the presence of fish.

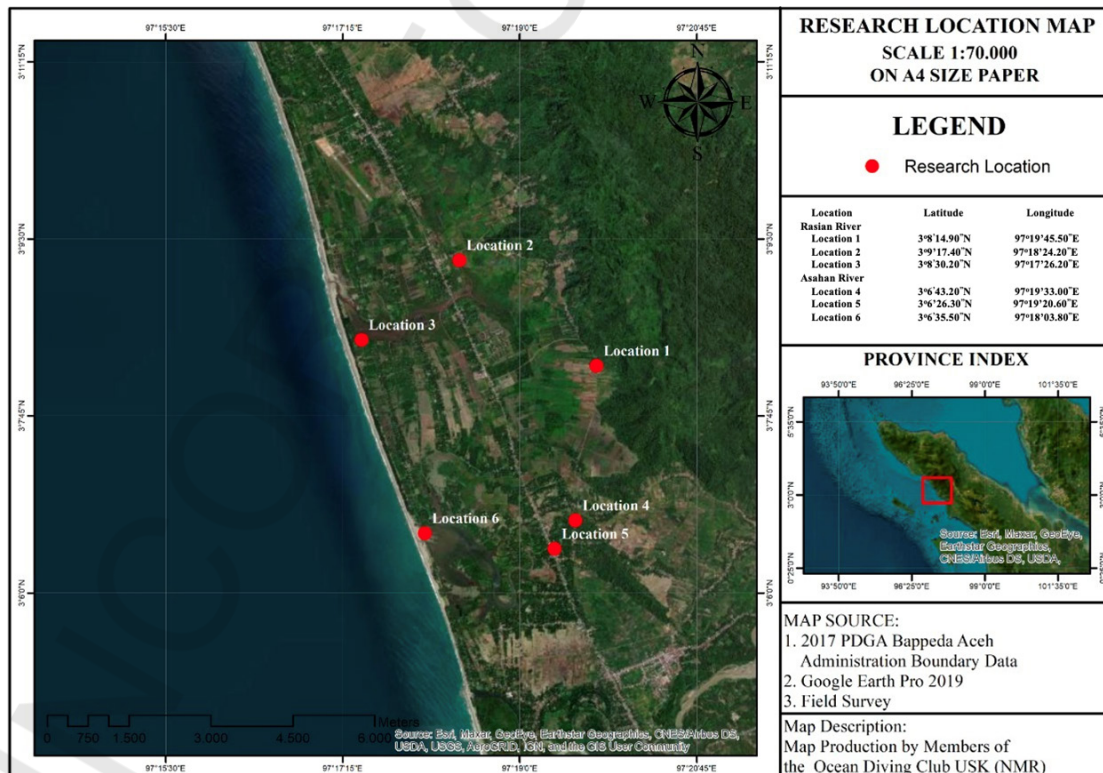


Figure 1. The map of the South Aceh district, showing the sampling location (sampling points are highlighted in red).

## 2.2 Fish sampling

Fish samples were caught using gill nets and casting nets with mesh sizes of 1.0 and 1.5 inches. Local names and the number of individuals of each species were recorded. The fish were cleaned, photographed for documentation, and preserved in 10% formalin solution. They were transported to the Ichthyology Laboratory, Faculty of Marine Affairs and Fisheries, Syiah Kuala University, Banda Aceh for the identification process which was conducted according to the procedures of Kottelat et al. (1993), Nelson (1994), Gilbert and Williams (2002), and Vida and Kotai (2006).

## 2.3 Fish community structure indices

The diversity of the fish was predicted using the Shannon-Wiener Diversity Index with the formula:  $H' = -\sum p_i \ln p_i$ ; where,  $H'$  = Shannon-Wiener Diversity Index,  $p_i = N_i/N$  ( $N_i$  is total number of individual of species  $i$ ),  $N$  = Total number of individual of all species. The diversity index category is:  $H' < 2.0$  = low;  $2.1 \leq H' \leq 4.0$  = moderate; and  $H' > 4$  = high (Odum 1971).

The uniformity index ( $E$ ) was calculated using the following equation based on Krebs (1985):  $E = H'/H_{max}$ ; where,  $E$  = uniformity index,  $H'$  = Shannon-Wiener diversity index,  $H_{max} = \log_2(S)$ ,  $S$  = number of identified species. According to Krebs (1985), the criteria for the level of species uniformity are  $0 < E < 0.4$  for low uniformity,  $0.4 < E < 0.6$  for moderate, and  $0.6 < E < 1$  for high. The Simpson Dominance Index is used to examine the dominance of certain species. It is calculated according to the formula presented by Odum (1971), which is as follows:  $C = \sum (n_i/N)^2$ ; where,  $C$  = dominance index,  $n_i$  = number of individuals,  $N$  = total number of individuals. The dominance index category is:  $C$  close to 0 ( $C < 0.5$ ) = no species dominate and  $C$  close to 1 ( $C > 0.5$ ) = there is a species that dominates. The Species Richness Index is calculated using the following equation:  $DMG = (S-1) / \ln(N)$ , where  $DMG$  = Species Richness Index,  $S$  = number of species, and  $N$  = the total number of individuals of all species.

## 2.4 Data analysis

The data were presented in tables and figures and were analyzed descriptively by comparing the results with related reports and references.

## 3. RESULTS AND DISCUSSION

The results of the study showed that the Rasian River contained 16 species belonging to 15 genera and 12 families of fish. Meanwhile, the Asahan River had 13 species belonging to 13 genera and 11 families. In total, 24 species, 23 genera, and 18 families were identified across both rivers, as shown in Table 1. Five species, namely *Ambassis gymnocephalus*, *Puntius brevis*, *Rasbora argyrotaenia*, *Crenimugil seheli*, and *Periothalamus* sp., were discovered in both rivers, with *P. brevis* in the upstream area, as well as *C. seheli* and *Periothalamus* sp. in the estuary region (Table 2). The Rasian River contained 11 species that were not present in Asahan, and they include *Caranx ignobilis*, *Channa striata*, *Mugil* sp., *Chelonodon patoca*, *Diodon* sp., *Geres punctatus*, *Luciocephalus pulcher*, *Megalops cyprinoides*, *Rasbora spilotaenia*, *Stipodon* sp., and *Toxotes chatareus*. However, the species identified in Asahan but not in Rasian are *Acentrogobius janthinopterus*, *Aplocheilus armatus*, *Bagrus nemurus*, *Ophiocara porocephala*, *Scatophagus argus*, *Sillago sihama*, *Trichogaster pectoralis*, and *Trichopodus trichopterus*, as shown in Table 2.

*P. brevis* was the dominant fish in the Rasian River, having up to 24 out of the 84 total individuals. As previously mentioned, this species was generally discovered in the upper stream of the river. In contrast, the dominant species in the Asahan River was the mullet *C. seheli*, which belongs to the Mugilidae family and is commonly identified in estuary areas but also in the middle of river bodies. The results showed that Cyprinidae and Oshpronemidae were the predominant families in the Rasian and the Asahan Rivers, respectively, as shown in Figure 2 and Table 1, where the number of species from the Cyprinidae and Osphronemidae families found is three species each. The photographs of fish caught during the study were presented in Figure 3.

The fish diversity indices were 2.28 and 2.23 in the Rasian and Asahan rivers, respectively, indicating moderate diversity. The uniformity index in the Rasian and the Asahan Rivers were 0.82 and 0.87, respectively, in the high uniformity category. Additionally, the dominance indices in both rivers were also high, with values close to one. The species richness of the Rasian and the Asahan Rivers were 3.42 and 3.17, respectively, as presented in Table 3.

Therefore, the findings showed that the Rasian River had higher species richness, where the dominant families and species in this river were Cyprinidae and *Puntius brevis*, respectively, reaching

Table 1. The composition of fish found in the Asahan and Rasian rivers.

Family	Species	Local name	Rasian River	Asahan River	Total
Ambassidae	<i>Ambassis gymnocephalus</i>	Serideng	7	2	9
Aplocheilidae	<i>Aplocheilus armatus</i>	Kepala Timah	-	4	4
Bagridae	<i>Bagrus nemurus</i>	Ikan Baung	-	1	1
Carangidae	<i>Caranx ignobilis</i>	Kuwe	8	-	8
Channidae	<i>Channa striata</i>	Gabus	1	-	1
Characidae	<i>Geres punctatus</i>	Kapas Kapas	2	-	2
Cyprinidae	<i>Puntius brevis</i>	Kepras/gro	24	9	33
	<i>Rasbora argyrotaenia</i>	Seluang	3	2	5
	<i>Rasbora spilotaenia</i>	Seluang	12	-	12
Eleotridae	<i>Ophiocara porocephala</i>	Lontok	-	5	5
Gobiidae	<i>Acentrogobius janthinopterus</i>	Goby	-	1	1
Megalopidae	<i>Megalops cyprinoides</i>	Bulan-bulan	3	-	3
Mugilidae	<i>Crenimugil seheli</i>	Belanak	3	10	13
	<i>Mugil sp.</i>	Belanak	1	-	1
Oshpronemidae	<i>Luciocephalus pulcher</i>	Lucio	7	-	7
	<i>Trichogaster pectoralis</i>	Sepat Siam	-	1	1
	<i>Trichopodus trichopterus</i>	Sepat Rawa	-	5	5
Oxudercidae	<i>Periothalamus sp.</i>	Blodok	4	1	5
	<i>Stipodon sp.</i>	Dheat	1	-	1
Scatophagidae	<i>Scatophagus argus</i>	Kitang	-	2	2
Sillaginidae	<i>Sillago sihama</i>	Ikan Rejung	-	1	1
Tetraodontidae	<i>Chelonodon patoca</i>	Buntal	4	-	4
	<i>Diodon sp.</i>	Buntal	3	-	3
Toxotiae	<i>Toxotes chatareus</i>	Sumpit	1	-	1
Total individual			84	44	128
Total species			16	13	24
Total genera			15	13	23
Total family			11	11	17

Table 2. Fish species and their contribution to the Rasian and Asahan rivers.

No.	Species	Rasian River			Asahan River		
		A	B	C	A	B	C
1	<i>Acentrogobius janthinopterus</i>	—	—	—	✓	—	—
2	<i>Ambassis gymnocephalus</i>	—	✓	✓	✓	✓	—
3	<i>Aplocheilus Armatus</i>	—	—	—	✓	✓	—
4	<i>Bagrus nemurus</i>	—	—	—	—	—	✓
5	<i>Caranx ignobilis</i>	✓	—	✓	—	—	—
6	<i>Channa striata</i>	✓	—	—	—	—	—
7	<i>Chelonodon patoca</i>	—	✓	✓	—	—	—
8	<i>Crenimugil seheli</i>	✓	—	✓	✓	✓	—
9	<i>Diodon sp.</i>	—	—	✓	—	—	—
10	<i>Geres punctatus</i>	—	✓	—	—	—	—
11	<i>Luciocephalus pulcher</i>	—	✓	✓	—	—	—
12	<i>Megalops cyprinoides</i>	—	—	✓	—	—	—
13	<i>Mugil sp.</i>	✓	—	—	—	—	—

Continuation of Table 2. Fish species and their contribution to the Rasian and Asahan rivers.

No.	Species	Rasian River			Asahan River		
		A	B	C	A	B	C
14	<i>Ophiocara porocephala</i>	—	—	—	—	—	✓
15	<i>Periothalamus sp.</i>	✓	—	✓	✓	—	—
16	<i>Puntius bervis</i>	✓	✓	✓	—	—	✓
17	<i>Rasbora argyrotaenia</i>	—	✓	—	✓	✓	—
18	<i>Rasbora spilotaenia</i>	✓	—	✓	—	—	—
19	<i>Scatophagus argus</i>	—	—	—	—	—	✓
20	<i>Sillago sihama</i>	—	—	—	—	—	✓
21	<i>Stipodon sp.</i>	✓	—	—	—	—	—
22	<i>Toxotes chatareus</i>	—	✓	—	—	—	—
23	<i>Trichogaster pectoralis</i>	—	—	—	—	✓	—
24	<i>Trichopodus trichopterus</i>	—	—	—	—	✓	✓

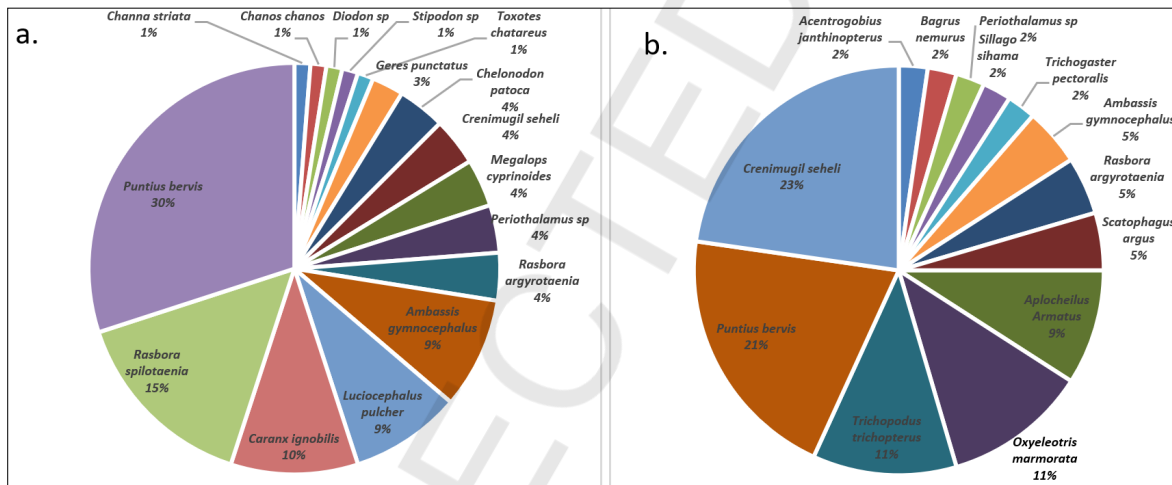


Figure 2. The proportion of individual fish according to species in Rasian River (a) and Asahan River (b).

Table 3. Diversity, uniformity, dominance, and species richness of the fish in Rasian and Asahan rivers.

Biological indices	Rasian River	Asahan River	Category
Diversity index (H')	2.28	2.23	Moderate
Uniformity index (E)	0.82	0.87	High
Dominance index (C)	1	1	High
Species richness (DMG)	3.42	3.17	-

30% of the total individual fish caught. However, *P. bervis* was also identified in the Asahan River, but the numbers were not dominant. The *P. bervis*, which inhabit freshwater habitats at an altitude of about 2000 meters above sea level (Rainboth 1996), are caught upstream. *P. bervis* lives in slow or stagnant waters, canals, and small rivers with vegetation. This fish feed on zooplankton, algae, crustaceans, and tubifex (Inel et al. 2022). Meanwhile, in the Asahan River, the dominant species is mullet *C. seheli* (Mungilidae), which accounts for 23% of the total individual fish caught. Mullet are classified as peripheral fish that can

live in brackish to fresh waters. On the other hand, *C. seheli* was only identified in the Asahan River estuary, which was still affected by tides (brackish waters). According to Yulianda et al. (2013), mullets live in waters near the coast and in sandy or muddy lagoon areas and exist in groups. They are omnivores and can utilize many food sources in the waters (Sitorus et al. 2017; Wahyudewantoro and Haryono 2011). Hence, the population dominates. Furthermore, this fish inhabits estuaries and can tolerate a wide range of salinity and temperature (Febriani et al. 2019; Nuringtyas et al. 2019).



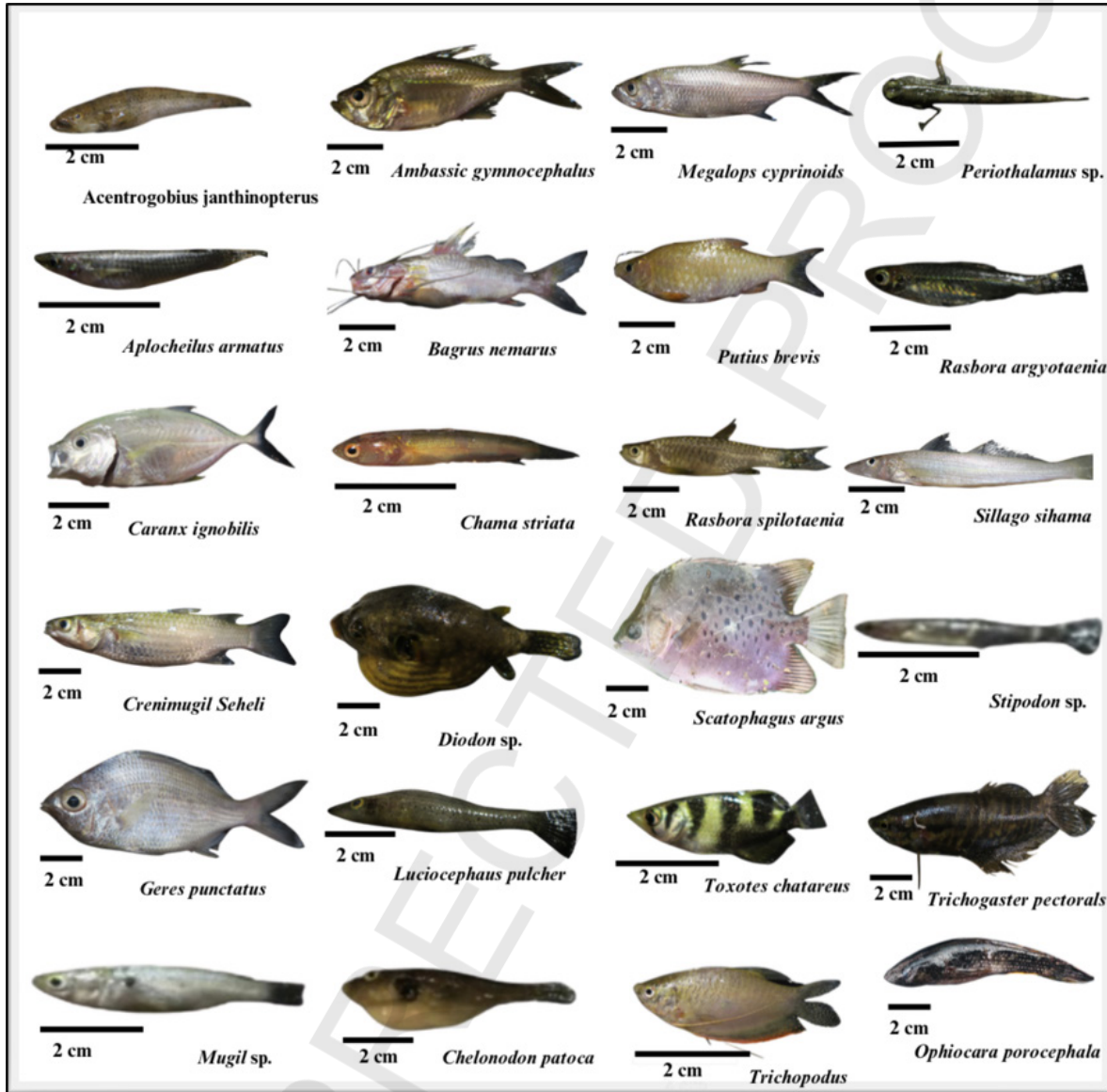


Figure 3. Photographs of fish species recorded in the Rasian and Asahan rivers.

Previous studies also showed that Cyprinidae dominated freshwater fish communities in several locations in Indonesia. For example, 75 species were found, and 29 species discovered in the swamp forest of South Sumatra are Cyprinidae (Nurdawati and Prasetyo 2007). Hadiaty (2001) reported that of the 40 species of fish in the Muara Kendawangan Nature Reserve, West Kalimantan, 11 are Cyprinidae. Furthermore, this particular species was also predominant in the Dong Sandar dan Rempangi rivers, Ketapang regency West Kalimantan (Saputra et al. 2018), and in the Rawas river and Watervang dam, Sumatra Selatan (Yusnaini et al. 2022; Harahap et al. 2020).

Based on the total number of fish caught, it was discovered that the highest number of individuals was present in the upper stream of the Rasian River. This is because the upper stream of the river is natural and has a heavy flow of clear and clean water, indicating a good water quality. Additionally, *P. brevis* is a dominant species in this area.

The diversity index of fish in these two rivers is in the moderate category, with values of  $H'$  ranging from 2.23 to 2.28. These values are higher than the diversity index of fish at several locations in Indonesia. For instance, in Lake Laut Tawar, the average value was 1.88 (Muchlisin and Siti-Azizah 2009). For Lake Lauik Tawar and Lake Lauulo in Simelue island, it was

1.52 and 1.09, respectively (Muchlisin et al. 2017). Meanwhile, the diversity index of Aneuk Laut Lake in Sabang City and Lake Toba ranges from 0.24 to 1.53 and 1.12 to 1.37, respectively (Defira and Nasir 2007; Siagian 2009). This result indicates that the two rivers are still in fairly good condition, with *P. brevis* and *C. seheli* dominating the Rasian and Asahan rivers, respectively.

During the study, one species of alien fish, namely *T. pectoralis* was found. This species was discovered in the middle area of the Asahan River, close to a paddy field. *T. pectoralis* is a herbivorous fish that feeds on aquatic plants and can tolerate low water pH and lack of dissolved oxygen. This is because they have an additional breathing apparatus called the labyrinth (Dina et al. 2020). The origin habitat of this species is the Mekong basin, and it has been introduced in other locations, including Indonesia (Rainboth 1996). This species was discovered in several locations in Aceh including Simpang Reservoir and Alue Pedegang River, Aceh Barat District, Tamiang river and Sibreh Reservoir Aceh Besar district (Muchlisin and Siti-Azizah 2009), Tripa peat swamp waters (Muchlisin et al. 2015), and Lake Aneuk Laot, Weh Island (Muchlisin et al. 2023), Krueng Balee Aceh Barat district (Nur et al. 2019), anak-anak sungai Krueng Aceh (Dekar et al. 2018), Meurebo river Aceh Barat district (Irhami et al. 2018), Kreg Sabee river Aceh Jaya district (Timorya et al. 2018).

Therefore, the number of alien fish in these two rivers is much less than in the Ibulao River in the Philippines, with 11 species (Tauli et al. 2022). The invasion of alien fish has become a prominent threat to native fish in recent years (Muchlisin 2011; Muchlisin 2012; Muralidharan et al. 2015). Therefore, immediate actions are crucially needed to anticipate the spread of alien fish in this region of waters. Based on the results of the ANOVA test for the two rivers, there is no significant difference in diversity ( $H'$ ) and species richness ( $E$ ) between the Asahan River and the Rasian River ( $p$ -value  $> 0.05$ ).

#### 4. CONCLUSIONS

It was concluded that a total of 24 fish species were successfully sampled during the study, of which 11 species were discovered in the Rasian River, 8 species in the Asahan River, and 5 species were found in both rivers. *P. brevis* (Cyprinidae) and *C. seheli* (Mugilidae) dominate the fish population in the Rasian and Asahan River, respectively. The index diversity of fish in both rivers was observed to be in the

moderate category, but the dominance and uniformity were high. Finally, the species in Asahan River with a low number of individuals is the alien fish.

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#### AUTHOR CONTRIBUTIONS

**Muchlisin ZA:** Conceptualization, Methodology, Supervision, Validation, and Funding Acquisition. **Ulfah M:** Investigation, Data Curation, Data Analysis, and Project Administration. **Ramadhaniaty M:** Investigation, Data Curation, Data Analysis, and Project Administration. **Nurfadillah N:** Investigation, Data Curation, Data Analysis, and Project Administration. **Amienatun T:** Investigation, Visualization, Resources, and Formal Analysis. **Syukran M:** Formal Analysis, Writing - original draft, and Software. **Muhammadar AA:** Resources, Software, and Validation. **Razi NM:** Investigation, Data Curation, Data Analysis, and Project Administration.

#### CONFLICT OF INTEREST

No conflict of interest was declared

#### ETHICS STATEMENT

The study was followed the Ethics of Animal Use for Research Purposes of Universitas Syiah Kuala Regulation Record No. 958/2015.

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