Biodiversity of fish resources in Sungsang Estuaries of South Sumatra

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Abstract. The purpose of this study was to assess the fish biodiversity of Sungsang estuaries in South Sumatra. The species diversity, evenness, dominance, degree of similarity, and composition of fish communities as well as some physicochemical conditions were analyzed in order to establish the baseline data inventory of Sungsang estuaries. The results show that all of the physico-chemical parameters were in good condition for fish sustainability. Forty-eight (48) species of fish belonging to 29 families of freshwater, brackish water and marine sources were encountered in the water bodies. *Johnius belangerii, Johnius amblycephalus* and *Setipinna taty* were species with a relatively high abundance, but the appearance frequency of these species was high, medium and low, respectively. The value of the Shannon's diversity index for fish resources was classified as moderate (H'=1.477-2.708). The index value of evenness was classified as high (J'= 0.616 – 0.876), while the index value of dominance was classified as low (D = 0.097 – 0.382). This result indicate that the species diversity was good enough, the species spread was evenly distributed, that there was a stable community structure and no domination.

Keywords: ecology, estuary, fish biodiversity

1. Introduction

Sungsang estuaries are a region between Musi River and Bangka Strait which has a very important role in providing many goods and services in support of the human economy and societal well-being. The estuaries have a complex productivity due to the wealth of nutrients and microorganisms as natural food [1]. The fish usually use this area as a nursery ground, spawning ground and feeding ground. These various functions make it an area of high diversity.

The people of Sungsang Estuaries utilize this estuaries area as fishing ground, housing, and transportation [2, 3]. In the period between 2009 and 2013, the number of fishing gear units operated by fisherman in Sungsang Village constantly increased from year to year [4]. The increase in fishing capacity induced by the fishing pressure on fish stocks is subsequently caused by over-exploitation and depletion of available fish stocks [5].

In addition to the increase in fishing activities, the increase in population waste, and increased transportation activities. Sungsang Estuaries can also be a pressure to the aquatic environment, especially fish resources. An interview with local fishermen revealed that at the beginning only adult fish were caught, but then the small fish were also caught. The management of river estuaries area was necessary to maintain the sustainability of fishery resources [6].

In order to support the conservation of fish resources in Sungsang Estuaries, appropriate data and information is required. One of which is a complete overview about the biodiversity of fish resources. The species abundance in estuaries area cannot be separated from the potential of ecosystems in providing space to reproduce, grow and as a food source [7]. The purpose of this study was to assess the biodiversity of fish resources in Sungsang Estuaries in South Sumatera.

2. Materials and Methods

The study was carried out in June 2015 in the area of Sungsang Estuaries of South Sumatra (figure 1).

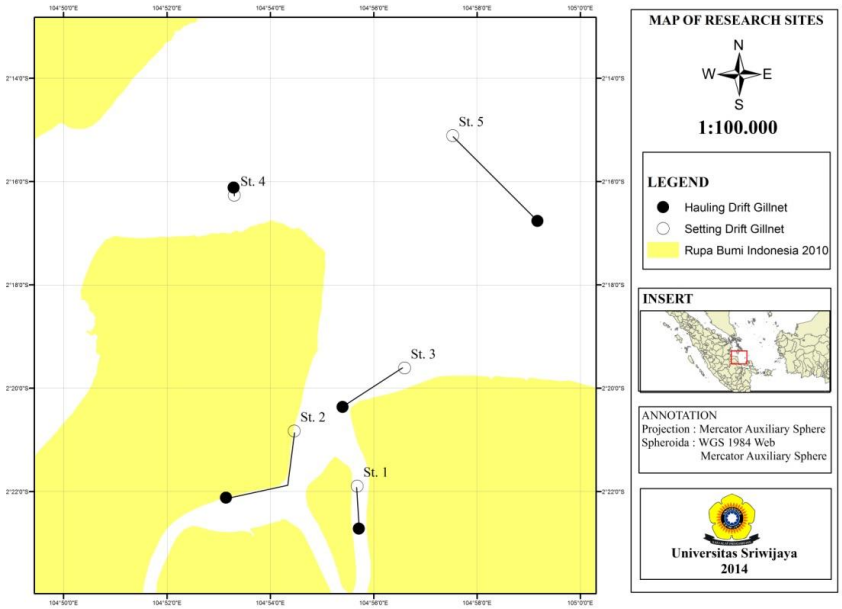

Figure 1. Location of the Sungsang Estuaries of South Sumatra and sampling sites.

Sampling stations were established based on characteristic of Sungsang Estuaries i.e. Station 1 in Payung Island set up as a mangrove ecosystem, Station 2 in Sungsang Waters as a settlement, Station 3 in Tanjung Buyut as transportation lines, Station 4 in Tanjung Carat as fishing ground in estuaries and Station 5 in Stationary Lift nets as a fishing ground in sea.

Hydro oceanography factors were measured at each station (temperature, salinity, DO, pH and turbidity, current velocity, phosphate, nitrate). Three replicates were recorded from each sampling station. Fish samples were taken using a drift gillnet (the length was 200 m and the width was 5 m with a mesh size of 2 and 3) for ±12 hours from morning to evening at each station. Fish samples were analyzed for species composition i.e. relative abundance (RA) and appearance frequency (AF) in accordance to [7,8], Shannon's diversity index (H') in accordance to [9, 10], Evenness index (J') in accordance to [9, 11, 12], Dominance index (D) in accordance to [13-15], and degree of Similarity between the communities in the different water bodies (Cs) in accordance to [9, 12, 16].

3. Result and Discussion

3.1. Physico-chemical parameters

The physical parameters in these waters show various value with the average brightness of the waters of around 7.5-120 cm, the water temperature of around 26-30°C, the current velocity of around 0.17-0.52 m/s. So do the chemical parameters of the waters, with an average salinity of around 2.7-307 ‰, DO of around 5-11.8 mg L^{-1}, pH of around 7.5-8.0, phosphate of around < 0.002-0.004 mg L^{-1}, and nitrate of around 0.07-0.55 mg L^{-1} (table 1). So, away from the beach, the closer to the sea, the higher the brightness value, DO, and salinity become. In contrast, the nitrate parameter indicated that the station adjacent to the sea contained a low nitrate. A high nitrate concentration was found in the station adjacent to the river and land. The higher nitrate concentration was found in Station 2 (the waters closer to the settlement area).

Table 1. The physico-chemical water quality parameters.

Water parameters	Station				
	1	2	3	4	5
Physic					
Brightness (cm)	35±0	20±0	7.5±0	27.5±0	120±0
Temperature (°C)	29.9±0.2	26±4.4	30±0	27.5±0.4	29.±0.3
current velocity (ms^{-1})	0.21±0.03	0.52±0.03	0.17±0.01	0.31±0.04	0.33±0.05
Chemical					
DO (mg L^{-1})	5±1.4	5.9±0.9	9.7±0.7	7.6±1	11.8±4.4
Salinity (‰)	2.7±0.6	7±0	21±0	25±0	30.7±0.6
pH	7.5±0	8±0	7.5±0	8±0	8±0
Phosphate (mg L^{-1})	< 0.002	0.004	0.003	< 0.002	< 0.002
Nitrate (mg L^{-1})	0.26	0.55	0.42	0.09	0.07

Based on KepMenLH No. 51 Year 2004 and PerGub SumSel No. 16 Year 2005, the physico-chemical water quality parameters in the Sungsang estuaries are below the water quality standard, so it is safe for the sustainability of fish.

Moving away from the beach, the value of some parameters (brightness, DO and salinity) increased. These results are consistent with the research of [17], as the estuarine waters of Sungsang at high tide and low tide heading towards the sea showed greater salinity values. This indicates that the physico-chemical water conditions in the estuaries are affected by the input of river water and seawater. The distribution of salinity has close links with the hydrodynamic elements, namely tidal [3]. On the condition of the tide, the influence of the seawater is not too far into the river. Whereas during low tide conditions, river water moves far out into the sea, and simultaneously affect the distribution of salinity in waters with currents that carry two different types of water masses.

The value of phosphates and nitrates are higher in the waters adjacent to settlements. This phenomenon may be caused by the domestic waste system into the estuarine waters of Sungsang. The phosphates can be a limiting factor, and the high concentrations recorded in the estuaries interior and at the inlet may be caused by large quantities of domestic detergents dumped into the system via urban drainage systems [18]. Another significant source of phosphates may be chemical fertilizer used on commercial crops in the region. The availability of essential nutrients (nitrate, ammonium, phosphate and silicates) in the bay waters is influenced by river system, photosynthetic activity and absorption and sedimentation by suspended particles [19].

The higher the nitrate the higher the (chlorophyll-a) phytoplankton. It is also explained that in addition to nitrate, pH also affects the chlorophyll-a [20]. The study showed that the level of nitrates and pH in the waters is affected by the photosynthetic activity of phytoplankton. Nitrate is one form of organic material needed in the process of photosynthesis. Nitrate is one type of macro nutrients that plays a role in the process of phytoplankton growth [21]. Photosynthesis is how a plant makes food. Without nitrates, photosynthesis cannot occur, and the plant will die from a lack of food. Therefore,

the optimal concentration of nitrate in the fishing ground (station 4 and 5) is expected to trigger high photosynthetic activity in these waters. The high photosynthesis activity of phytoplankton affects the high value of DO (the highest DO was in Station 5). DO fluctuations in Sungsang Estuaries, other than as a result of photosynthetic activity, may be due to the dynamics caused by wind and shallow waters. In addition to nitrate, sunlight is an important aspect of photosynthesis. The higher the sun is absorbed into the waters (High brightness values), the greater the chances of solar light energy utilized in the process of photosynthesis. These results are indicated by the highest value of brightness and DO which occurred in station 5, probably due to the high photosynthetic activity in the area. So far away from the beach, the DO level gets higher caused by the open area and diffuses oxygen into water more easily [17]. High turbidity in estuaries is caused by the input of suspended solids through the estuarine river system, which affects the decrease of turbidity level and the abundance of phytoplankton in bay waters [19]. High abundance of plankton indicates high marine productivity. The higher the brightness, the higher the primary productivity of waters [21]. The most important factors [22] that can describe most of the changes in the abundance and diversity of phytoplankton in the Mond River estuaries system are NO_3, PO_4, pH, salinity and temperature, respectively. This increases primary production and is consequently an important factor in determining fish abundance and biomass [16].

This research shows that the further away from the mainland, the higher the pH value tends to be. These results are consistent with the results of [17], the more it gets away from mainland then the pH will be more alkaline caused by the increasing number of carbonate ions in water. The concentration of pH in waters is a limiting factor for the life aquatic of organisms, because aquatic organisms can live in a body of water that has a pH value with a certain tolerance range. The ideal pH value for the life of aquatic organisms in general ranges from 7 to 8.5 [23]. The pH value determines the dominance of phytoplankton. The pH value of water has a considerable influence on aquatic organisms so it is often used as an instruction to declare the merits of a body of water [12]. The fluctuations of pH value are influenced by fluctuations of O_2, CO_2, and the alkalinity of waters. The higher the concentration of CO_2, the lower the pH of water. The CO_2 concentration is also determined by the balance between photosynthesis and respiration. Photosynthesis is a process that absorbs CO_2, thus increasing the pH of the water. While respiration produces CO_2 into the ecosystem, so that the pH of the water decreases, CO_2 in aquatic ecosystems is generated through the process of respiration by all organisms and the reform process of organic and inorganic materials by bacteria. While alkalinity shows the ability of water to neutralize the presence of a strong acid or when the pH decreases. The salinity in Sungsang Estuaries is higher closer to the sea. This is due to the influence of fresh waters (low salinity) when getting less towards to the sea. The salinity appears to be a major factor in influencing the abundance and diversity of fin and shell species in the estuaries [24].

3.2. Fish species composition in Sungsang Estuaries

The results of the observations in five research stations in the water of Sungsang Estuaries were collected from as many as 657 individuals and identified as 48 species from 29 families of fish (table 2). Most species of fish coming from family Engraulidae (5 species), then the family Sciaenidae and Carangidae with each amount of 4 species.

Based on habitat, the fish species composition found consists of brackish species (33 species), marine species (10 species) and the rest (5 species) were freshwater species. The relative abundance ranged between 0.152% - 26.332% where the species *Johnius amblycephalus* from family Sciaenidae had the higher relative abundance, and then the *Thryssa kammalensis* (family Engraulidae) and *Johnius trachycephalus* (Sciaenidae) each had relative abundance values of 18.113% and 9.741%. *J. trachycephalus* was the fish with high relative abundance and found in almost every station (except station 2 which was located near the settlement) with the frequency of appearance of 80% (figure 1).

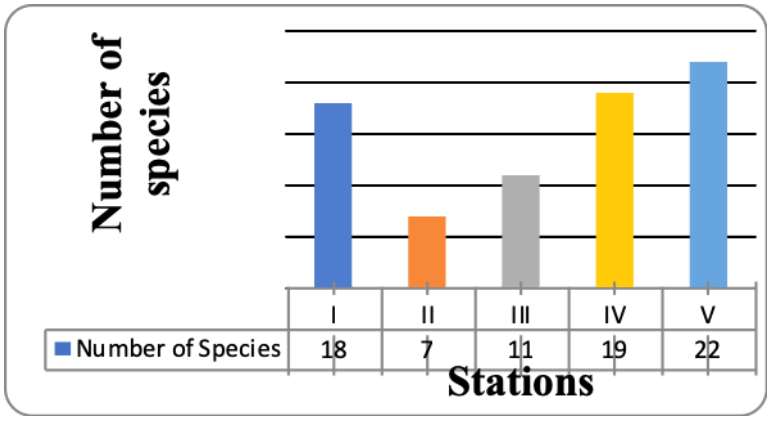

Figure 2 the most species found in the fishing ground around stationary lift net (station 5) was 22 species then in the fishing ground around estuaries (station 4) and in the waters around mangrove (station 1). By contrast, the waters around the settlement (station 2) and in the ship transportation lines (station 3), fewer species were found as many as 7 species and 11 species.

The waters around the mangrove ecosystem (station 1) are dominated by species from the family Aridae and Sciaenidae (each of the 3 species), then the family Polynemidae and Engraulidae (each of the 2 species). The most common species caught in this area was *Johnius amblycephalus* with 69 individuals. The waters around the settlement (station 2) are dominated by species from the family Engraulidae (2 species). When it was compared with other species found in this area, most commonly found was *Coilia lindmani* (8 individuals). The ship transportation lines (station 3) are dominated by species from the family Engraulidae (4 species) and Sciaenidae (4 species). *T. kammalensis* from family Engraulidae was the most commonly found as many as 108 individuals.

The most common species found around the fishing ground near the early point of Sungsang Estuaries (Station 4) was the species from family Sciaenidae (3 species) and family Engraulidae (3 species). The most common species caught in this area was *J. amblycephalusn* (103 individuals). The species from family Carangidae were most commonly found in fishing grounds around the stationary lift net (Station 5) consisting of 4 species. Species *Stolephorus dubiosus* from the family Clupeidae was the most commonly found (13 individuals), when compared to other species found in the area.

The number of fish species found in Sungsang Estuaries (48 species) is lower when compared to other estuary areas, such as: Segara Anakan Estuaries which amounts to 87 species [7], the Teluk Kendari Estuaries had 76 species [25] and Mayangan Estuaries had 77 species [26]. Otherwise, in Pahang Estuaries only 24 species were found [27], and Sepang Besar Estuaries only 29 species were found [28].

In estuarine waters of Sungsang, the fish community consisting of freshwater, brackish and marine species. These results are consistent with the research in Segara Anakan Estuaries [7] which found four categories of species, there were: 1) invasive species (migrant) from the sea dominated by Balystidae, Carangidae, Leiognathidae, Lutjanidae, and Mugillidae; 2) Genuine estuaries species (fish species with a complete life cycle occurs in estuaries), including some species from Family Ambassidae, Clupeidae, Engraulidae, Gobiidae; 3) invasive species from freshwater including family Cichlidae and Opichthidae; and 4) Anadromus species represented by *Anguila bicolor* from family Angulidae.

Table 2. Fish species composition, relative abundance (RA) and frequency of appearance (FA) at each sampling location in Sungsang Estuaries of South Sumatera.

No	Family	Species		Environment*)			Station					Number of individuals	FA (%)	RA (%)
		Local Name	Scientific Name*)	Fresh	Brackish	Marine	1	2	3	4	5			
1	Bagridae	Lundu	*Mystus gulio*	Yes	Yes	No	1	1	-	-	-	2	0.304 L	40 L
2	Engraulidae	Bilis Bulu ayam	*Coilia lindmani*	Yes	Yes	No	2	8	1	-	-	11	1.674 L	60 M
3	Pangasidae	Patin	*Pangasius pangasius*	Yes	Yes	No	9	-	-	-	-	9	1.370 L	20 L
4	Cyprinidae	Lumajang	*Cyclocheilichthys enoplos*	Yes	No	No	5	3	12	-	-	20	3.044 M	60 M
5	Datnioididae	Elang	*Datnioides microlepis*	Yes	No	No	1	-	-	-	-	1	0.152 L	20 L
1	Ariidae	Dukang	*Nemapteryx caelata*	No	Yes	Yes	1	-	-	-	-	1	0.152 L	20
2	Carangidae	Selar Papan	*Alepes vari*	No	Yes	Yes	-	-	-	-	1	1	0.152 L	20 L
3	Carangidae	Talang-talang	*Scomberoides commersonnianus*	No	Yes	Yes	-	-	-	-	5	5	0.761 L	20 L
4	Clupeidae	Bilis teri	*Stolephorus dubiosus*	No	Yes	Yes	-	-	-	1	13	14	2.131 L	40 L
5	Clupeidae	Tamban sisik	*Sardinella fimbriata*	No	Yes	Yes	-	-	-	-	1	1	0.152 L	20 L
6	Drepaneidae	Daun baharu	*Drepane longimana*	No	Yes	Yes	-	-	-	2	-	2	0.304 L	20 L
7	Engraulidae	Teri	*Setipinna taty*	No	Yes	Yes	-	-	-	-	1	1	0.152 L	20 L
8	Engraulidae	Teri	*Thryssa kammalensis*	No	Yes	Yes	-	-	108	11	-	119	18.113 H	40 L
9	Engraulidae	teri Putih	*Stolephorus indicus*	No	Yes	Yes	-	1	17	6	1	25	3.805 M	80 H
10	Latidae	Bebaji/kakap laut	*Psammoperca waigiensis*	No	Yes	Yes	3	-	-	17	-	20	3.044 M	40 L
11	Leiognathidae	Pepetek	*Eubleekeria splendens*	No	Yes	Yes	-	-	-	-	1	1	0.152 L	20 L
12	Muraenesocidae	Belut	*Congresox talabon*	No	Yes	Yes	-	-	4		-	4	0.609 L	20
13	Paralichthyidae	ikan Sebelah	*Pseudorhombus arsius*	No	Yes	Yes	-	-	-	-	3	3	0.457 L	20 L
14	Polynemidae	Cawang	*Leptomelanosoma indicum*	No	Yes	Yes	-	-	-	3	1	4	0.609	40 L
15	Sciaenidae	Gulamo	*Johnius belangerii*	No	Yes	Yes	14	-	13	28	9	64	9.741 H	80 H
16	Sciaenidae	Gulama tigawaja	*Panna microdon*	No	Yes	Yes	-	-	3	1	5	9	1.370 L	60 M
17	Stromateidae	Bawal	*Pampus chinensis*	No	Yes	Yes	-	-	-	6	-	6	0.913 L	20 L
1	Ambassidae	Seriding	*Ambassis nalua*	Yes	Yes	Yes	1	-	-	-	-	1	0.152 L	20 L
2	Ariidae	Manyung	*Netuma thalassina*	Yes	Yes	Yes	5	2	-	-	-	7	1.065 L	40 L
3	Ariidae	Duri dukang	*Osteogeneiosus militaris*	Yes	Yes	Yes	4	-	-	-	-	4	0.609 L	20 L
4	Chanidae	Bandeng	*Chanos chanos*	Yes	Yes	Yes	-	-	-	2	-	2	0.304 L	20 L
5	Clupeidae	Selangat	*Anodontostoma chacunda*	Yes	Yes	Yes	1	-	-	-	-	1	0.152 L	20 L
6	Cynoglossidae	Lidah	*Cynoglossus lingua*	Yes	Yes	Yes	-	-	8	19	3	30	4.566 M	60 M
7	Engraulidae	Pirang	*Setipinna melanochir*	Yes	Yes	Yes	19	-	12	2	-	33	5.023 M	60 M
8	Hemiscylliidae	Hiu punai	*Chiloscyllium indicum*	Yes	Yes	Yes	-	-	-	-	3	3	0.457 L	20 L
9	Latidae	Kakap	*Lates calcarifer*	Yes	Yes	Yes	-	-	-	1	-	1	0.152 L	20 L
10	Mugilidae	Belanak	*Planiliza subviridis*	Yes	Yes	Yes	-	-	-	1	-	1	0.152 L	20 L
11	Plotosidae	Sembilang	*Plotosus canius*	Yes	Yes	Yes	2	-	-	2	-	4	0.609 L	40 L
12	Polynemidae	Senangin	*Eleutheronema tetradactylum*	Yes	Yes	Yes	1	-	-	-	-	1	0.152 L	20 L
13	Polynemidae	Kurau	*Polynemus dubius*	Yes	Yes	Yes	3	-	-	2	-	5	0.761 L	40 L
14	Scatophagiadae	Kiper	*Scatophagus argus*	Yes	Yes	Yes	-	1	-	7	-	8	1.218 L	40 L
15	Sciaenidae	Gulama	*Johnius trachycephalus*	Yes	Yes	Yes	25	3	2	-	-	30	4.566 M	60 M
16	Sciaenidae	Gulama janggut	*Johnius amblycephalus*	Yes	Yes	Yes	69	-	1	103	-	173	26.332 H	60 M
1	Carangidae	Cupak	*Carangoides malabaricus*	No	No	Yes	-	-	-	-	2	2	0.304 L	20 L
2	Carangidae	Selar Bulat	*Caranx djedaba*	No	No	Yes	-	-	-	-	2	2	0.304 L	20 L
3	Chirocentridae	Parang-parang	*Chirocentrus nudus*	No	No	Yes	-	-	-	-	1	1	0.152 L	20 L
4	Dasyatidae	Pari	*Hemitrygon laevigata*	No	No	Yes	-	-	-	1	-	1	0.152 L	20 L
5	Leiognathidae	Pepetek	*Eubleekeria jonesi*	No	No	Yes	-	-	-	-	12	12	1.826 L	20 L
6	Psettodidae	Mata sebelah	*Psettodes erumei*	No	No	Yes	-	-	-	-	2	2	0.304 L	20 L
7	Scombridae	Tongkol	*Euthynnus affinis*	No	No	Yes	-	-	-	-	1	1	0.152 L	20 L
8	Scombridae	Tenggiri papan	*Scomberomorus lineolatus*	No	No	Yes	-	-	-	-	3	3	0.457 L	20 L
9	Synodontidae	Conor	*Saurida tumbil*	No	No	Yes	-	-	-	-	4	4	0.609 L	20 L
10	Triacanthidae	Tunjang Langit	*Triacanthus nieuhofii*	No	No	Yes	-	-	-	-	2	2	0.304 L	20 L

Notes: H: High; M: Moderate; L: Low; *): According to www.fishbase.org

Table 3. Species characteristics based on relative abundance (RA) and appearance frequency (FA).

Relative abundance (RA)	Appearance Frequency (AF)		
	High (AF > 71.42)	Moderate (42.86 < AF < 71.43)	Low (AF < 42.86)
High (RA > 5.686%)	*J. belangerii*	*J. amblycephalus*	*S. taty*
Moderate (2.845 < RA < 5.686)	*S. indicus,*	*C. enoplos, J. trachycephalus, T. kammalensis, C. lingua,*	*P. waigiensis,*
Low (RA < 2.845)		*P. microdon, C. lindmani*	*M. gulio, D. microlepis, P. pangasius, P. dubius, L. indicum, E. tetradactylum, A. nalua, N. caelata, N. thalassina, O. militaris, P. subviridis, C. talabon, P. canius, S. argus, C. chanos, C. malabaricus C. djedaba, A. vari, S. commersonnianus, C. nudus, A. chacunda, S. fimbriata, S. dubiosus, H. laevigata, D. longimana, S. melanochir, C. indicum, L. calcarifer, E. jonesi, E. splendens, P. arsius, P. erumei, E. affinis, S. lineolatus, P. chinensis, S. tumbil, T. nieuhofii*

The appearance frequency and relative abundance for 48 species found in Sungsang Estuaries varies from low to high. Most of its relative abundance is included in the low category (table 2). table 3 shows that *Johnius belangerii* had a high value of relative abundance as well as value of appearance frequency. *J. amblycephalus* had a high value of relative abundance but a moderate value of appearance frequency. *Setipinna taty* had a high value of relative abundance and conversely a low value of appearance frequency. *Stolephorus indicus* had a moderate value of relative abundance and a high value of appearance frequency. *Psammoperca waigiensis* had a moderate value of relative abundance but a low value of appearance frequency. *Cyclocheilichthys enoplos*, *Johnius trachycephalus*, *T. kammalensis*, and *Cynoglossus lingua* had a moderate value for relative abundance and appearance frequency. Whereas *Panna microdon* and *C. lindmani* have a low value for relative abundance but a moderate value for appearance frequency.

Variations in relative abundance of each species are likely due to the differences in species response (tolerance level) to the physico-chemical conditions of the waters. In addition, the physico-chemical conditions of the water also affect primary productivity [24] and primary productivity affects the abundance of fish [18] in estuarine waters.

3.3. Fish biodiversity

The value of diversity index of fish in the 5 stations was around 1.477 – 2.708 (moderate category), the value of evenness index was around 0.616 – 0.876 (High), dominance index was around 0.097 – 0.382 (low), and species similarity index was around 5% - 66.67% (not similar to similar). The value of diversity index (H') and the highest evenness index was found in the fishing ground around stationary lift net (station 4) and the lowest was in around the ship transportation lines (station 3). Instead, the value of the highest dominance index was located in the ship transportation lines (Station

3) and the lowest was in fishing ground stationary lift net (station 5). At the same time, the species found in the waters of the settlement (station 2) and in the ship transportation lines (station 3) had the highest similarity degree that showed with the value of similarity degree index 66.67%. By contrast, between species that were around the mangrove ecosystem (station 1) and species that were in fishing ground around stationary lift net (station 5) had the lowest similarity degree. Based on the criteria by [11], almost all of fish species between one station to another had no similarity (except between Station 2 and Station 3) which was indicated by the similarity index value greater than 50% (table 4).

Table 4. Diversity index analysis (H'), evenness index (J'), and dominance index (D) in Sungsang Estuaries of South Sumatera.

Station	Diversity (H')		Evenness (J')		Dominance (D)	
	Value	Category	Value	Category	Value	Category
1	2.002	Moderate	0.693	High	0.222	Low
2	1.649	Moderate	0.847	High	0.247	Low
3	1.477	Moderate	0.616	High	0.382	Low
4	1.898	Moderate	0.645	High	0.267	Low
5	2.708	Moderate	0.876	High	0.090	Low

Note: High ($H' > 3$; $J' \geq 0.6$; $D > 0.7$); Moderate ($1 < H' \leq 3$; $0.4 < J' < 0.6$; $0.5 < D \leq 0.7$); low ($H' < 1$; $J' \leq 0.4$; $D \leq 0.5$).

Species diversity is a useful parameter for the comparison of communities under the influence of biotic disturbances or to know the state of succession and stability in the community [29]. Species diversity in Sungsang Estuaries varied in every observation station and all of diversity index value included in medium category. Station 5, which was located in fishing grounds around stationary lift net had the highest diversity index than other station. This was indicated by the existence of brackish fish species (9 species) which were also found in station 5. It means that the brackish fish species are still able to tolerate the salinity in station 5 which reached 30.7‰. Furthermore, station 5 was an area of fishing grounds likely to have a suitable condition for marine fish as well as brackish fish.

The H' value varied in every station because of the effect of variations in the number of species caught at each station and the number of individual fish per species. Variations in the number of individuals and the species were allegedly closely associated with factors that affect the stability of the community was the ability of a community structure to be unaffected by the disruption of its components, such as physico-chemical factors of the waters [18, 24] and biological factors. Physicochemical factors such as tidal water, temperature, current speed, salinity, nutrients, and substrate conditions. Whereas the biological factors usually associated with adaptation patterns, predator, distribution or fixed pattern of habitat. Fluctuations in temperature and salinity in the waters of the estuaries can be a pressure for estuarine organisms, as a result these organisms perform morphological and physiological adaptations in order to survive and colonize the estuaries area.

The relative species abundance in a community is another factor that affects diversity [29]. A community is deemed to have a high species diversity when there are many species which have the amount of each individual that is evenly distributed and vice versa the low diversity is when there is fewer species and the individuals are not evenly distributed [30]. A community, although many of its kind, but when the spread is uneven then biodiversity is undervalued [12]. Factors that affect the diversity are time, space heterogeneity, competition, predation and productivity [31].

In contrast to the diversity index (H'), evenness index (J') in each station is considered to be high category. It means that, species and number of individuals of each species are evenly distributed, the communities are stable and a there is a high degree of balance in the community [15, 25, 31]. The number of individuals of each species which is evenly distributed also shows no inclination of species dominance. This is also reinforced by the low value of domination index in each station. The results are similar with the results in estuarine waters of Sembilang National Park of South Sumatera [32] and Banyuasin Coastal Waters [33].

Dominance index (D) indicates the presence or absence of the species that dominate other species. The calculations show that the index value of dominance (D) on the entire stations were considered as low category. It means that species located in each station are not dominated and the community structure is in a stable state. The intensity of the index of dominance was because of the number of individuals of each species varies. The number of individuals of each species varies depending on the level of adaptation and tolerance of each species to environmental conditions or habitat.

Dominance index value is inversely proportional to the value of evenness, which means that if the Dominance index is low than the evenness index is high, and vice versa. The lowest dominance value and the highest evenness value in Station 5 indicate that the fish community structure in Station 5 is the most stable compared to the other stations. It means that, the ability of the fish community structure in Station 5 is better in dealing with disturbances from its component (physicochemical factors and biological factors).

Based on the similarity index (Cs) in table 5 shows that there was only fish species in the waters around the settlements (station 2) and around the ships transportation lines (station 3) had in common and the similarity index value was the highest (66%). Whereas fish species in the waters around the mangrove ecosystem (station 1) and species in fishing ground around stationary lift net had the lowest similarity level of species and included in the non-similar category (Cs = 5%). Species dissimilarities between Station1 and Station 5 may be due to differences in the DO and salinity (table 1) which was very striking between the two. DO and salinity differences are likely to influence the species and density of fish species in these two communities.

Table 5. Similarity index (C_s) of Fish in Sungsang Estuaries of South Sumatera.

Station	1	2	3	4	5
1	-	8.00 N)	41.38 N)	32.43 N)	5.00 N)
2	-	-	66.67 S)	46.15 N)	6.90 N)
3	-	-	-	40.00 N)	6.06 N)
4	-	-	-	-	10.53 N)
5	-	-	-	-	-

Notes: S: similar (Cs > 50); N: not similar (Cs ≤ 50).

4. Conclusion

The number of fish found in Sungsang Estuaries was 48 species from 29 family dominated. The species that had a high value of relative abundance were *J. belangerii*, *J. amblycephalus* and *S. taty*, but the appearance frequency of these species was high, medium and low respectively. Fish biodiversity in Sungsang Estuaries has a moderate species diversity (H' = 1.477 – 2.708), the number of individuals or species evenly distributed (J'= 0.616 – 0.876) and there is no dominant species with a stable community structure (D = 0.097 - 0.82). Almost all species between the observation locations bear no resemblance to each other except between species in the waters around settlements and the ship transportation lines.

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