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Fish Diversity in River Sapuregel of Segara Anakan Eastern Area Cilacap

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Abstract. River Sapuregel empties into the eastern region of Segara Anakan Cilacap. It is one of the major rivers surrounded by mangrove forests and has a variety of biological resources, including fish. The research aimed to study the fish diversity and composition Sapuregel river mouth of Segara Anakan Eastern Area Cilacap. Research on fish diversity was carried out from April to September 2018. The method was purposive random sampling at the Sapuregel estuary. The results showed that 1,446 individuals representing 23 families and 34 species were dominated by Engraulidae families in the rainy season (42.57%) and dry season (57.41%) followed by Gobidae (16.82%) in the rainy season and Mugilidae (19, 44%) in the dry season. Small fish within the range of 2.7–22.9 cm dominated the caught fish. Fish Diversity Index ranges from 1.71 to 1.843 in the rainy and dry seasons between 1.352–1.56. These results indicated that fish diversity in the rainy season was higher than the dry season. Evenness Index ranges from 0.1907 to 0.2178 in the rainy season, between 0.2274 and 0.28 in the dry season, the species similarity in the dry season was higher than the rainy season. The size of the fish obtained varied from juvenile to adult size. It was dominated by small fish so that it was suspected that the waters of the River Sapuregel were used as spawning grounds and enlargement of several types of fish.

1. Introduction

Segara Anakan is a brackish water lagoon ecosystem with the most extensive mangrove forest located in the Cilacap district of Central Java, which is flanked by two mainlands, Java and Nusakambangan Island. These waters have a variety of biological resources such as fish, shrimp, crabs, and mollusk that inhabit the lagoons, tidal flats, or mangrove forests. Segara Anakan Lagoon is a feeding area, spawning, and nursery ground for several notable species of fish and crustaceans. There are 45 fish species live in the area consisting of 17 demersal, 12 natives, and 16 seasonal migrant species.

Segara Anakan is an estuarine ecosystem that receives freshwater supplies from several large rivers such as Citanduy, Cibeureum, Cimeneng, Ujungalang, Sapuregel, and Donan, which empties into the region. The saltwater supply comes from the Indonesian Ocean through two canals, the western and the eastern canals. One river that empties into the eastern canal is River Sapuregel [1].

The Segara Anakan ecosystem is a very fertile ecosystem with high biodiversity. There are main problems in Segara Anakan, one of which is the decline of biological resources (illegal logging, conversion, overexploitation) so that there is a possibility of being threatened. Thus, it needs to be



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managed and protected. In 2000, fisheries production in the lagoon reached 488 tons consisting of 41% shrimp, 39% fish, 13% crab, and 7% other biotas [2]. If it is not quickly addressed, this situation disturbs the balance of the inhabiting community, especially fish. The possibility that will occur is the reduced fish population inhabiting the area. Segara Anakan mangrove area has contributed to coastal fisheries production that reaches more than 62 billion rupiahs in one year [3]. It is reported that the fish composition includes 28 species from 19 tribes, 24 genera on the River Bojong Langkap, and Ciperet Segara Anakan [4].

This study aimed to determine the fish diversity and composition of River Sapuregel estuary in Segara Anakan, Cilacap. The results are expected to update information and contribute to scientific data for the local government to continually manage the area.

2. Methods

The study was conducted from April to September 2018 at the mouth of River Sapuregel. These waters are located in the management area of Segara Timur with coordinate points of SL 07°43'12" EL 108°58'14". The research used a survey method. Sampling was purposive at the mouth of River Sapuregel during rainy and dry seasons (Figure 1).

The fish collection was carried out using a mesh (diameter of 1-2 cm) and gillnet mesh (1.25 - 10 cm in diameter) with a net (30 m long and 18 m wide). Net installation was carried out at low tide then lifted at high tide. The caught fish was preserved using 4% formalin and labeled. Furthermore, fish were handled in the Aquatic Biology Laboratory, by washing formalin-fixed fish with running water, then replaced with 75% alcohol as a fixed preservative. The fish were identified following [5, 6], Marine Portal Identification, and Fish Base.

The composition of fish species was analyzed qualitatively. Fish species composition distinguished fish species based on identification results. Relative abundance was used to see the diversity of fish species at the study site. The relative abundance of species was obtained by calculating the number of individuals of each species of fish per total individual species caught.

The data were analyzed using the Shannon-Wiener Diversity Index, and evenness index (E) with the PAST 3 software.

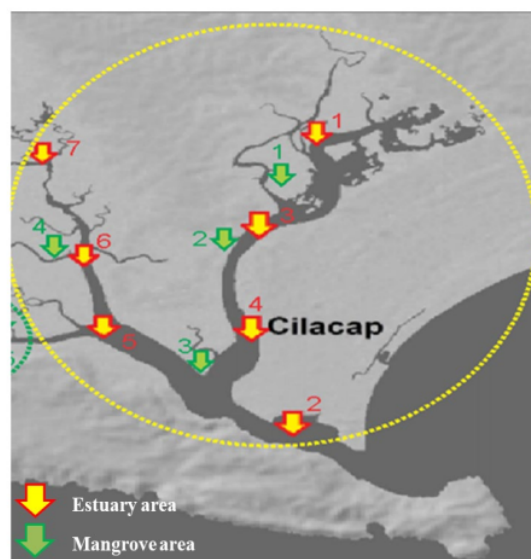


Figure 1. Scheme of Sampling Location in Segara Anakan

3. Results

The number and species of fishes caught in the River Sapuregel was 1.446 individuals representing 23 families and 34 species, dominated by the Engraulidae family in the dry season (57.41%) and rainy season (42.57%) followed by Mugilidae (19, 44%) in the dry season and Cygnoglossidae (21.04%), Gobiidae (16.82%) in the rainy season (Table 1).

Table 1. Number and type of fish caught on the River Sapuregel

No	Family	No	Species	Dry Season	Rainy Season	Total
1	Gobiidae	1	<i>Pseudogobius javanicus</i>	0	207	207
2	Mugilidae	2	<i>Valamugil seheli</i> *	42	70	112
3	Cygnoglossidae	3	<i>Cygnoglossus microlepis</i>	0	259	259
4	Tetraodontidae	4	<i>Tetraodon kretamensis</i> *	1	4	5
		5	<i>Lagocephalus sp</i>	0	1	1
5	Leiognathidae	6	<i>Leiognathus oculus</i> *	5	14	18
6	Carangidae	7	<i>Caranx ignobilis</i>	0	29	29
		8	<i>Trachurus symmetricus</i>	0	4	4
		9	<i>Alectis indicus</i>	0	1	1
7	Ambassidae	10	<i>Ambassis kopsii</i>	0	3	3
		11	<i>Parambassis sp</i>	0	1	1
8	Drepanidae	12	<i>Drepane longimana</i>	0	6	6
9	Scianidae	13	<i>Nibea sp</i> *	4	6	10
10	Sillagnidae	14	<i>Sillago sp</i> *	1	1	2
11	Belanidae	15	<i>Xenentodon canula</i>	0	1	1
12	Oxuderidae	16	<i>Taenoides cirratus</i>	0	4	4
		17	<i>Sicyopterus sp</i>	0	8	8
13	Terapontidae	18	<i>Terapon jarbua</i>	0	1	1
		19	<i>Terapon theraps</i>	0	1	1
		20	<i>Mesopristes cancellatus</i> *	14	1	15
14	Engraulidae	21	<i>Stolephorus indicus</i> *	124	524	648
15	Ophichthidae	22	<i>Lamnostoma mindora</i>	0	1	1
		23	<i>Ophichthus aphostistos</i> *	1	57	58
		24	<i>Ophichthus frontalis</i>	4	0	4
16	Platycephalidae	25	<i>Platycephalus indicus</i>	0	4	4
17	Serranidae	26	<i>Epinephelus sp</i> *	4	5	9
18	Scatophagidae	27	<i>Scatophagus argus</i>	0	4	4
19	Lutjanidae	28	<i>Lutjanus russelii</i>	0	12	12
20	Paralichthyidae	29	<i>Pseudorhombus elevatus</i> *	1	1	2
		30	<i>Pseudorhombus arsius</i>	1	0	1
21	Muraenidae	31	<i>Gymnothorax polyuranodon</i>	2	0	2
		32	<i>Uropterygius concolor</i>	4	0	4
22	Eleotridae	33	<i>Eleotris acanthopoma</i>	4	0	4
23	Anguillidae	34	<i>Anguilla bicolor</i>	4	0	4
				216	1230	1.446

*= species caught in the dry and rainy seasons

All types of fish caught in the study location were mostly juvenile to adolescent stages, with 2.7–22.9 cm body length (85–90%) except eel with a body length of 70.6–84.8 cm.

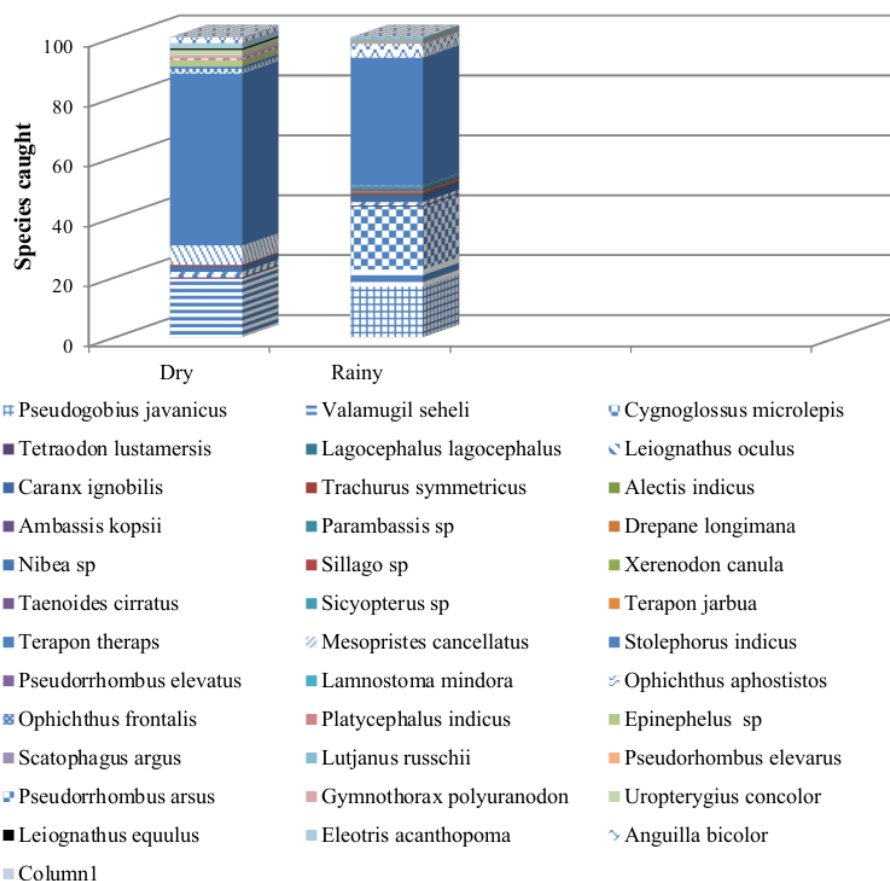


Figure 2. Composition of fish caught in the Sapuregel river

Fish species caught in both seasons (dry and rainy) comprised 10 species consisted of *Stolephorus indicus* (44.78%), *Valamugil seheli* (7.74%), *Ophichthus aphostistos* (4.01%), *Leiognathus oculus* (1.24 %), *Mesopristes cancellatus* (1.04%), *Nibea sp* (0.69%), *Epinephelus sp* (0.62%), *Tetraodon lustamersis* (0.35%), *Sillago sp* (0.14%) and *Elevarus pseudorhombus* (0.14%) (Figure 2).

The highest abundance of fish in the River Sapuregel was families of Engraulidae (dry and rainy), Mugilidae (dry), Cynoglossidae and Gobiidae (rainy) (Figure 3).

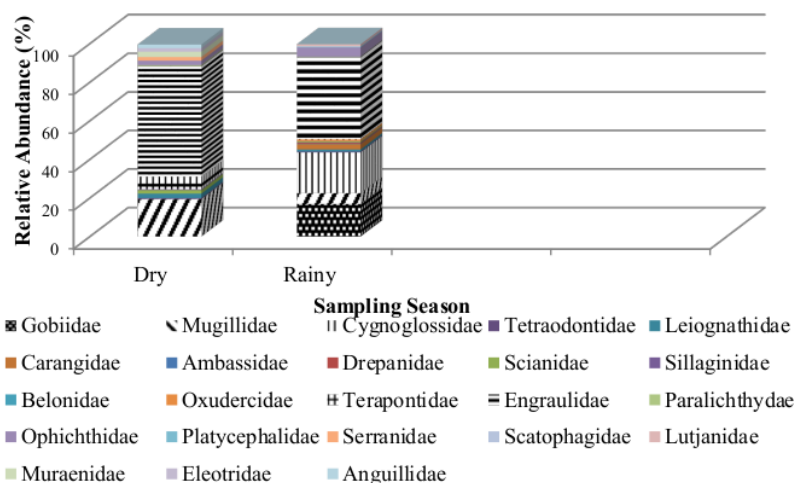


Figure 3. Relative abundance (%) of fish based on family

Fish species were part of the community; only a few species were predominant groups. Among the 23 fish families found in River Sapuregel, two of them dominated both the dry and rainy seasons, Engraulidae and Mugillidae. The diversity and uniformity of fish in the River Sapuregel during dry and rainy season were very diverse (Table 2).

Table 2. Diversity and uniformity of fish in the Sapuregel river

Index	Dry season	Rainy season
Shannon_H	1,352 - 1,56	1,71 - 1,843
Evenness_e^H/S	0,2274 - 0,28	0,1907 - 0,2178

4. Discussion

Most of the caught fish were juveniles. It agrees with the claim that the mangrove ecosystem is known as nursery and feeding ground [7]. River Sapuregel includes in mangrove ecosystem, thus fertile waters for fish habitat. This finding indicated that the biological function of the river in the mangrove area was a spawning ground or nursery for shrimp, fish, crabs, shellfish, and others, which, after adults, return to the coast.

Fish caught in the rainy season was more dominant than the dry season. It is because during the rainy season, the water level raised, and some fish in the euryhaline estuary habitat was carried into the river, especially during the high tide. Fishing was done by installing nets during low tide, then lifted during high tide. Thus, caught fish was affected by tidal conditions. During high tide, the chemical-physical conditions of the waters in estuary rivers tend to be the same as mangrove waters due to the presence of tidal currents [8].

Out of ten species of fish, the *Stolephorus indicus* (anchovy) was caught the most indicating that the fish was well adapted to the River Sapuregel, both in dry and rainy seasons. These results follow a study reporting that *Stolephorus indicus* was found and well adapted in the Segara Anakan area of Cilacap [9]. *Valamugil seheli* (mullet fish), which has euryhaline properties, can live in a wide range of salinity because it lives in freshwater, brackish, and sea, associated with reefs, and often entering estuaries and rivers. Mullet fish is catadromous, and migrates to the river to reproduce (fish base). This finding coincided with reports claiming that mullet, anchovy, glodog fish caught in mangrove waters

are sapling and juvenile phases [10, 8, 11]. *Ophichthus aphostistos* (sea eel), belongs to snake eels group (Anguilliformes), is caught mainly in the rainy season even though they inhabit muddy waters [5]. In general, the types of fish caught in both seasons (dry and rainy) were able to adapt to River Sapuregel habitat, and have relatively high abundance.

The families of Engraulidae and Gobiidae are often caught in the River Sapuregel. Fish species, including families of Engraulidae and Gobiidae, are quite an abundance such as *Stolephorus indicus* (teri) and *Pseudogobius javanicus* (glodog fish). Fish belonging to this family are classified as real estuary species whose life cycle is completed in the estuary. A published report has shown that the Engraulidae family spread evenly in the Segara Anakan region [9]. Anchovy belonged to Clupeiformis order, is a planktivorous carnivore, mainly eating in the pelagic environment in planktonic crustaceans, bivalves, gastropods, and various foods [12]. Glodog fish belonging to Gobiidae family have not been used as food by residents in Indonesia. They are demersal fish capable of tolerating fresh and seawater, living on muddy and sandy grounds, and spawning in the estuary region. They have unique behavior as glodog fish have been seen walking and climbing mangrove roots, and escape to a hiding hole to avoid danger [4]. Gobiidae fish juvenile is herbivores eating diatoms and filamentous algae, while the adults turn to crustaceans, polychaete, and land insects. This amphibious life places them to a trophic position as zoobenthivore and predator [13]. Glodok fish use the estuary area and mangrove waters as a feeding ground, and available holes as houses, a spawning ground, nursery and rearing ground.

The fish belonging to the Mugilidae family were found mainly in the dry season on River Sapuregel. Fish in this family are migrant species from the sea and are the largest up in the estuary in both the subtropical and tropical regions [14]. The Cygnoglossidae family in the rainy season was dominant. The fish species in this family inhabit the sea, and are euryhaline. Their abundance in River Sapuregel River was influenced by tide carrying the fish into the river, place them as a migrant species from the sea.

The diversity index (H') of fish in River Sapuregel ranged from 1.35 to 1.56 (dry season) and 0.23 - 0.28 (rainy season). The evenness index (E') was from 0.23 to 0.28 (dry season) and 0.19 - 0.22 (rainy season). The H' average reached 1.42 (dry season) and 1.76 (rainy season), indicating that fish diversity in River Sapuregel was moderate in both seasons. This H' was higher than that of Laguna North Florida river with a value between 0.9 and 1.4 (108 species in 43 families) [15]. However, it was lower than H' of River Musi that ranged between 2.30 and 2.56 (32 species in 28 families) [16]. Also, it was lower than H' of River Choto Jamuna Bangladesh (3.43 - 3.82) [17].

Diversity in River Sapuregel is caused by several dominating species, such as anchovy and mullet. Fish diversity in a particular area is high if it is diverse and not dominated by certain species. A community generally has many species, but only a few species are dominant [18]. Fish diversity is influenced by variations in seasonal nutrients in particular habitats, currents, environmental conditions, and seasonal fish migration [19]. The evenness index is similar in the dry and rainy seasons and low so that the individual distribution in River Sapuregel between fish species is uneven so that the community balance is low. The more even distribution of individuals between species, the more balanced the ecosystem will be.

5. Conclusion

Fish caught on River Sapuregel River were 1446 individuals consisting of 23 families and 34 species, dominated by the Engraulidae family (dry and rainy seasons) followed by Mugilidae (dry season), Cygnoglossidae, Gobiidae (rainy season). The diversity of fish in the rainy season was higher than in the dry season. Fish diversity was moderate with a similar evenness index in both seasons. This study demonstrated higher fish composition in the rainy season with moderate diversity. This result provides essential information for the conservation of fish in the River Sapuregel of mangrove areas.

Acknowledgments

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