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Diversity of Fish Larvae around the Estuary of the Banyuasin River, South Sumatra Province

Moh. Rasyid Ridho[1]*, Enggar Patriono[1], Sarno[1], Sahira Wirda[1]

[1]*Department of Biology, Faculty of Mathematics and Natural Sciences, Sriwijaya University*

*Corresponding author

E-mail address: moh.rasyidridho@mipa.unsri.ac.id
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Abstract :

The initial phase of the fish life cycle is a critical phase associated with high mortality due to sensitivity to predators, food availability, and also environmental changes that occur in nature. Disruption of the initial stages of fish life has a negative impact on fish populations. Until now there has been no information about fish larvae around the Banyuasin River Estuary. Therefore, research is needed on the diversity of fish larvae around the Banyuasin River Estuary, South Sumatra Province. This research were used purposive sampling method, sampling technique in the form of Cruise Track Design with continuous parallel survey trajectory. Based on the results of the study found as many as 10 families consisting of 1483 individuals of fish larvae in March and 1013 individuals of fish larvae in May consisting of Engraulidae 1,601 individuals of fish larvae, Mugilidei as many as 109 individuals, Leiognathidae 50 individuals, Chanidae 453 individuals, Scatophagidae 20 individuals, Belonidae 39 individuals, Gobioididae 5 individuals, Chandidae 183 individuals, Syngnathidae 6 individuals, and Gobiidae 30 individuals fish larvae. The index value of fish larvae diversity is classified as medium category (March 1.02 and May 1.12), Morisita index shows the distribution pattern of fish larvae classified as a group (March 0-14.17 and May 2.43-10.40), and the evenness index value is in the medium category (March 0.437 and May 0.521).

Keywords: River Estuary, Diversity, Fish Larvae.

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1. Introduction

The coastal area of East Coastal, South Sumatra, which is located in the Banyuasin District, is a part of the mouth river area. Communities in the mouth of Banyuasin River estuary mostly use this area as a place to find fish for sale or self-consumption, but fish resources are highly dependent on fish larvae resources.

Disruption of the initial stages of fish life has a negative impact on fish populations. If at the larval stage there is an excessive shortage, it will then have an impact on reducing adult fish stocks.

According to [1] the development of fish from the larval stage to juvenile has ecological consequences so that there is a critical relationship to survival and growth. The most important ecological consequences that are influential include those relating to food and predation (food and feeding), predator detection and escape and habitat shift which in turn will greatly affect the recruitment of fish stocks in a waters.

The existence of a planned reclamation [17] activity in the mouth of Banyuasin River allows environmental impacts, in the form of a decrease in water quality. In addition, community activities such as settlements, industries, and tourist areas also result in changes in water quality which in turn will negatively affect the existence of fish larvae. Research conducted by [18] in the mouth of the Musi River, the coast of Banyuasin regency was found as many as 438 individual fish with 32 species belonging to 28 families. However, until now there is no information about fish larvae around the mouth of Banyuasin River. So, further research needs to be done on the diversity of fish larvae that exist around the mouth of Banyuasin River, South Sumatra Province.

2. Materials and Methods

This research was conducted in March and May 2019 in mouth of Banyuasin River, South Sumatra Province.

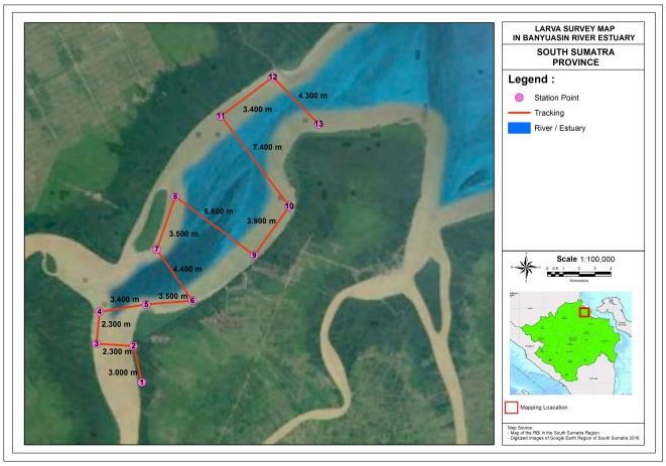

Figure 1. Map of research site.

This research were used purposive sampling method while the sampling technique used is Cruise Track Design in the form of sampling technique based on cruise with design, then in the form of continuous parallel survey trajectory (continuously) [10], and each station track is done one pull by using Larva Net up to the 12th station track channel using the swept area method, and from the data the number and types of fish larvae obtained and the data are processed using diversity index and distribution patterns.

Fish Larva Identification

Samples taken around the mouth of the Banyuasin River, South Sumatra Province were identified at the Biosystematics Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences. Identification of fish larvae samples was done using a microscope and given a lugol solution so that fish larvae can be clearly identified at the time of observation. Fish larvae identification also uses identification books which were Field Guide to Lombok Island (Identification Guide to Marine Organisms in Seagrass Beds of Lombok Island, Indonesia by [12]; Fresh Water Fish of Western Indonesia and Sulawesi by [8]; An Atlas of the Early Stage Fishes In Japan by [15]; A guide to the eggs and larvae of 100 common Western Mediterranean Sea bony fish species [20]; Ichthyoplankton by [24]; and [15] as fish larvae identification tools.

Fish Larvae Distribution

Distribution patterns of fish larvae in this study were determined using the Morisita Index (Iδ). This index is not influenced by the sampling station area and is very good for comparing population distribution patterns. The formula used is as follows:

$$I\delta = n(\sum Xi^2 - Ni)/(Ni\,(Ni-1))$$

Where:
Iδ = distribution of Morisita Index
Ni = total individu in n
n = total station
$\sum Xi^2$ = The square of the number of speciesi larvae per station for a total of n stations.

Morisita index results obtained are grouped as follows:
Iδ<1: Individual distribution patterns tend to be random.
Iδ = 1: Individual distribution patterns are evenly distributed.
Iδ> 1: Individual distribution patterns tend to be in groups.

Diversity Index (*H'*)

The diversity index calculation is based on [3], using the Shannon-Wiener index as follows:

$$H' = -\sum_{n}^{i=1} pi \ln pi$$

Where:
H'= Diversity Index Shannon-Wiener.

$$pi = \frac{n_i}{N}$$

pi = Comparison of inumber of individuals with total number of individuals (ni / N)
n_i = Number of i individual taxa
N = Number of individuals of all taxa in a community
If value:
H '<1: Low diversity
H '1-3: Medium diversity
H '> 3: High diversity

Evenness Index (E)

Evenness Index (E) is a good estimate to determine dominance in an area. According to [14] analyzing the evenness index can be calculated using the following formula:

$$E = \frac{H'}{H\,maks}$$

Where:
E = Index evenness
H '= Shannon-Wiener diversity index
S = Number of fish larvae (number of species) in the community

H'maks = Maximum Diversity Index
= ln S,

3. Results and Discussion

Based on the results of the research, the composition and number of fish larvae caught in March and May 2019 are shown in Table 1 and Table 2.

Tabel 1. Composition and number of fish larvae caught for each sampling (March 2019)

No	Family	Sampling Location												Total	Average	Persentage (%)
		1	2	3	4	5	6	7	8	9	10	11	12			
1.	Engraulidae	0	0	0	15	250	0	45	67	232	201	155	12	977	81.41	65.88
2.	Mugilidae	0	0	0	2	4	8	8	3	24	16	24	9	98	8.16	6.6
3.	Leiognathidae	0	0	0	2	19	0	0	0	0	0	0	0	21	1.75	1.41
4.	Chanidae	0	0	0	68	4	7	0	29	48	0	57	119	332	27.66	22.4
5.	Scatophagidae	0	0	0	2	0	0	0	0	0	1	0	0	3	0.25	0.2
6.	Belonidae	0	0	0	0	3	2	0	1	0	8	0	0	14	1.16	0.93
7.	Gobioididae	0	0	0	0	0	1	0	0	0	0	0	0	1	0.08	0.06
8.	Chandidae	0	0	0	0	1	1	0	0	0	8	0	0	9	0.75	0.6
9.	Syngnathidae	0	0	0	0	0	0	0	0	2	0	1	0	3	0.25	0.2
10.	Gobiidae	0	0	0	0	0	0	0	0	3	0	3	19	25	2.08	1.7
	Total	0	0	0	89	280	19	53	100	309	234	240	158	1483	123.47	100

Tabel 2. Composition and number of fish larvae caught for each sampling (May 2019)

No	Family	Sampling Location												Total	Average	Persentage (%)
		1	2	3	4	5	6	7	8	9	10	11	12			
1.	Engraulidae	155	11	51	120	14	24	192	17	10	0	6	23	624	52	61.62
2.	Mugilidae	0	0	0	0	0	0	0	0	0	0	3	8	11	0.91	1.07
3.	Leiognathidae	7	3	0	6	0	2	10	0	0	1	0	0	29	2.41	2.85
4.	Chanidae	5	0	0	1	1	0	29	10	9	2	2	62	121	10.08	11.94
5.	Scatophagidae	4	0	3	1	0	0	3	2	4	0	0	0	17	1.41	1.67
6.	Belonidae	6	0	8	2	0	0	2	0	0	0	2	5	25	2.08	2.46
7.	Gobioididae	0	0	0	0	0	0	0	0	3	0	1	0	4	0.33	0.39
8.	Chandidae	73	13	16	16	0	2	33	0	0	0	9	12	174	14.5	17.18
9.	Syngnathidae	0	0	0	0	3	0	0	0	0	0	0	0	3	0.25	0.29
10.	Gobiidae	0	1	3	0	0	0	0	0	0	0	1	0	5	0.41	0.48
	Total	250	28	81	146	18	28	269	29	26	3	24	110	1013	84.38	100

Based on research that has been done, fish larvae that have been obtained by family are 10 families in March and May 2019. Fish caught in March 2019 are only in the 4th location to the 12th location. Whereas in the 1st to 3rd location, no there are fish larvae caught. Sampling in May 2019 fish larvae were caught in all locations. Not catching fish larvae in March allegedly related to the presence of adult fish in that location which acts as a predator for fish larvae because at the time of sampling in the first to third locations there are large fish caught.The existence of predators, in this case large fish causes competition for food is also getting bigger so that competition for food is also getting bigger, so that only certain species can survive in such environmental conditions. In addition, in a fish density there will be competition for food, age of the larval stage, and will increase the mortality stage [24]. Species density of fishes and fish larvae is greatly affected by psychological stress and physical damage, algal blooms and poisons, pollution, disease and pollution, food availability, and predation [24]; [6]; [20].

Based on Table 1 and Table 2 of the 12 track pathways carried out there is 1 location with the most fish larvae, which is location 1 where the area is close to the mangrove area. Abundance of fish larvae is more common in mangrove areas with dense densities compared to mangrove areas with medium and rare densities. This is certainly influenced by the presence of mangrove vegetation that has ecological functions as spawning ground, nursery ground, feeding ground.

Based on Table 1 and Table 2 it can be seen that the most abundant fish found are in the family of Engraulidae. The abundance of fish is likely due to the area is an estuary area so many fish are swimming to find food and spawn in the area. This is in accordance with the research of [11] at Muara Sungai Pilang Sari, that the fish larvae caught were dominated by *Stolephorus* sp. from the Engraulidae family. In addition, [25] also confirm that the Engraulidaespawn throughout the year and are biologically plankton feeders that inhabit coastal and estuary areas, living in groups, especially small species consisting of scool of hundreds to thousands fish, which is why the Engraulidae family dominates the waters of the Banyuasin river estuary because it is thought to be related to the spawning season for the Engraulidae family as well as the influence of the tides.

Diversity Index

Based on the analysis conducted fish larvae diversity index in March and May 2019 are presented in Figure 2. The diversity index in March 2019 of 1.02 was classified as moderate diversity and in May 2019 it was 1.21 classified as moderate diversity. The higher *H'* indicates the

higher number of species and their relative abundance, according to [26]. According to [9], its stability or moderate diversity with the number of individuals of each species is not uniform but none is dominant. Research conducted by [21] in the Banyuasin estuary also shows the results of a diversity index with a moderate category. That was according to [18] who say that the fish diversity in Musi river estury In June 2013, the diversity index (*H*') was 2,304, and in July 2013 was 2,561.

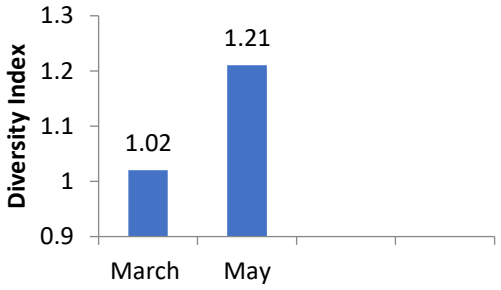

Figure 2. Diversity Index of fish larvae in river downstream of Banyuasin

Based on Figure 2 the diversity index in May 2019 is higher than in March this is thought to be related to the time of sampling at high tide conditions. This relates to the ecological conditions of river downstream which have water characteristics that are affected by tides. At high tide conditions, marine water will enter the river downstream carrying fish larvae from the beach and the sea into the river downstream. Meanwhile, when the water recedes will come out of the river estuary waters into the sea, where this water flow will bring fish larvae out of the river estuary waters back to the sea [11].

In addition, according to [22], the high and low values of diversity indexes depend on variations in the number of individuals of each type of fish caught. The greater the number of species of fish and the variation in the number of individuals of each type, the level of diversity of fish in an aquatic ecosystem will be even greater, and vice versa.

Diversity index (H') based on the calculation of the composition of fish larvae in mangrove conservation areas in Sayung sub-district conducted by [19] at each point shows the diversity of the number of populations with quite diverse values. According to [5] that a community is said to have high species diversity, if the abundance of each is high and conversely species diversity is low if there are only a few species that are abundant.

Analysis of the Morisita Index

The results of the research that have been carried out and the results of the analysis of the morisita index for 2 repetitions, namely in March 2019 to May 2019 are presented in the form of Table 3.

Table 3. Analysis of Fish Larva Morisita Index at the Mouth of Banyuasin River during the research.

	Tracking flow	Morisita Index ($I\delta$)	Note
March 2019	1	0	-
	2	0	-
	3	0	-
	4	6.50	Grouped
	5	3.99	Grouped
	6	3.23	Grouped
	7	8.86	Grouped
	8	6.35	Grouped
	9	7.11	Grouped
	10	8.92	Grouped
	11	5.77	Grouped
	12	14.17	Grouped
May 2019	1	5.50	Grouped
	2	4.31	Grouped
	3	5.29	Grouped
	4	8.24	Grouped
	5	10.40	Grouped
	6	8.82	Grouped
	7	7.95	Grouped
	8	5.37	Grouped
	9	3.32	Grouped
	10	3.99	Grouped
	11	2.43	Grouped
	12	4.49	Grouped

Based on Table 3, the Morisita Index analysis results show that the distribution patterns of fish larvae around the river downstream of Banyuasin are relatively grouped. The morisita index in March 2019 ranged from 0-14.17 and in May 2019 ranged from 2.43-10.40. According to [2], the pattern of spreading is to be random if the value of the index is Iδ<1; even if the individual distribution pattern is Iδ = 1 and tends to be grouped if the individual distribution pattern is I> 1.

The nature of the group obtained from the morisita index may be caused by several factors, including environmental conditions, as well as eating habits and ways of reproduction of fish. According to [5], dispersal in groups means that a species has a high tolerance level for the environment it occupies. The existence of species has a tendency to live in groups and can live anywhere in an ecosystem.

In addition, according to [23] in [7] patterns of group dispersal are caused by negative interactions between individuals, for example competition for food. In addition, according to [26], physical, chemical, and biological factors which are almost evenly distributed in waters and the availability of food also influence living organisms in their habitat and determine whether these

organisms live in groups, random or homogen.

Evenness Index Analysis

Based on research that has been done, the fish larvae evenness index in March and May 2019 at the river downstream of Banyuasin Estuary can be seen in Table 4.

Table 4. Analysis of Evenness Index of Fish Larvae in the Banyuasin River Estuary during the research.

No.	Family	March	May
1.	Engraulidae	0.119	0.129
2.	Mugilidae	0.077	0.021
3.	Leiognathidae	0.026	0.044
4.	Chanidae	0.143	0.11
5.	Scatophagidae	0.005	0.029
6.	Belonidae	0.019	0.039
7.	Gobioididae	0.001	0.009
8.	Chandidae	0.013	0.131
9.	Syngnatihidae	0.005	0.007
10.	Gobiidae	0.029	0.002
	Eveness Index	0.437	0.521

Based on Table 4, the results of the evenness index are 0.437 in March and 0.521 in May, it can be seen that the level of evenness index can be seen from the condition of the community structure that is evenly distributed and included in the medium category. According to [26], species diversity of a community is largely determined by species richness and evenness. Evenness index is classified as high if there is no individual concentration of a particular species.

Based on Table 4, it can be seen that the Evenness index value is higher in May. This is likely due to different sampling times. The first sample was taken in March and taken when the water was in transition from tide to ebb while in May the sampling was when the water began to tide. This is also supported by [11] that the tidal pattern that occurs in river mouth waters greatly determines the distribution and abundance of fish larvae in these waters. At high tide, sea water will enter the river downstream carrying fish larvae from the beach and the sea into the river downstream. Evenness index shows the distribution of fish evenly in waters. If the evenness index is high, it can be said that the distribution of each species is evenly distributed [16].

Analysis of the Characteristics of Physical and Chemical Factors Around the Mouth of Banyuasin River

Based on observations obtained the characteristics of physical and chemical factors of waters in March 2019 and May 2019 can be seen in Table 5.

Tabel 5. Characteristics of Physical and Chemical Factors Around the river downstream of Banyuasin

Station	Temperature(°C)		DO (mg/I)		Brightness (cm)		pH		Salinity (ppt)		Current (m/s)	
	March	May	March	May	March	May	March	May	March	May	March	May
1	33.8	33,7	5.09	5.07	14	11	7.06	7.04	0	0	0.08	0.07
2	33.9	33,7	5.14	5.12	24	22	6.95	6.92	0	0	0.15	0.13
3	31.9	31,6	5.51	5.5	14	10	6.53	6,5	0	0	0.42	0.40
4	32.9	32,7	6.46	6.44	13	10	7.02	7	0	0	0.09	0.06
5	32.4	32,2	6.47	6.44	27	26	7.15	7.11	8	5	0.25	0.22
6	31.6	31,5	6.31	6.27	18	15	7.21	7.17	10	5	0.08	0.06
7	31.0	30,9	6.50	6.47	23	20	7.15	7.16	11	5	0.20	0.18
8	30.3	30	6.60	6.58	19	17	7.18	7.16	13	10	0.17	0.15
9	30.2	30	6.08	6.03	37	36	6.70	6.68	18	15	0.03	0.02
10	28.9	28,7	6.81	6.8	40	38	7.53	7.5	25	23	0.09	0.05
11	29.5	29,4	5.22	5.17	28	25	7.01	6.99	21	15	0.15	0.10
12	28.8	28,7	7.06	7.04	24	17	7.00	6.97	20	15	0.16	0.10
13	28.4	28,2	7.43	7.4	46	42	7.42	7.39	25	24	0.10	0.06
Range	28.4-33.9	28.2-33.7	5.09-7.43	5.07-6.58	13-46	10-42	6.53-7.42	6.50-7.39	0-25	0-24	0.03-0.42	0.02-0.40

In Table 5 it can be seen that the results of the analysis of measurements of physical and chemical factors in the waters around the river downstream of the Banyuasin, South Sumatra Province for 2 months, namely in March and May 2019. During the sampling period, the location of station 1 to station 13 has decreased significantly. the further towards the sea the temperature has decreased but slightly and vice versa, and still in normal range for the life of fish larvae.

The value of DO ranges from 5.07-7.43. Brightness ranges between 10-42 cm. which according to [4] and [13], the content of dissolved oxygen that is suitable for fish life is 6-7 mg /l which indicates that it is still good for the life of fish larvae.

Brightness ranges from 10-46 cm. It is still good for the life of fish larvae there. This is in accordance with in

[18] that productive brightness ranges from 20-60 cm, where the process of photosynthesis of aquatic plants can take place properly.

Values of pH range from 6.50 to 7.50. Based on that, it can be concluded that the waters around the river downstream of Banyuasin are still quite stable and are classified as normal for fish life. According to [14] the pH value in waters varies from the direction of the river to the sea, the higher the sea the value is. A low pH value is generally obtained in a river body and the further toward the sea the higher the value.

Salinity based on Table 5 ranges between 0-24‰. According to [4], the natural value of salinity in marine waters ranges from 30- 40 ‰.

The currents obtained in the waters of the river downstream of Banyuasin River range from 0.02 to 0.42 m/s. This value indicates that the current category in the waters around the river downstream of Banyuasin has a slow current. According [1], states that currents also have an important role in the lives of fish or other organisms, because currents can cause changes in temperature and spread food, carry, and spread larvae to other places.

4. Conclusion

Based on the results of research that has been done, the following conclusions are obtained:

1. River downstream of Banyuasin River, South Sumatra Province found as many as 10 families consisting of 1,601 individuals Engraulidae, 109 of Mungiloidei, 50 of Leiognathidae, 453 Chanidae, 20 of Scatophagidae, 39 of Belonidae, 5 of Gobioididae, 183 of Chandidae, 6 of Syngnatihidae, and 6 of Gobiidae
2. Index of diversity of fish larvae with moderate level of diversity (March 1.02 and May 1.12), Morisita index shows the distribution patterns of fish larvae classified as grouped (March 0-14.17 and May 2.43 -10,40), and the evenness index value is included in the medium category (March 0.437 and May 0.521).

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