



The Structure Community of Ichthyofauna in the Region Buffer Resorts Suo-Suo of Bukit Tigapuluh National Park, Indonesia

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Abstract

The buffer zone of Suo-Suo Resort has a direct supply of biodiversity of flora and fauna directly from the core zone of Bukit Tigapuluh National Park. In addition, the area was faced high pressure on the existing ecosystem because this area is known to be productive and often become an exploiting area. This study aims to record the biodiversity of fish and its related dynamics such as the study of composition, community diversity and fish distribution. Research carried out during the two seasons of the dry season and the rainy season. Fish sampling using the fish net and gills net in pairs in the river body. The results showed some physical and chemical properties of waters are still quite feasible in supporting the life of aquatic biota. The fish obtained during the study consisted of 18 families with the highest Cyprinidae family then followed by the Bagridae family.

Keywords: Diversity index; Fish Community; River water quality

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1. Introduction

Suo-Suo Resort is part of Bukit Tigapuluh National Park which is included in SPTN Region I Tebo District Jambi Province, this area is divided into core area and buffer zone. Geographically the buffer zone is located adjacent to the core area, the topography is not much different as it has a fairly steep hills-shaped landscape with an altitude between 60 - 843 m above sea level. Based on the Schmidt and Ferguson classification, the Bukit Tigapuluh National Park area includes a B-type climate that has temperatures ranging from 20.8 - 33° C with annual rainfall of 2,577 mm / year.

As a buffer zone of Suo-Suo Resort, this area has its own advantages of obtaining a direct supply of biodiversity of flora and fauna directly from the core zone of Bukit Tigapuluh National Park, but it also has a deficiency such as high pressure on the existing ecosystem because this area is known to be productive and often become exploitation areas either in the form of concession disputes to land conversion for forest concession, mining and illegal logging activities.

Various kinds of pressures that occur can affect the biodiversity of existing fauna, especially the type of ichthyology (fish), large-scale and uncontrolled forest exploitation activities cause pollution, one of them anthropogenic in the rivers that exist in the forest. Bukit Tigapuluh National Park itself is part of the River Basin (DAS) River Batanghari in Jambi Province and Gansal River in Riau Province which has several sub-watersheds such as Sumay River, Pengabuhan, Cinaku and Keritang.

Based on previous research Bukit Tigapuluh National Park itself recorded 97 species with 25 families of fish species collected by Siregar et al. In 1993 on the SPTN of Region II Siberida Riau Province, whereas Jambi Province has 297 species of freshwater fish in Batanghari River Basin, 25 species in Batang Bungo River and 49 species in Harapan Rainforest Jambi spread over various habitat types [1,2,3].

Departing from the issues and problems above would be a concern related to the decline of biodiversity and even the extinction of fish especially in this area, while the comprehensive data of biodiversity of the fish that have been owned so that the fish can be extinct before they are identified and described. It is therefore important that a series of research be conducted to record the biodiversity of fish and its associated dynamics such as the study of composition, community diversity and fish distribution. This study is expected to illustrate the potential of fisheries in this area which can later be used as a foundation in the preparation of specific fisheries management strategies and forest restoration in general.

2. Material and Methods

2.1. Sampling Locations

This research was conducted in buffer area of Suo-Suo Resort of Bukit Tigapuluh National Park part SPTN Region I Tebo District Jambi Province, specially Block One area covering 10-point observation station (Figure 1). Observations were made during two seasons: dry season (August 2015) and rainy season (February 2016). Determination of observation station through purposive sampling with target of main water body in this area.

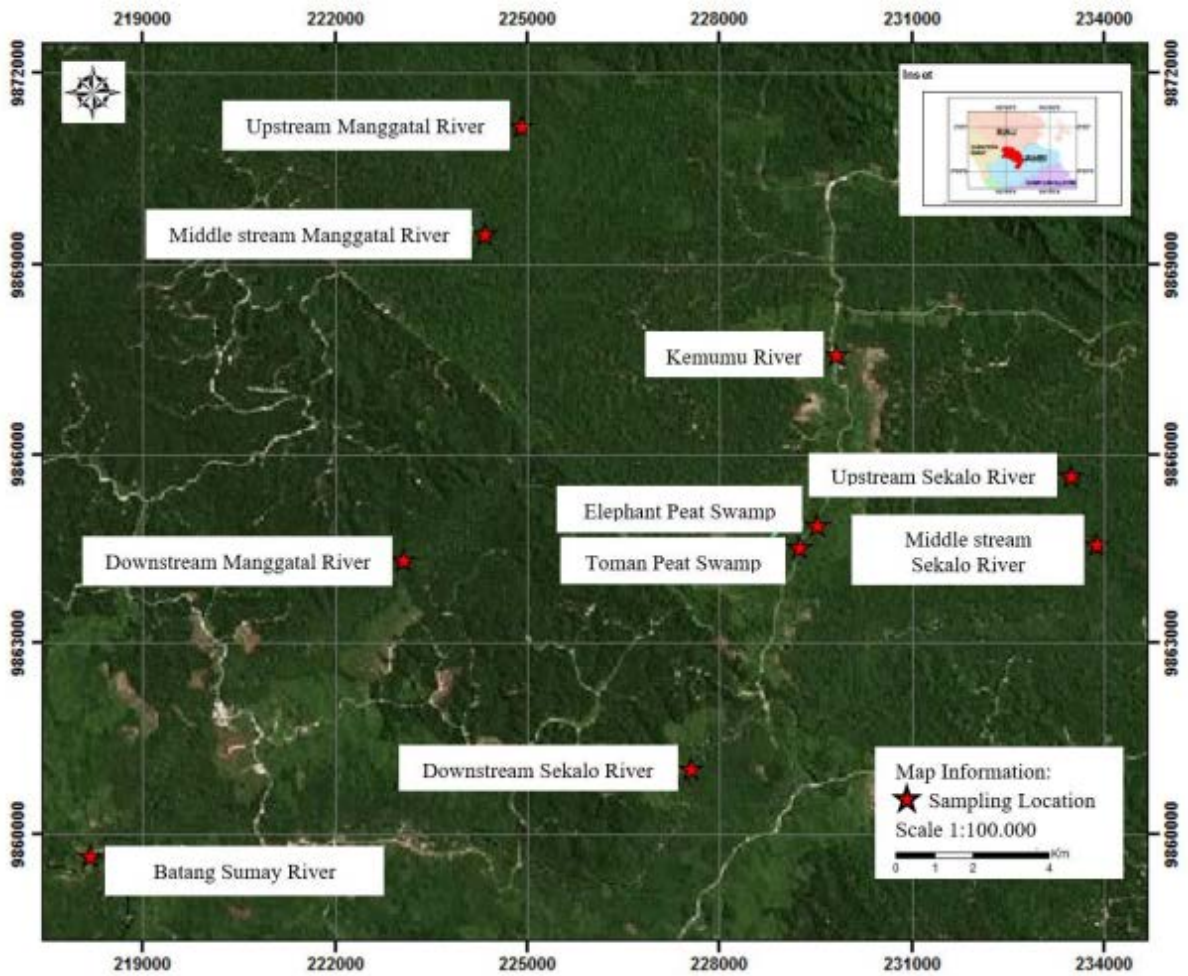


Figure 1: Sampling Locations

2.2. Tools and Materials

Fish sampling refers in [3] using a net with a length of 3 m, a height of 2 m, a mesh size of 0.5 inches and a gillnet measuring ± 30 m long, 1 m high with each size Eye nets 0.5, 0.75 and 1 inch. The spreading mesh is operated at the center of the river which has a relatively high current velocity for approximately 1 hour at each station, whereas gillnet is operated in deep water for 6 hours and is lifted 2 hours at a distance of each net ± 50 m, while for the edge of the waters covered with vegetation, fishing with fishing rod, *tajur*, *serok* and *bubu* [4], Haryono 2006 in Sukmono [3].

The abundance of each species (species) of fish began to be estimated or calculated when it was captured, sorted and grouped according to species and size at each observation station, then weight measurement and length. Sampled fish samples were immediately preserved with 10% formalin solution and included in a sample container that had been labeled local fish, station, collection date, and collector name.

Grouped fish species are calculated and identified by morphometric and meristic characters based on [1,5,6,7,8,9,10]. The results of the identification obtained are then confirmed at the Bogor-LIPI Zoological Museum, Cibinong and compared with the existing data at fishbase.com. Fish specimens that have been

identified immediately were washed with running water and stored in a sample container containing 70% alcohol solution as a scientific collection.

While the water morphometry was measured in the morning between 08.00-09.00 WIB shortly before the sampling of fish, including: (1) depth with stick estimator; (2) length, maximum width, and flow width by meter. While water quality parameters include: (1) water color and brightness observed visually with secchi disk; (2) temperature with thermometer; (3) the current velocity with the ball of the estimator; (4) dissolved oxygen by titration of winkler method; (5) basic substrate by manual; (6) surrounding vegetation with visual; (7) water pH with digital pH meter; And (8) the position of coordinates and altitude with GPS Garmin. Habitat conditions in general will be tabulated and described.

2.3. Data Analysis - Water Characteristics

To know condition of general description of research location and water characteristic descriptive analysis to primary and secondary data of waters obtained through field observation, interview and data obtained from related institution.

2.4. Data Analysis – Species Composition

The species composition was analyzed based on identification results from family level to fish species, while the formula used was as follows:

$$p_i = \frac{n_i}{N} \times 100\%$$

Information :

p_i : Comparison between the number of individual fish species i to the total number of individual fish

n_i : Number of individual fish species to- i

N : Total number of individual fish

2.5. Data Analysis - Diversity Index (H')

The diversity index (H') represents the richness of fish species which can be seen from the presence of the number of species in a community with relative abundance (the number of individuals per species). The most commonly used diversity index is the index by Shannon-Wiener [11], denoted by (H') which is limited as:

$$H' = - \sum_{i=1}^n (p_i)(\log_2 p_i)$$

Information :

H' : Diversity index (Shannon - Weiner)

p_i : Comparison between the number of individual fish species i to the total number of individual fish (the number of individual species i , $p_i = n_i / N$)

n : The total number of species

2.6. Data Analysis - Uniformity Index (E)

Uniformity is a description of the individual distribution of fish of each species in a community, the more evenly distributed individual species within a community then the balance of the ecosystem will also increase as there is no tendency of a particular species of fish that dominates. The uniformity index (E) of fish can be calculated based on the following equation [12]:

$$E = \frac{H'}{H'_{max}}$$

Information :

- E : Uniformity index
- H' : Index of diversity
- H' max : Maximum diversity index or $\ln s$
- S : Number of genera

2.7. Data Analysis - Simpson's Dominant Index (C)

To see the dominant level of certain species of fish species used Simpson dominance index with the following formula [1993]:

$$C = \sum_{i=1}^s (P_i)^2$$

Information :

- C : Index of dominance
- s : Number of species species
- P_i : The proportion of the to-i fish
- N : Total number of individual fish

3. Results and Discussion

3.1. Water Characteristics

From observation of physical properties of river such as base substrate, current velocity, water temperature, depth and boundary limit and measurement of several chemical parameters such as pH and DO and combined with visual observation of vegetation and land use, Manggatal River and Sekalo River can be divided into three, Namely the upstream (source), the middle and the downstream (mouth). While Kemumu River belongs to the minor tributaries of the major tributaries of the Manggatal River, Elephant Peat Swamp and Toman Peat Swamp enter into minor tributaries of the major tributaries of the Sekalo River. Characteristics of observation stations can be seen in table 1.

The buffer zone of Resort Suo-Suo Bukit Tigapuluh National Park part SPTN Region I Tebo District Jambi Province, especially block area one has heterogeneity habitat of public waters are quite diverse. Based on the results of the research supported by secondary data through questionnaires and interviews, there are two main

river streams that exist in this area which include: Manggatal River and Sekalo River, both empties into the River Batang Sumay. However, according to [14] that Sumay River system is part of the upstream Batanghari River, Sumay River system consists of three major tributaries, namely: 1) Manggatal River; 2) The Endelang River; and 3) Kemumu River.

If we refer to the result of local information tightening and information today, basically Kemumu River was minor tributaries of the central tributaries of the central Manggur River, and the Sekalo River is one of the major tributaries, River Batang Sumay system. While Toman Peat Swamp and Elephant Peat Swamp are part of minor tributaries (minor tributaries) of the major tributaries of the downstream Sekalo River.

Different perceptions in the division and naming of the river can be due to the changing of the river landscape or the understanding of the community in naming the river from time to time, as well as a small river near the Talang Mamak tribe of Semarantihan Hamlet becoming one of the observation stations also called Kemumu River. Basically, this small river is in the middle between the edge of the river minor that flows in Toman Peat Swamp and Elephant Peat Swamp with the middle stream of the actual Kemumu River, so the supply of water is thought to come from the two streams of minor.

Returning to Toman Peat Swamp and Elephant Peat Swamp, these waters, in addition to obtaining minor tributaries from the major tributaries of the downstream Sekalo River, are also supplied by streams of minor tributaries originating from the major tributaries of the lower Manggatal River. In other words, the major tributaries of Manggatal River and the major tributaries of the Sekalo River are connected through its minor tributaries that meet downstream before being reunited in the Batang Sumay River system.

At first the minor tributaries of the major tributaries of the downstream Sekalo River flow along the road to Semarantihan Hamlet, the village of Talang Mamak, but due to a road transport project development, the river was cut off and Experiencing habitat fragmentation so that some form of *banjiran* and oxbow swamps such as Elephant Peat Swamp and Toman Peat Swamp stations.

Basically, the public waters located in this region has the character as a river flooded with several creeks and swamps along the flow. During the dry season swamps are generally not experiencing drought and act as a refuge area of fish, while during the rainy season the waters merge with streams of creeks. Swamps that experience such phenomena include Toman Peat Swamp and Elephant Peat Swamp.

Changes in the general waters landscape of the buffer zone of Suo-Suo Resort of Bukit Tigapuluh National Park is believed to be caused by large-scale land conversion in this area, such as illegal logging and forest clearing for the garden. The park's buffer zone is known to be vulnerable and is often the target of exploitation, because ecologically this area is classified as productive and supported by the distribution of flora and fauna originating from the core area of the national park, whereas legally the area is considered vulnerable because it has no certainty Law in its management. Overlapping ownership and exploitation of forest causes this region to be difficult to manage optimally because of the many interests of diverse stakeholders.

Basically, Batang Sumay River station is not included in the public waters of Suo-Suo Resort buffer zone, but still the author of input as a comparison station, because weigh this location is the estuary of the Manggatal

River and Sekalo that has an important role both in terms of ecology of fish distribution and economy for people around Batang Sumay River.

Table 1: Position and characteristics of observation stations

Station	Location Name	Coordinate Position	Description
HUM	Upstream Manggatal River	X: 0224939 Y: 9871150 Elevation 85 m above sea level	The colored water is very clear with rocky substrates. River width 15 m, flow width 12 m and depth of lubuk 170 m. The river border is a jungle.
TSM	Middle stream Manggatal River	X: 0224374 Y: 9869461 Elevation 85 m above sea level	Clear colored water with sandy rock substrate. It is an estuary of the middle encounter of the Manggatal River with the minor stream of the Beringin River. The width of the river is 13 m, the flow width is 11.5 m and the depth of the hole is 150-200 m. Part of the river border found some piles of rattan that will be swept away.
HIM	Downstream Manggatal River	X: 0223094 Y: 9864305 Elevation 70 m above sea level	The water is cloudy with sandy substrates. Downstream Manggatal River is also located near the pedestrian bridge PT. Wirya Karya Sakti (WKS) and PT. Lestari Alam Jaya (LAJ) with relatively open area because it is located in main road corridor and adjacent to rubber plantation. River width 28 m, flow flow 150-200 mm and depth of the hill reaches ± 2 m. Often it becomes a dock rattan carrier and other forest products derived from drift upstream Manggatal River.
HUS	Upstream Sekalo River	X: 0233500 Y: 9865616 Elevation 107 m above sea level	The colored water is very clear with rocky substrates. It is the estuary of the Sekalo River upstream and the minor riverbed of Lubang Punai River. In the middle, there is a stretch of pebbles and found a lot of elephant dung. River width 30 m, 15 m wide flow and 150 m depth. The river border is a jungle.
TSS	Middle Stream Sekalo River	X: 0233899 Y: 9864548 Elevation 100 m above sea level	Water is colored with sandy stone substrates. It is the middle estuary of the Sekalo River with the minor tributary of the Tengkalous River. River width 25 m, flow width 17 m, and deep depth 70-120 m. The river border section found many piles of illegal logging logs to be swept away.
HIS	Downstream Sekalo River	X: 0227586 Y: 9861007 Elevation 72 m above sea level	The water is cloudy with sandy substrates. Downstream Manggatal River is located near the pedestrian bridge PT. Wirya Karya Sakti (WKS) and PT. Lestari Alam Jaya (LAJ) with the condition of the area is relatively open because it is located in the main road corridor. The river width is 34.2 m, flow 14.16 m and the depth of the hole reaches ± 3 m. Often it becomes a jetty carrying logs from illegal logging from the upstream Sekalo River.
BSY	Batang Sumay River	X: 0218219 Y: 9859654 Elevation 63 m above sea level	Dark brownish water with sand substrate mixed with soil mud. It is a meeting of Sungai Manggatal and Sekalo River, located in a densely-populated area of Batang Sumai village. River width 35 m, flow width 25 m and 150 m depth. The edge is bordered by palm oil plantations and serves as a place for local residents.
SKM	Kemumu River	X: 0229855 Y: 9867560 Elevation 80 m above sea level	Clear small brownish river with sandy substrate. 7.8 m wide river width, 2-3 m flow width, 55 m deep depth. Located in Semerantihan Village and serves as a place for local people. The river border is overgrown with bamboo clumps, rattan and rubber gardens.
RWT	Toman Peat Swamp	X: 0229545 Y: 9864863 Elevation 89 m asl	The water catchment area surrounded by a small hill with a width of ± 300 m and a depth of 2-3 m. Water is blackish with rivarian vegetation grass. Being in KM 31 towards Semerantihan Village.
RWG	Elephant Peat Swamp	X: 0229269 Y: 9864494 Elevation 98 m above sea level	The former dead river area where the elephant puddles with a width of ± 180 , a length of 150 m and a depth of 2 m. The water surface is filled with weeds with riparian grass and ferns.

From the observation of several physical and chemical properties of waters referring to the water quality of Class III for all fisheries activities in the RI Government Regulation [15], the existing waters in the Suo-Suo

Resort buffer zone, in particular the one block as a whole, is still relatively reasonable to support the life of aquatic biota, only at the Toman Peat Swamp and Elephant Peat Swamp stations during the rainy season decreasing dissolved oxygen that exceeds the standard threshold Water quality Class III in [15] explained the range of quality standard DO water class 3 is 3 m / l, while at Toman Peat Swamp station is about 2.81 m / l and Elephant Peat Swamp was about 2.56.

The decrease in DO at Toman Peat Swamp and Elephant Peat Swamp stations is thought to be caused by eutrophication symptoms, although the relative brightness of the waters is increasing, but the sides and partial water surfaces have been overgrown with shrubs and other grass vegetation. As for the Elephant Peat Swamp station almost the entire surface has been filled with *Azolla* similar plants. The emergence of *Azolla* plants that indicate this eutrophication process indicates the amount of organic material present in these waters, this is also supported by obtaining leeches (*Hirudo medicinalis*) at the time of observation.

The existence of leeches (*Hirudo medicinalis*) in waters indicates that the waters are classified as polluted. Leeches (*Hirudo medicinalis*) itself is an organism classified as macrozoobentoz which belongs to a group of intolerant organisms that can be used as bioindicator of environmental pollution of freshwater waters [16]. According to [17], leeches are usually found in eutrophic, poly-saprobic waters and waters of medium pressure or high pressure.

The high organic matter that caused polluted Elephant Peat Swamp station is believed to be caused by the frequent entry of elephant groups into these waters, the existence of the elephant group is not only stirring the waters but also adding the organic material waters through the dirt they leave behind.

Actually, the existence of leeches is also found in Downstream Sekir station, but not as much as the Elephant Peat Swamp station. Physical structures of the flood waters of the Elephant Peat Swamp and have limited input and output access cause the existing anthropogenic waste to accumulate in these waters, in contrast to the Sekera Downstream station which is part of the Sekalo River having the physical characteristics of the flowing waters which must have had input and output access better.

3.2. Species Composition

The total number of individual fish collected were 1132 individuals from 746 and 386 heads each catch in the dry and rainy season. Globally the highest catch is upstream of Sekalo River 342 individuals (30.21%), middle of Sekalo River 197 individuals (17.40%), and upstream of Manggatal River 148 individuals (13.07%). While the lowest catch is at Toman Peat Swamp 7 individuals (0.62%), Kemumu River 55 individuals (4.86%) and downstream of Manggatal River 58 individuals (5.12%) (Figure 2).

The temporal variation of the catch in the dry season was 65.9% greater than the rainy season of 34.1%, while the per-station was more fluctuating. During the dry season the highest catches were upstream of Sekalo River 220 individuals (29.49%), middle of Sekalo River 168 individuals (22.52%) and upstream of Manggatal River 119 individuals (15.95%), while the lowest in Tandawa Peat Swamp 2 individuals (0.27%), Elephant Peat Swamp of 16 individuals (2.14%) and Kemumu River (3.35%). In the rainy season the highest catches on the Upper Sekalo River were 122 individuals (31.61%), Elephant Peat Swamp 56 individuals (14.51%) and middle

Manggatal River 45 individuals (11.66%), while the lowest in Toman Peat Swamp 5 individuals (1.30%), Batang Sumay River 17 individuals (4.40%) and downstream Sekalo River 22 individuals (5.70%).

Identification results obtained 71 species belonging to 18 families and 8 orders, while temporarily obtained 65 species 17 families and 8 orders during the dry season and 46 species 14 families and 7 orders in the rainy season. Temporally, during the dry season the highest species caught were *Osteochilus waandersii* 145 individuals (19.44%), *Mystacoleucus marginatus* 129 individuals (17.29%) and *Labiobarbus festivus* 100 individuals (13.40%), while in the rainy season the highest species caught were *Trichogaster leerii* 56 Individuals (14.51%), *Mystacoleucus marginatus* 50 individuals (12.95%) and *Barbonymus schwanenfeldii* 31 individuals (8.03%).

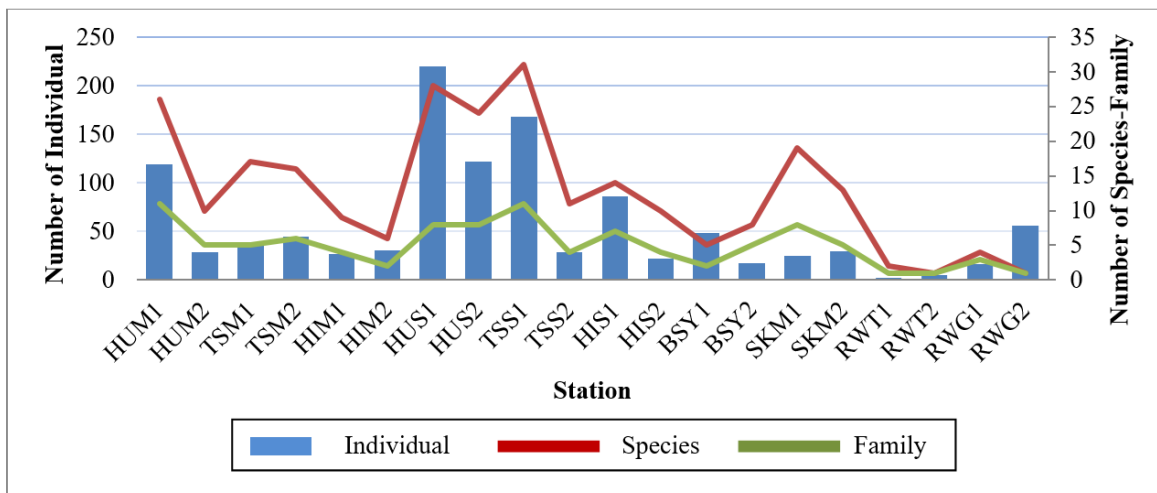


Figure 2: Percentage distribution of the number of fish species, species and families present in the public waters of the Suo-Suo Resort area of Bukit Tigapuluh National Park

Spatially-temporal, species that have the highest catch of each station and season look more varied. As in the upper reaches of the Manggatal River, *Mystacoleucus marginatus* species became the highest catch species of 31 individuals (26.05%) in the dry season and 11 individuals (37.93%) of the rainy season. Upstream Sekalo River dry season highest species *Osteochilus waandersii* 69 individuals (31.36%) and *Rasbora elegans* 20 individuals (16.39%) in the rainy season. In the middle of the Manggatal River in the dry season the highest species of *Hampala macrolepidota* and *Mystacoleucus marginatus* were 6 individuals (17.14%) and *Mystacoleucus marginatus* 13 individuals (28.89%) in the rainy season. In the middle of Sekalo River dry season highest species *Osteochilus waandersii* 33 individuals (19.64%) and *Rasbora elegans* 9 individuals (31.03%) in the rainy season.

While on the lower reaches of the Manggatal River in dry season the highest species of *Labiobarbus festivus* 7 individuals (25.93%) and *Barbonymus schwanenfeldii* 17 individuals (54.84%) in the rainy season. Upstream and downstream of the Sekalo River in the dry season *Mystacoleucus marginatus* 45 individuals (52.33%), in the rainy season *Barbonymus schwanenfeldii* and *Puntigrus tetrazona* each of 4 individuals (18.18%).

At Toman Peat Swamp dry season captured *Channa micropeltes* and *Channa striata* each one individual (50%), in rainy season only caught 5 individual *Channa micropeltes* (100%). While on the Elephant Peat Swamp in the

dry season caught 4 species, namely *Trichogaster leerii* 10 individuals (62.5%), *Channa striata* 3 individuals (18.75%), *Parachela hypothalamus* 2 individuals (6.25%) and *Puntigrus tetrazona* 1 individual (6.25%), Rainy season only caught *Trichogaster leerii* 56 individuals (100%).

At Batang Sumay River dry season highest species *Mystacoleucus marginatus* 21 individual (43.75%) and lowest in rainy season *Hemibagrus planiceps* and *Mystacoleucus marginatus* respectively 4 individuals (23.53%). On the Kemumu River dry season highest species *Barbodes binotatus* 5 individuals (20%) and in the rainy season *Mystacoleucus marginatus* 6 individuals (20.00%).

Overall, from 18 families collected in the buffer waters of Suo-Suo Resort of Bukit Tigapuluh National Park (Figure 3), the tribe of Cyprinidae is the highest with 33 species, followed by Bagridae with 7 species, Zenarchopteridae with 4 species, Aksyssidae, Channidae, Nemacheilidae with 3 species and other fish tribes each 1-2 species. This is in line with the results of [18] in Bukit Tigapuluh National Park on the SPTN Region II Siberida Riau Province that the Cyprinidae are the main inhabitants of these waters, followed by the Catfish. The Sukmono research in 2013 in the waters of the Hope Forest also obtained similar results, from 123 collected species, 59 species (48%) of which are Cyprinidae.

The large percentage of the Cyprinidae tribe in the common waters is not surprising anymore, as this tribe is well-known to dominate across the common waters of the world, except in Australia, Madagascar, New Zealand and South America [5]. The Cyprinidae tribe is also known to be the largest tribe inhabiting the common waters of Southeast Asia and the island of Sumatra, followed by Catfish species such as the Bagridae, Clariidae and Pangasidae [5].

In general, the number of species and family compositions collected in this study was lower than that of authors [18] that collected 97 species and 25 families of fish species in Bukit Tigapuluh National Park part SPTN Region II Siberida Riau Province, this is due to the type and character of different habitats or environmental conditions are different because geographically Siregar et al conduct research in the core region, while this observation only focuses on buffer zone Suo-Suo Resort SPTN Region I Tebo District Jambi Province.

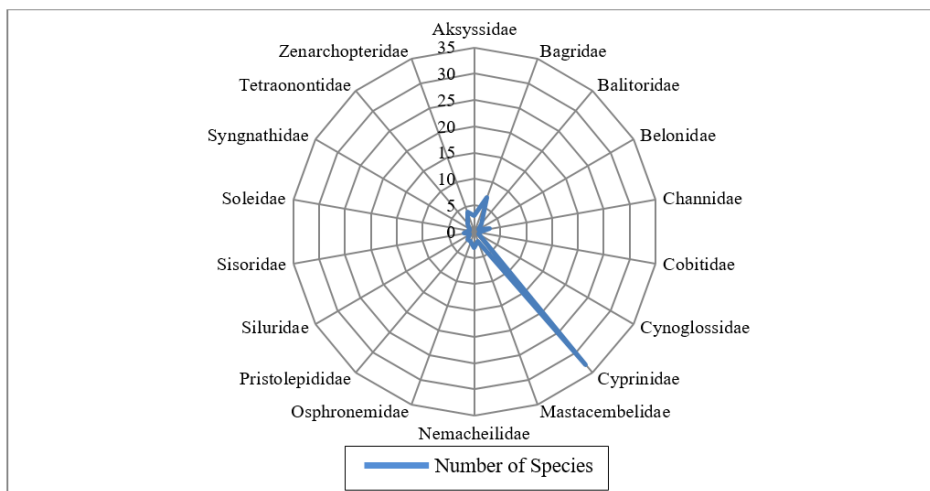


Figure 3: The composition of fish species by family and species in the buffer zone of Suo-Suo Resort of Bukit Tigapuluh National Park

Specifically, the number of individual compositions, species and families in the dry season is higher than in the rainy season, due to the high-water turbidity during the rainy season, which then correlates to the availability of habitats or niches for fish communities [4].

If we compare the data of fish species per season, the fish species that are not found in the dry season *Glyptothorax platypogon*, *Mystus nigriceps*, *Rasbora ennealepis*, *Rasbora ruttanii*, and *Xenentodon* sp, whereas species that are not found in the rainy season is *Achiroides leucorhynchus*, *Acrochordonichthys melanogaster*, *Acrochordonichthys* sp, *Anematicichthys repasson*, *Barbichthys leavis*, *Crossocheilus* sp, *Doryichthys martensii*, *Glyptothorax major*, *Hampala bimaculata*, *Labiobaebus kuhlii*, *Labocheilos falcifer*, *Macrognathus* sp, *Nemacheilus kapuasensis*, *Nemacheilus selangorivus*, *Nemacheilus spiniferus*, *Osteochilus hasseltii*, *Osteochilus microcephalus*, *Pao leiurus*, *Parachella hypothalamus*, *Pristolepis fasciata*, *Silurichthys phaisoma*, *Tor soro*, *Tor tamra*, *Zenarchopterus dispar*, and *Zenochepterus buffonis*.

Further species are found both in the dry season and the rainy season is *Acanthopsis dialuzona*, *Acrochordonichthys rugosus*, *Bagrichthys* sp, *Barbodes binotatus*, *Barbonymus schwanenfeldii*, *Channa lucius*, *Channa micropeltes*, *Channa striata*, *Cyclocheilichthys apogon*, *Cyclocheilichthys armatus*, *Cynoglossus waandersii*, *Epalzeorhynchus kalopterus*, *Hampala macrolepidota*, *Hemibagrus nemurus*, *Hemibagrus planiceps*, *Hemirhamphodon* sp, *Hemirhamphodon* tengah, *Homoleptera nebulosus*, *Homoleptera* sp, *Labiobarbus fasciatus*, *Labiobarbus festivus*, *Labocheilos bo*, *Leiocassis* sp, *Luciosoma setigerum*, *Macronagthus maculates*, *Mystacoleucus marginatus*, *Mystus micracanthus*, *Mystus* sp, *Osteochillus kapenii*, *Osteochilus waandersii*, *Oxygaster anomalura*, *Pao nigrovirdis*, *Parachela oxygastroides*, *Pristolepis grootii*, *Puntigrus tetrazona*, *Puntius lateristriga*, *Rasbora bankanensis*, *Rasbora dusonensis*, *Rasbora elegans*, and *Trichogaster leerii*.

3.3. Diversity Index (H'), Uniformity (E), and Domination (D)

The fish community structure of each station shows in Table 2. Based on Table 2, the values of diversity (H') range from 1.00 to 3.99. In the dry season the highest diversity index is located at Kemumu River station with a value of 3.99 and the lowest is Toman Peat Swamp station with a value of 1.00. In this case, although the Kemumu River is only a small river and not a minor stream, it has a high frequency of diversity index. This is allegedly due to the supply of a stream of minor that flows Toman Peat Swamp and the Elephant Peat Swamp with the middle of the actual Kemumu River flow. However, these waters are composed of fish smaller than other stations, as seen from the percentage of biomass and the type of fish caught.

Table 2 also shows that the Sekalo River has a diversity index ranging from 2.28 - 3.89, which means higher than Manggatal River which has a diversity index (H') ranging from 2.84 to 3.65. This is allegedly because the Sekalo River has minor rivers more than the Manggatal River, at least recorded there are three minor rivers located in the Sekalo River the Lubang Punai River located in the upper river Sekalo, Tengkalau River in the middle of the Sekalo River and the minor stream that runs through Toman Peat Swamp and the Elephant Peat Swamp. While the Manggatal River only recorded two minor streams are the Beringin River in the middle of the Manggatal River and Kemumu River which is located between the middle and lower Manggatal River.

Table 2: Diversity index (H'), uniformity (E), and dominance (D) of species level

Station	ΣN		ΣS		Index					
					(H')		(E)		(D)	
	K	H	K	H	K	H	K	H	K	H
HUM	119	29	26	10	3.64	2.83	0.77	0.85	0.13	0.20
TSM	35	45	17	16	3.65	3.48	0.89	0.87	0.10	0.13
HIM	27	31	9	6	2.84	1.86	0.90	0.72	0.16	0.37
HUS	220	122	28	24	3.69	3.99	0.77	0.87	0.14	0.08
TSS	168	29	31	11	3.89	2.99	0.79	0.86	0.11	0.17
HIS	86	22	14	10	2.28	3.15	0.60	0.95	0.33	0.12
BSY	48	17	5	8	1.65	2.75	0.71	0.92	0.37	0.17
SKM	25	30	19	13	3.99	3.38	0.94	0.91	0.08	0.12
RWT	2	5	2	1	1.00	-	1.00	-	0.50	-
RWG	16	56	4	1	1.50	-	0.75	-	0.45	-

K: Dry Season; H: Rainy Season

Furthermore, on the Batang Sumay River which is the estuary of the Manggatal River and Sekalo River has a lower index of diversity than the two main tributaries namely Manggatal River and Sekalo River. This is presumably because of the location of the waters in open space, causing the intensity of activities in these waters is higher and more complex, such as continuous over-fishing exploitation, water transport traffic and anthropogenic waste derived from bath wash toilet activities surrounding communities.

Toman Peat Swamp Station and the Elephant Peat Swamp are also experiencing the same thing and more extreme, these waters obtain the lowest frequency index indices from other stations. This is not only due to the waters that are also located in the open space, but also the shape and character of different habitats with river-type stations. The condition of Toman Peat Swamp waters and the fragmented Elephant Peat Swamp as described on the previous page makes these waters as isolated with low and limited fish community structures.

Furthermore, during the rainy season the diversity index ranges from 1.86 to 3.99, the highest frequency is on the Upper Sekalo River station with a value of 3.99 and the lowest is at the downstream station of Manggatal River with a value of 1.86, while the Toman Peat Swamp and Elephant Peat Swamp stations only obtain one species only.

If we compare the Manggatal River and Sekalo River, the Sekalo River diversity index in the rainy season is also higher than the Manggatal River. Only on the Manggatal River has a significant index decline, especially in the upstream and downstream. Likewise, with Sekalo River there is a decrease in index in the middle, but increased in the upstream and downstream. The variation in frequency of this diversity index is due to the increase of turbidity and water volume which is correlated with the increasing available habitat area. The same is true in the upstream waters of the Asahan River and its tributaries in Riau Province, that there is a temporal decline of fish communities during the rainy season [4].

The uniformity index (E) is used to describe the equity of the distribution of species composition within a fish community [19], the more evenly distributed the individual species among fishes the ecosystem balance will increase. From the results of the study, the uniformity index obtained in the range 0.95 - 0.60.

In the dry season the highest uniformity value is found at Toman Peat Swamp station with value 1.00 and the lowest is Sekalo River Downstream station with value 0.60. The high frequency of uniformity index at Toman Peat Swamp station is caused by the number of individual and captured frequencies that are caught and small, in other words Toman Peat Swamp waters are composed of low fish community structure. Likewise, on the Kemumu River station and Batang Sumay River station, these waters obtain a high uniformity index, but are composed of a diverse community of fish structures.

Furthermore, if we compare Manggatal River and Sekalo River, the uniformity index of Manggatal River that ranges from 0.77 to 0.90 is higher than the Sekalo River which ranges from 0.60 to 0.79. The tendency of the lowest frequency of uniformity lies in the downstream of the Sekalo River with a uniformity index of 0.60, indicating the presence of certain species that dominate the waters.

While in the rainy season the value of uniformity tends to be high and uniform, which ranges from 0.72 to 0.95. The highest uniformity index is located at Sekera River Downstream station with value 0.95 and lowest is at downstream station of River Manggatal with value 0.72. However, there are some stations that experience uniformity index cannot be expressed, that is at Toman Peat Swamp station and Elephant Peat Swamp, this is caused by extreme frequency of species abundance value obtained.

If we compare the index of uniformity and index of dominance, then there is a positive correlation that appears both spatially and temporally. In the dry season, the dominance index ranges from 0.08 - 0.50. The highest dominance index is located at Toman Peat Swamp station with value 0.50 and the lowest is Kemumu River station with value 0.08. In the rainy season, the uniformity index ranges from 0.08 - 0.37. The highest dominant frequency value is found at the downstream station of Manggatal River were 0.37 and the lowest is at the upstream station of the Sekalo River at 0.37.

Globally the majority of spatial-temporal dominant indices of both the Manggatal River and the Sekalo River are moderate, meaning that certain species predominate. So also on the Kemumu River station, Batang Sumay River, Toman Peat Swamp and Elephant Peat Swamp. The expression of dominance index in the frequency level of moderate dominance is characterized by the emergence of several species that have large proportions in abundance such as species *Mystacoleucus marginatus*, *Labiobarbus festivus*, *Barbonymus schwanenfeldii*, *Hampala macrolepidota*, *Epalzeorhyncos kalopterus* and *Puntius lateristriga*.

4. Conclusion

The results showed some physical and chemical properties of waters are still quite feasible in supporting the life of aquatic biota. The fish obtained during the study consisted of 18 families with the highest Cyprinidae family then followed by the Bagridae family. The total number of individual fish collected were 1132 individuals from 746 and 386 each catch in the dry and rainy season.

The temporal variation of the catch in the dry season was 65.9% greater than the rainy season of 34.1%, while the per-station was more fluctuating. In the dry season the highest diversity index is located at Kemumu station with a value of 3.99 and the lowest is Toman Peat Swamp station with a value of 1.00. Furthermore, during the rainy season the diversity index ranges from 1.86 to 3.99, the highest frequency is on the Upper Sekalo River

station with a value of 3.99 and the lowest is at the downstream station of Sungai Manggatal with a value of 1.86, while the Toman Peat Swamp and Elephant Peat Swamp stations only obtain one species only.

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