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LISTS OF SPECIES

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Ichthyofauna of Tripa Peat Swamp Forest, Aceh province, Indonesia

Zainal A. Muchlisin[1*], **Qurrata Akyun**[1], **Satria Rizka**[1], **Nur Fadli**[1], **Sugianto Sugianto**[3], **Agus Halim**[3] and **Mohd N. Siti-Azizah**[2, 4]

1 Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh 23111, Indonesia
2 School of Biological sciences, University Sains Malaysia, Penang 11800, Malaysia
3 Faculty of Agriculture, Syiah Kuala University 23111, Indonesia
4 Centre for Marine and Coastal Studies Universiti Sains Malaysia, Penang, Malaysia
* Corresponding author E-mail: muchlisinza@unsyiah.ac.id

Abstract: The Tripa Peat Swamp Forest (TPSF) suffers from deforestation due to agriculture, this habitat degradation potentially has a negative impact on fish biodiversity and community assemblages. The objective of this study was to develop an inventory of the fish fauna, evaluate the spatial variation in assemblage structure, document alien species, and quantify the economic value of fish species found from the area. Fish assemblages from the main rivers and tributaries of TPSF were sampled on May to June 2013. A total of 764 individuals were sampled during the survey, constituting 34 families, 47 genera, and 73 species where 46 species are categorized as fish consumption, 17 have potential for aquaculture, and 10 species have potential for ornamental, and three are non native. Cyprinidae is the predominant fish family within the TPSF. Fish assemblages were generally characterized by small population size for each species and low similarity among sites, reflecting the distinctive nature of each sampling site.

Key words: Sumatra, peat swamp, fish biodiversity, Nagan Raya, Aceh Barat Daya

INTRODUCTION

Indonesia is recognized as a country of "mega biodiversity" second in fish species richness only to Brazil (Muchlisin and Siti-Azzizah 2009). Djajadiredja (1977) estimated there being 4,000 fish species in Indonesian waters, a large proportion of which occurring in freshwater. Suwelo (2004) reported that there are at least 1,000 species of freshwater fishes found in Indonesian waters, Kottelat *et al*. (1993) estimated more than 964 species of freshwater and brackish water fishes in western Indonesia and Sulawesi, and about 114 species of fish had been recorded from Aceh, northern Sumatra (Muchlisin and Siti-Azizah 2009). Kottelat and Whitten (1996) estimated that approximately 400–600 species of fishes from Indonesian waters have yet to be described and a greater research effort was needed, especially in hitherto unsurveyed habitats such as peat swamps.

Peat swamps are aquatic habitats overlaying and draining areas dominated by peat soils, formed from historical forest litter deposition. They are hydrologically important water storages in the landscape and important habitat for a range of fauna including fish. The soil of peat swamps has high organic matter content and varies in thickness from less than 0.5 m to a depth of more than 20 m (Wahyunto *et al*. 2005). Tropical peat swamps typically contain a high biodiversity of plants and animals. There are approximately 20.6 million ha of peat swamp forests in Indonesia, and approximately 35% are found in Sumatra, 32% in Kalimantan and 30% in Papua Islands. Approximately a quarter of Indonesian peat swamp forests have been deforested and converted to palm oil plantations and other agricultural activities (Task Force REDD 2012), potentially degrading the flora and fauna of this ecosystem, including the fish communities.

Aceh province, northern Sumatra has two significant peat swamp forest ecosystems: Tripa and Singkil peat swamps. To date, no information on the fish biodiversity from these areas is available, yet the deforestation of peat swamp forests in Aceh, especially Tripa, continues unabated. The Tripa peat swamp forest ecosystem originally covered approximately 61,000 ha and by 2007 approximately 49% had been deforested and converted to palm oil plantations, and a further 27% had been cleared one year later (PIU-SERT 2013). Impact assessment of this change on the aquatic component in this forest is hampered by lack of pre impact data, but it is known that conversion of forests to palm oil plantations has caused an increase in the incidence and severity of forest fires in the drought season and floods in the rainy season (unpublished data). Forest conversion in this area has had minor positive economic benefit for local communities (Wahyunto *et al*. 2005). In contrast, the increased incidence of natural disasters, for example, the increased frequency and severity of floods during the last decade, has had negative local economic effect.

There are four main rivers flowing across the Tripa peat swamp ecosystem, the Tripa, Seumanyam, Seuneam and Batee Rivers. In addition to the influence of these rivers, this ecosystem is bordered and affected by the tidal regime of the adjacent Indian Ocean. Consequently, the aquatic habitats of the Tripa system are highly dynamic. According to YLI-AFEP

(2008) the TPSF provides habitat for a range of vertebrates of high conservation significance including the Orangutan (*Pongo abelii*), Mentok Rimba or White-winged Duck (*Cairina scutulata*), Sumatran Tiger (*Panthera tigris sumatrensis*), Estuary Crocodile (*Crocodilus porosus*), Honey Bear (*Helarctos malayanus*) and Rangkong or Hornbill (*Buceros* spp.). However, there exists little information on the fish fauna in Tripa peat swamp forest; an information gap crucially important in the formation of better conservation strategies for the aquatic ecosystem of the Tripa peat swamp. Hence, the objective of the present study was to establish an inventory of the fish fauna of the Tripa Peat Swamp Forest and evaluate economic and conservation significance of the fish fauna.

MATERIALS AND METHODS

Location and sampling

The Tripa peat swamp forest is situated in Nagan Raya and Aceh Barat Daya districts at coordinates 03°44′–03°56′ N and 096°23′–096°46′ E. The study was conducted between May and June 2013 at twelve sampling locations in Tripa peat swamp (Figure 1). Sample locations were chosen to cover a wide array of estuarine, riverine and tributary habitats. Typical habitats of sampled sites are shown in Table 1 and Figure 2. Fish assemblages were sampled using a variety of methods including cast nets, gillnets, handnets (all with various mesh sizes: 0.5, 1.0, and 1.5 inches) and hook and line. Sampling occurred during both day and night at every location being sampled over a period of one or two days.

Preservation and identification

Collected fish were placed in 10% formalin and curated at the Laboratory of Ichthyology, Faculty of Marine and Fisheries Syiah, Kuala University, Banda Aceh, Indonesia. Species were identified using Kottelat *et al.* (1993), Saanin (1968) and Froese and Pauly (2014).

Analysis

The frequency of incidence (FOI) of each species was estimated according to Muchlisin and Siti-Azizah (2009) as follows: $FOI = N_i \cdot St / N_i \cdot St \times 100\%$

Where, $N_i.St$= total nuber of locations where the species i where found, N.St= total number of sampling locations. Remaining biological indices were estimated using routines available within the software package Plymouth Routines in Multivariate Ecological Research (Primer E) version 6. Margalef's species richness index (d) was estimated according to the formula (Mugurran 1998) as follows:

$$d = \frac{(s-1)}{\log N}$$

Where, d = species richness, s = total species, N = total individual of all species.

According to Magurran (1988), d value less than 3.5

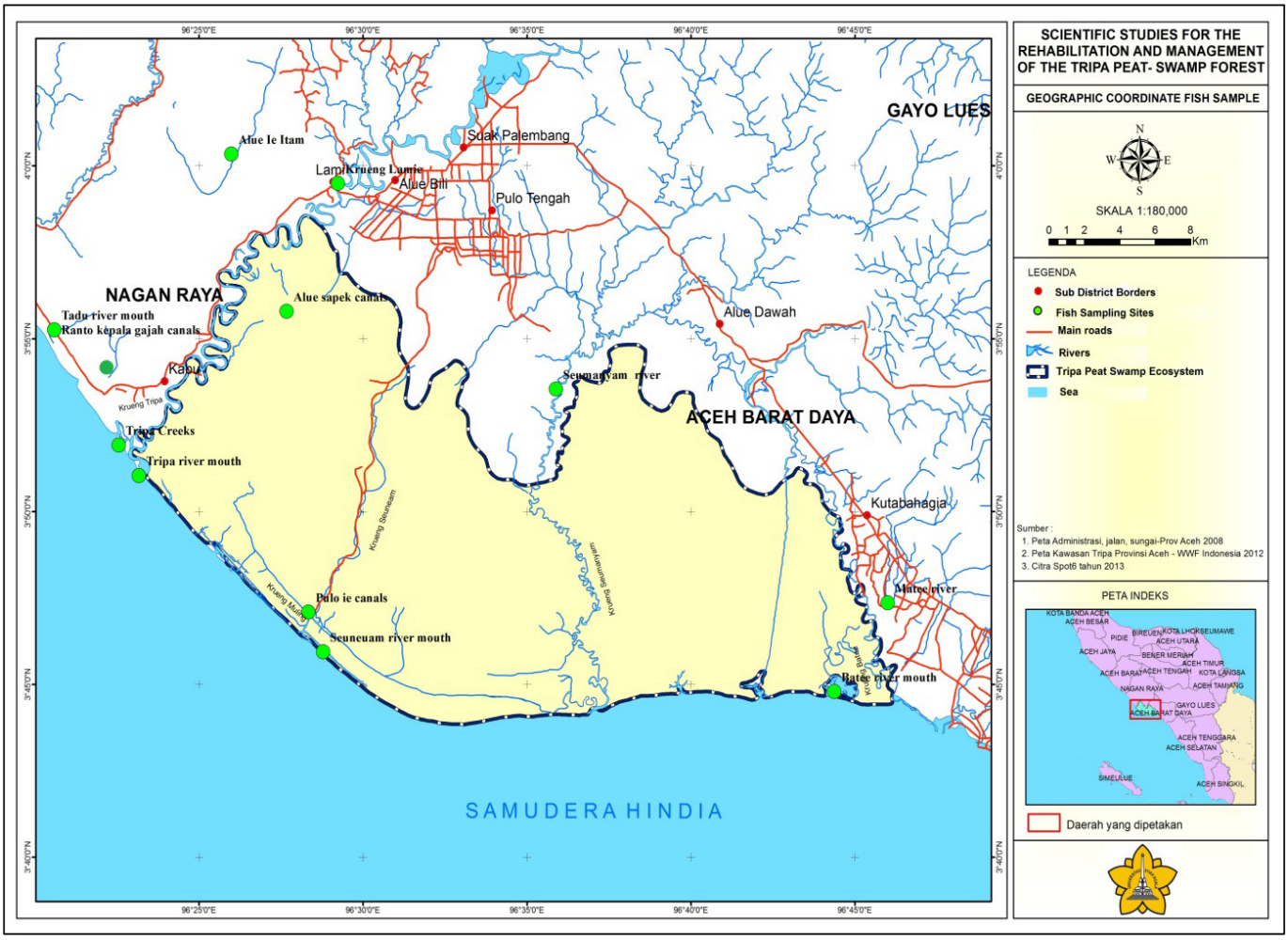

Figure 1. Map of the Tripa Peat Swamp Forest in Nagarn Raya and Aceh Barat Daya, Indonesia showed sampling sites (green circles).

indicates low species richness, value between 3.5–5.0 indicates moderate species richness, and value higher than 5 indicates high specie richness.

The Shannon Winner diversity index was calculated as follows:

$$H = -\Sigma Pi\ LnPi$$

Where, H = Shannon Winner diversity index, $P_i = N_i/N$, (N_i = total number of individual of species i, N = total number of individual of all species.

The diversity index expresses the species richness in a community and shows the balance in individual proportion of every species. According to Odum and Barret (2004) the Shannon Winner diversity index is classified into three levels, low (H<2), moderate (2<H<4), and high (H>4).

The Simpson dominance index (D) was calculated as follows:

$$D = \Sigma_i^s = 1(pi)^2 = \Sigma_i^s = 1(\frac{ni}{N})^2$$

Where N_i = total number of individuals of species i, N = total number of individuals of all species, and S= total number of species. These values are ranged between 0 and 1with values near 0 (lower) indicate no species was numerically dominant, while values tend to 1 (higher) indicate that the fish community was dominated by few species.

Presence or absence of data species for each site was used to construct a site by site similarity matrix based on the Bray Curtis similarity distance. This matrix was then used to generate a dendogram of site similarities based on the UPGMA routine available within Primer-E. Version 1.2 (Clarke and Warwick 2001; Clarke and Gorley 2005). Before calculating the Bray-Curtis similarity coefficient, the standardised data was root transformed. This has the effect of scaling down the importance of abundant species (Clarke and Warwick 2001).

Introduced and economic status of fishes

The indigenous status of each fish was determined based on the Global Invasive Species Database (http://www.issg.org/database/welcome/), relevant on-line resources (*e.g.*, Froese and Pauly 2014) and published literature (*e.g.,* Muchlisin 2012). The economic status of fish species was assessed with regard to its potential as a fish target for aquaculture whether as food fish or as an ornamental species based on Muchlisin (2013a).

RESULTS

Abundance and distribution

A total of 764 individuals representing 34 families, 47 genera and 73 species were sampled during the study. Of the 73 species, 32 were restricted to freshwater, 37 restricted to brackish water and 5 occurred in both fresh and brackish waters (Table 2). The Tripa River mouth (site A) has higher number of species, while Pulo ie canals, Matee river and Lamie river have lower number of species richness (Table 2). The largest number of individuals were recorded from the mouth of the Tripa River (site A), and a lower number was recorded at Ranto Kepala Gajah Canals (site I) (Table 3).

A total of eighteen species were unidentifiable to the species level (*Barbonymus* sp., *Butis* sp 1., *Butis* sp 2., *Caranx* sp., *Channa* sp., *Cyclocheilichthys* sp., *Glossogobius* sp., *Kryptopterus* sp., *Leiognathus* sp., *Lethrinus* sp., *Lutjanus* sp., *Osteochilus* sp., *Oxyeleotris* sp., *Rasbora* sp., *Synaptura* sp., *Valamugil* sp., *Tetraroge* sp. and one unknown genus (within family Cyprinidae). Fish samples ranged between 32–321 mm in total length; the smallest fish was *Solea ovata* and largest was *Tor tambra*. Cyprinidae constitutes the prominent fish composition of Tripa peat swamp (Figure 3).

Three species were found to be widely distributed throughout the Tripa peat swamp; *Puntius brevis* (FOI= 66.7%), *Hampala macrolepidota* (FOI= 50%) and *Osteochilus vittatus* (FOI= 41.7%). The majority of species were recorded from one or two sites only and uncommon (Table 2). The diversity index of Tripa peat swamp fish community ranged between of

Table 1. Study location, GPS coordinates and characteristics of each sampling location.

No	Sampling location	Coordinates	Characteristic of location
1.	Tripa River mouth	03°51′02.6″ N, 096°23′10″ E	River mouth with brackish water characteristic. The location was flooded regularly during rainy season. There is a traditional fish landing near to sampling location.
2.	Tripa Creek	03°51′55.6″ N, 096°22′33.3″ E	The site is tributary of Tripa River. The water characteristic is fresh to brackish.
3.	Seuneuam River mouth	03°55′47.9″ N, 096°27′40″ E	River mouth closed by sand bar and it has brackish water characteristic. The sand bar would be broken during rainy season and the river mouth was closed at the time of sampling.
4.	Pulo Ie Canals	03°47′05″ N, 096°28′20.9″ E	This location is the creek of Seuneuam River with freshwater characteristic. There is a palm oil processing plant near to location. Strong suspicion that the waste discharged into the canal and creeks indicated by physical condition of water (coagulants suspended).
5.	Batee River mouth	03°45′56.9″ N, 096°28′47.6″ E	The mouth of Batee River with brackish water characteristic and strong affected by tides, It is covered by mangrove at some parts.
6.	Tadu River Mouth	03°54′38.6″ N, 096°36′25.7″ E	Represent of saline to brackish water characteristics, directly connected to the sea.
7.	Alue Sapek Canal	03°44′47.4″ N, 096°44′22.7″ E	This location is big canal of palm oil plantation (deforested peat swamp forest) and has freshwater characteristic
8.	Seumayam River	03°55′15.8″ N, 096°20′35.3″ E	Freshwater characteristic. The river was flooded regularly during rainy season and most river bank is intensively eroded. The location is commercial palm oil plantations and unfortunately the team was not permitted to come into the mouth of the river due to security reason.
9.	Ranto Kepala Gajah Canal	03°57′53.4″ N, 096°18′31.8″ E	The main canal discharges from palm oil plantations and freshwater characteristic
10.	Matee River	03°47′21.6″ N, 096°46′00.0″ E 03°54′50.6″ N, 096°25′51.7″ E	The main canal discharges from palm oil plantations and freshwater characteristic
11.	Lamie River (Keubejagat & Jembatan)	04°02′33.7″ N, 096°27′31.9″ E	The location is the Tripa watershed and has freshwater characteristic.
12.	Alue Ie Itam	04°02′33.7″ N, 096°27′31.9″ E 04°02′20.7″ N, 096°27′22.2″ E	It has blackwater characteristic and represent of palm oil plantation in some areas.

Figure 2. The general description of every sampling location at Tripa peat swam forest; (**a**) Tripa River mouth, (**b**) Tripa Creek, (**c**) Seuneuam River mouth, (**d**) Pulo Ie Canals, (e) Batee River mouth, (**f**) Tadu River mouth, (**g**) Alue Sapek Canal (**h**) Seumayam River, (**i**) Ranto kepala gajah canal, (**j**) Alue Ie Itam, (**k**) Matee River, (**l**) Lamie River (Alue kebea jagat).

1.23–2.71, indicates moderate value in average with the highest diversity being found at Kuala Batee. The dominance index ranged between 0.44–0.96 in eight localities categorizing in the higher category (>0.75), 0.5–0.75 in three localities categorizing in the moderate category, and <0.5 in one location categorizing in the low category (Table 3). Fish assemblages present at individual sites within the Tripa swamp forest were dissimilar (<40% similarity) reflecting the low frequency of incidence of most species. The dendrogram (Figure 4) indicates that the sites could be partitioned into two distinct groups generally reflecting site location freshwater and brackish water characteristics.

Economic status and alien species

The economic status for each species was based on local market consumption or potential value in the ornamental

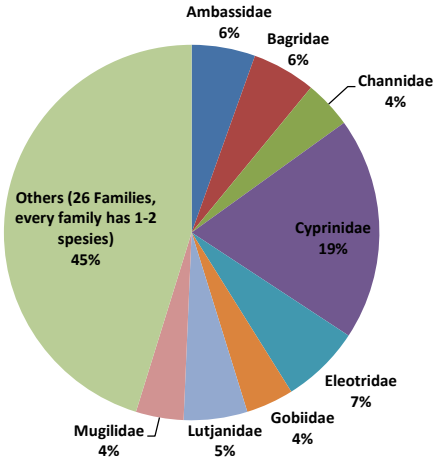

Figure 3. Composition of fish families in Tripa peat swamp to species members.

Table 2. List of fish species and total individuals, economic status and its distribution in Tripa peat swamp of Aceh province, Indonesia.

Scientific name	Family	Local name	A	B	C	D	E	F	G	H	I	J	K	L	FOI	ES	Voucher Code
Ambassis kopsii Bleeker, 1858	Ambassidae	Serideng	-	-	7	-	-	3	-	-	-	-	-	-	16.7	HC	FKP-099
Ambassis miops Günther, 1872	Ambassidae	Serideng	5	2	-	-	5	-	-	-	-	-	-	-	25	HC	FKP-091
Ambassis nalua Hamilton, 1822	Ambassidae	Serideng	4	-	-	-	4	-	6	28	-	-	-	-	33.3	HC	FKP-001
Ambassis vachellii Richardson, 1846	Ambassidae	Serideng	48	-	-	-	-	-	-	-	-	-	-	3	16.7	HC	FKP-039
Anabas testudineus Bloch, 1792	Anabantidae	Krup	-	-	-	-	-	-	-	-	1	2	-	-	16.7	HC/PFC	FKP-102
Anematichthys repasson Bleeker, 1853	Cyprinidae	Mirah mata	-	-	-	-	-	-	-	2	-	6	-	-	16.7	HC/PFC	FKP-184
Anguilla bicolor McClelland, 1844	Anguillidae	Kiree	-	-	-	-	-	-	2	-	-	-	-	-	8.3	HC/PFC	FKP-104
Apogon hyalosoma Bleeker, 1852	Apogonidae	Serideng	-	-	-	-	3	3	-	-	-	-	-	-	16.7	UK	FKP-108
Barbonymus sp.	Cyprinidae	Naleh	-	-	-	-	-	-	-	4	-	-	-	-	8.3	HC/PFC	FKP-465
Butis gymnopomus Bleeker, 1853	Eleotridae	Cong	2	-	-	-	-	-	-	-	-	-	-	-	8.3	UK	FKP-110
Butis sp1.	Eleotridae	Cong	-	2	-	-	-	-	-	-	-	-	-	-	8.3	UK	FKP-112
Butis sp2.	Eleotridae	Cong	1	-	-	-	1	-	-	-	-	-	-	-	33.3	UK	NV
Caranx sexfasciatus Quoy & Gaimard, 1825	Carangidae	Merah mata	-	-	-	-	10	-	-	-	-	-	-	-	8.3	HC	FKP-140
Caranx sp.	Carangidae	Langkituk	12	2	-	-	-	11	-	-	-	-	-	-	25	HC	FKP-116
Channa lucius Cuvier, 1831	Channidae	Bujok	4	-	-	-	-	-	3	-	-	-	-	-	16.7	HC/PFC	FKP-152
Channa striata Bloch, 1793	Channidae	gGbus	-	-	-	-	-	-	1	-	-	1	-	-	16.7	HC/PFC	FKP-159
Channa sp.	Channidae	Gabus	-	-	-	-	-	-	1	-	-	1	-	-	16.7	HC/PFC	FKP-157
Chelonodon patoca Hamilton, 1822	Tertaodontidae	Bukum	4	2	-	-	1	1	-	-	-	-	-	-	33.3	OF	FKP-167
Clarias batrachus Linnaeus, 1758	Clariidae	Lele	1	-	-	-	-	-	-	-	-	1	2	-	25	HC/PFC	FKP-170
Cyclocheilichthys sp.	Cyprinidae	Mirah mata	-	-	-	-	-	-	-	2	-	2	-	-	16.7	HC/PFC	FKP-188
Gerres longirostris Lacepede, 1801	Gereidae	Kapas-kapas	-	-	-	-	2	-	-	-	-	-	-	-	8.3	HC	FKP-191
Glossogobius aureus Akihito & Meguro, 1975	Gobiidae	Cong Puteh	2	-	-	-	2	-	-	-	-	-	-	-	16.7	UK	FKP-193
Glossogobius sp.	Gobiidae	Cong rahang pendek	2	-	-	-	-	-	-	-	-	-	-	-	8.3	UK	FKP-198
Hampala macrolepidota Kuhl & Van Hasselt, 1823	Cyprinidae	Kebaree	2	2	-	-	-	-	-	2	1	1	-	2	50	HC/PFC	FKP-202
Hemibagrus olyroides Roberts, 1989	Bagridae	Suik	-	-	-	4	-	-	-	-	-	-	-	-	8.3	UK	FKP-210
Johnius coitor Hamilton, 1822	Sciaenidae	Gelama	1	-	-	-	-	-	-	-	-	-	-	-	8.3	HC	FKP-212
Kryptopterus minor Roberts, 1989	Siluriidae	Leupek	-	-	-	-	-	-	-	11	-	-	-	-	25	HC/OF	FKP-222
Kryptopterus sp.	Siluriidae	Leupek	15	-	-	-	-	-	-	-	-	-	-	-	8.3	HC/OF	FKP-226
Kuhlia marginata Cuvier, 1829	Kuhliidae	Besi-besi	3	-	-	-	-	-	-	-	-	-	-	-	8.3	HC	FKP-239
Leiognathus equulus Forsskal, 1775	Leiognathidae	Cirik tanah	-	8	-	-	-	-	-	-	-	-	-	-	8.3	HC	FKP-270
Leiognathus sp.	Leiognathidae	Cirik	-	-	-	-	1	-	-	-	-	-	-	-	8.3	HC	FKP-268
Lethrinus sp.	Lethrinidae	Tenga	1	-	-	-	-	-	-	-	-	-	-	-	33.33	HC	FKP-242
Lutjanus argentimaculatus Forsskal, 1775	Lutjanidae	Bateng	2	2	1	-	9	-	-	-	-	-	-	-	33.3	HC	FKP-256
Lutjanus johnii Bloch, 1782	Lutjanidae	Ramong	-	-	-	-	2	-	-	-	-	-	-	-	8.3	HC	FKP-258
Lutjanus russelli Bleeker, 1849	Lutjanidae	Ikan tanda	-	-	-	-	2	-	-	-	-	-	-	-	8.3	HC	FKP-267
Lutjanus sp.	Lutjanidae	Ikan tanda	-	-	1	-	6	-	-	-	-	-	-	-	1.7	HC	FKP-265
Megalops cyprinoides Broussonet, 1782	Megalopidae	Ikan bulan	-	-	-	-	1	-	-	-	-	-	-	-	8.3	UK	FKP-277
Microphis brachyurus Bleeker, 1854	Syngnathidae	Kuda kuala	-	-	-	2	-	-	-	-	-	-	-	-	8.3	OF	FKP-279
Mugil cephalus Linnaeus, 1758	Mugilidae	Belanek	6	-	-	-	-	31	-	-	-	-	-	-	16.7	HC	FKP-301
Mystus micracanthus	Bagridae	Baong	-	-	-	-	-	-	-	-	-	-	2	-	8.3	OF	FKP-3-3
Mystus nigriceps	Bagridae	Baong	1	-	-	-	-	-	-	-	-	1	-	-	16.7	UK	FKP-304
Mystus cavasius Hamilton, 1822	Bagridae	Baong	-	-	2	-	-	-	-	-	-	2	-	-	16.7	UK	NV

Continued

Table 2. *Continued.*

Scientific name	Family	Local name	A	B	C	D	E	F	G	H	I	J	K	L	FOI	ES	Voucher Code
Ophiocara porocephala Valenciennes, 1837	Eloetridae	Cong itam	-	-	2	5	-	-	-	-	-	-	-	-	16.7	HC/PFC	FKP-410
Oreochromis niloticus Linnaeus, 1758	Cichlidae	Nila	6	-	-	-	1	3	-	-	-	-	-	-	25.-	HC/PFC/AS	FKP-412
Osteochilus schlegelii Bleeker, 1851	Cyprinidae	Serukan	-	-	-	-	-	-	-	-	-	8	-	-	8.3	HC/PFC	FKP-431
Osteochilus vittatus Valenciennes, 1842	Cyprinidae	Serukan	-	-	-	-	-	-	3	10	-	1	5	5	41.7	HC/PFC	FKP-430
Osteochilus sp.	Cyprinidae	Seurukan	-	-	-	-	-	-	-	-	2	98	-	-	16.7	UK	FKP-467
Oxyeleotris sp.	Eleotridae	Ketetu	-	-	-	-	-	-	-	2	-	-	-	-	8.3	HC/PFC	NV
Periophthalmus argentilineatus	Gobiidae	Cicak bakoi	-	-	-	-	1	-	-	-	-	-	-	-	8.3	UK	FKP-449
Platycephalus indicus Linnaeus, 1758	Platycephalidae	Baji-baji	9	-	-	-	-	-	-	-	-	-	-	-	8.3	UK	FKP-452
Polydactylus sexfilis Valenciennes, 1831	Polynemidae	Senangin	6	-	-	-	1	-	-	-	-	-	-	-	16.7	HC	NV
Pterygoplichthys pardalis Castlenau, 1855	Macrouridae	Sapu-sapu	-	-	-	-	-	-	1	-	-	-	-	-	8.3	OF/AS	FKP-443
Puntius brevis Bleeker, 1850	Cyprinidae	Groe	2	-	-	-	-	1	6	39	4	9	4	9	66.7	HC	FKP-501
Rasbora argyrotaenia Bleeker, 1849	Cyprinidae	Bileh	-	-	-	-	-	-	-	-	-	-	11	-	8.3	UK	FKP-509
Rasbora sumatrana Bleeker, 1852	Cyprinidae	Kedawah	-	-	-	-	-	-	-	2	1	1	-	3	33.3	UK	FKP-506
Rasbora torneiri Ahl, 1922	Cyprinidae	Bileh	-	-	-	-	-	-	-	-	-	1	-	-	8.3	OF	FKP-517
Rasbora sp.	Cyprinidae	bileh krueng	-	-	-	4	-	-	-	-	-	-	-	-	8.3	UK	FKP-504
Scatophagus argus Linnaeus, 1766	Scatophagidae	Kitang	-	-	-	-	2	1	-	-	-	-	-	-	16.7	HC	FKP-519
Sillago sihama Forsskål, 1775	Sillaginidae	Cuet	1	-	-	-	-	-	-	-	-	-	-	-	8.3	HC	FKP-520
Solea ovata Richardson, 1846	Soleidae	Sebelah	-	-	5	-	3	-	-	-	-	-	-	-	16.7	HC	FKP-527
Stolephorus indicus van Hasselt, 1823	Engraulidae	Cet-cet	1	1	-	-	-	-	-	-	-	-	-	-	16.7	HC	FKP-522
Synaptura sp.	Soleidae	Sebelah	3	-	-	-	-	-	-	-	-	-	-	-	8.3	HC	FKP-523
Terapon jarbua Forsskål, 1775	Teraponidae	Kekirong	-	1	1	-	1	-	-	-	-	-	-	-	25	HC	FKP-614
Tetraroge barbata Cuvier, 1829	Tetrarogidae	Leupoh	82	-	-	-	-	-	-	-	-	-	-	-	8.3	UK	FKP-535
Tetraroge sp.	Tetrarogidae	Lepoh	-	-	-	-	1	-	-	-	-	-	-	-	8.3	UK	FKP-610
Tor tambra Valenciennes, 1842	Cryprinidae	Keureling	1	-	-	-	-	-	-	1	-	-	-	-	16.7	HC/PFC	FKP-612
Toxotes jaculatrix Pallas, 1767	Toxotidae	Sumpit	-	-	-	-	2	-	-	-	-	-	-	-	8.3	OF	FKP-632
Trichopodus pectoralis Regan, 1910	Osphronemidae	Sepat siam	-	2	-	7	-	-	-	-	-	1	-	-	25	HC/PFC/AS	FKP-617
Trichopodus trichopterus Pallas, 1770	Osphronemidae	Ssepat rawa	-	-	-	-	-	-	-	-	10	14	-	-	16.7	OF	FKP-63-
Valamugil cunnecius Valenciennes, 1836	Mugilidae	Kadra panjang	-	-	-	-	-	4	-	-	-	-	-	-	8.3	HC	FKP-444
Valamugil sp.	Mugilidae	Kadra	3	-	-	-	-	1	-	-	-	-	-	-	16.7	HC	FKP448
Zenarchopterus beauforti Mohr, 1926	Zenarchopteridae	Ikan murung	-	-	-	-	2	-	-	-	-	-	-	-	8.3	UK	FKP-634
Cyprinidae sp. (cryptic taxa)	Cyprinidae		-	-	6	-	-	-	-	-	-	-	-	-	8.3	OF	FKP-610
Total individual			230	24	25	22	63	59	23	103	19	150	24	22			
Total species			**29**	**10**	**8**	**5**	**23**	**10**	**8**	**11**	**6**	**17**	**5**	**5**			

Note: A= Tripa River mouth, B= Tripa Creek, C= Seuneam River Mouth, D=Pulo Ie Canals, E= Batee River Mouth, F= Tadu River Mouth, G= Alue Sapek Canals, H= Seumanyam River, I= Ranto Kepala Gajah, J= Alue Ie Itam, K= Matee River, L= Lamie River, FOI= Frequency of Incidence, ES= Economic Status, HC= Human Consumption, OF= Ornamental Fish, UK= Unknown, AS= Alien Species, PFC= Potency as Fish Culture, NV= No voucher was available

Table 3. The total genera, species and biological indices of Tripa peat swamp forest fishes assemblages.

No.	Sampling location	Total Genera	Total Species	Total Ind.	Margalef's D	Evenness index	Diversity index
1.	Tripa River mouth	25	29	230	5.33	0.69	2.35
2.	Tripa Creek	10	10	24	2.83	0.90	1.66
3.	Seuneuam River mouth	8	8	25	2.04	0,85	1.66
4.	Pulo Ie Canals	5	5	22	1.29	0.96	1.54
5.	Batee River mouth	18	23	63	4.91	0.89	2.71
6.	Tadu River mouth	8	10	59	2.21	0.68	1.57
7.	Alue Sapek Canal	6	8	23	2.23	0.89	1.85
8.	Seumayam River	9	11	103	2.16	0.73	1.74
9.	Ranto Kepala Gajah Canal	6	6	19	1.82	0.89	1.43
10.	Matee River	4	5	24	1.26	0.87	1.40
11.	Lamie River (Keubejagat and Jembatan)	5	5	22	1.50	0.93	1.67
12.	Alue Ie Itam	10	17	150	3.05	0.44	1.23

aquarium trade. Of the 73 species recorded, 46 species were categorized as valuable for human consumption, of these 17 species have potential as fish target for aquaculture namely; *Anabas testudineus, Anguilla bicolor, Channa* sp., *C. lucius, C. striata, Clarias batrachus, Anematichthys repasson, Cyclocheilichthys* sp., *Hampala macrolepidota, Ophiocara porocephala, Oreochromis niloticus, Osteochilus vittatus, O. schlegelii, Oxyeletris* sp., *Barbonymus* sp., *Tor tambra* and *Trichopodus pectoralis*. The following ten species are potentially valuable as ornamental fish (Table 2). This latter group included *Chelonodon patoca, Kryptopterus minor, Krypropterus* sp., *Microphys brachyurus, Mystus micracanthus, Pterygoplichthys pardalis, Rasbora torneiri, Trichopodus trichopterus, Toxotes jaculatrix* and Cyprinidae sp. (cryptic taxa). A total of three alien species were recorded during the study; *Pterygoplichthys pardalis (*sapu kaca), *Oreochromis niloticus* (nila) and *Trichopodus pectoralis* (sepat siam).

DISCUSSION

Cyprinidae is the largest group of freshwater fishes in the world and was the dominant family recorded from the Tripa peat swamp, Aceh province, Indonesia. Cyprinidae is similarly dominant in many other freshwater habitats throughout Asia, for example Muara Enim, Southern Sumatra Indonesia (Junaidi 2004), Pahang River System, Malaysia (Miyazaki *et al*. 2013) and the Yangtze River in China (Fu *et al*. 2003). Among the freshwater fishes, *Puntius brevis* and *Osteochilus vittatus* were commonly found at most sites. *Chelonodon patoca* and *Lutjanus argentimaculatus* were commonly found in brackish water of river mouths. This is in agreement to Simanjuntak *et al*. (2011) who reported that *C. patoca* and *L. argentimaculatus* occupy coastal habitats with sandy and muddy water bottoms and can be found at the river mouth or estuary areas as recoded in this study.

According to Muchlisin and Siti-Azizah (2009), there are at least four species of catfish (*Clarias teijsmanni, C. nieuhofii, C. batrachus,* and *C. gariepinus*) and three species of mahseer (*Tor tambra*, *T. soro* and *T. tambroides)* found in Aceh. However, only one species of catfish and mahseer were sampled from the TPSF during the study. The total number of catfish and mahseer in Tripa peat swamp waters is probably higher than recorded in this study and further sampling using a greater diversity of sampling gears and sampling duration would be needed to detect them.

We recorded three species of alien fishes in Tripa peat swamp; *Trichopodus pectoralis* or known as Siamese gourami has been present in Indonesia waters for an extended period

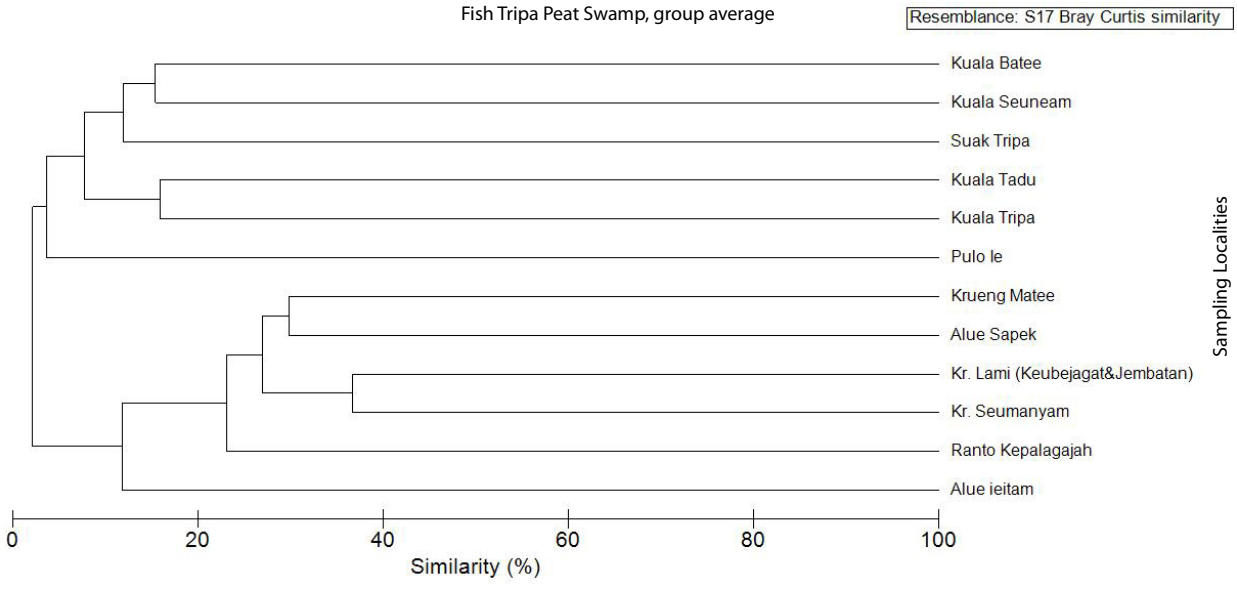

Figure 4. The similarity distance of fish community structure among locations in Tripa peat swamp .

and are well-adapted to this region. It believed that this species is originated from Mekong basin and introduced to Indonesia on 1934. *Oreochromis niloticus* was introduced into Indonesia by the Center of Research and Development for Freshwater Aquaculture, Marine and Fisheries Affairs of Republic Indonesia in 1969. It is estimated that these species became established in Aceh province in the 1990s (Muchlisin 2012), this is the first recording of these species from the TPSF. *Pterygoplichthys pardalis* was first observed in 2007 in Alue Sapek waters (personal communication, local fishermen of Alue Sapek village, Suka Makmur District). This species is an aquarium fish, but frequently released into open waters when it achieves large size and is no longer attractive as an ornamental fish. Public awareness campaigns are required to prevent this from continuing to occur in the future.

The negative impact of alien fish species on indigenous fish communities include predation on local fishes (Nicola *et al*. 1996), competition for food and habitat (Alcaraz and Garcia-Bethou 2007), interference with mate selection (Seehausen *et al*. 1997), and unexpected cross breeding with local fish resulting in depressed genetic diversity and distinctiveness of local fishes and the transmission of disease (Almodovar *et al*. 2006). However, the total number of alien fish species in the TPSF is lower than that recorded in other regions of Aceh province. At least six introduced fish species were recorded in Lake Laut Tawar, Takengon, and five species of alien fish species occur in the irrigation canals and paddy fields of Sibreh, Aceh Besar (Muchlisin 2012).

There are at least 40 species of freshwater fishes in Aceh waters known to be of economic value; either as species valuable for human consumption or as aquarium fishes (Muchlisin 2013a). Of the 73 species recorded in this study, 46 species have value for human consumption; of these, 17 species have potential for aquaculture, and 10 species are potential in the aquarium trade. The experimental cultures of indigenous freshwater fish species in Aceh province, Indonesia has been started for *T. tambra* (Muchlisin, 2013b), *Osteochilus vittatus* (Muchlisin et al. 2014) and *A. testudineus,* some studies are initially conducted for these species, but other potential species as recorded in this survey need more attention to be studied prior to be commercially cultured.

The catfish (*C. batrachus*) and Acehnese mahseer (*T. tambra*) (locally know as sengko and keureling, respectively) are two species favored and targeted by local fishermen. Only one individual of *T. tambra* and four individuals of *C. batrachus* were recorded during the survey. Populations of these species in the wild have apparently decreased significantly in recent years. According to local fishermen, the reduction in catfish catches over the last two decades is about 80%. In the 1970s, catches of this species with a *bubu* (a local traditional trap) weighed 5–10 kg. Current catches of catfish have decreased to less than 1 kg (*personal communication by senior author with local fishermen*). We believe that similar reductions in abundance and population structure are also occurring for other fish species of Tripa peat swamp. The high value of fishes recorded from the Tripa peat swamp system strongly suggests that this system contains biological resources of high economic potential and value, in addition to their intrinsic biological value. Depletion in abundance and species richness of catfish in Tripa peat swamp waters is closely associated with devastation of Tripa peat forests, which has degraded and reduced catfish habitat (i.e. previously perennial habitats now dry out during the dry season). Only approximately 12,000 ha (less than 20% of original extent) of Tripa peast swamp forest currently remains in good conditions.

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