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Research Article

Segara Anakan Lagoon (SAL): Fish Biodiversity and the Ecological Role

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ABSTRACT

Two life stages of fish were sampled to examine the fish biodiversity and the ecological role of Segara Anakan lagoon (SAL). The fish were observed in during 2004 – 2014 while the larvae were sampled twice monthly during the full moon and dark periods in daylight hours only over 11 month periods (Novembre 2005 to Septembre 2006) at 10 sites located at SAL, Cilacap. Each trip two samples of the high tide and low ebb periods were taken from each station. The mature fish were sampled at Klaces and Karanganyar. The fish were also collected from fisherman. At least 90 genera of 48 family (65 mature fish and 64 larvae) were recorded at SAL. Gobbidae (range between 67.3 – 72.9 %) and Engraullidae (16.7 – 19.3 %) are the two most abundant larvae captured. Of the fish, at least 40 genera belongs to 16 families are of resident species that inhabit SAL for whole their life cycles. In other hand, 50 genera belongs to 31 families use SAL as temporary habitat (migratory). This finding suggests the important ecological role of SAL for fish.

Keywords : *segara anakan lagoon, biodiversity, ekological role*

1. Introduction

It has been established that estuaries are coastal lagoon where temperature, salinity, oxygen, and turbidity fluctuate dramatically occur because of the influence of tides and mixing of salt and freshwater. This makes the estuaries are highy dynamic and diverse region of high productivity with fish faunas (Gunter, 1961; Haedrich, 1983; Day et al., 1989).

At this time SAL is facing some ecological problems. One of them is sedimentation, the one that causes the narrowing the SAL which is coming from Citanduy, Cibeureum, and Cikonde Rivers. In the past, Segara Anakan had around 4603 ha of mangrove areas. However, illegal logging had caused the decrease the area of mangrove forest. It was around 1454 ha between 1974 and 1987. In 1989, about 16.5 ha of mangrove forest in the Segara Anakan areas had been converted into shrimp ponds (Nuryanto and Susanto, 2010). A high rate of exploitation and declining of the Segara Anakan areas are presumed to have direct impact on its animal communities, including fish assemblages and the ecological role of SAL.

As an estuarine ecosytem, SAL is inhabited by many fish, both migratory and resident species, therefore SAL Segara Anakan as an estuarine ecosytem has an important ecological role for these organism, particularly for fish. It is well known that many aquatic organisms use the lagoon as spawning ground, nursery ground and feeding ground, since the lagoon rich of nutrient for their growth and development (Dando, 1984; Neira et. al., 1994; Tominaga et al., 2000). Infact, the study of the ecological role of Segara Anakan for fish is scarce. For this reson, we conducted the study to investigate the ecological role of Segara Anakan and to determine the inhabitant status of fish in using the SAL as habitat.

2. Material and Methods

To record the biodiversity and to determine the ecological role of Segara Anakan a survey on the existence of the mature fish was done since Novembre 2004 to Septembre 20014. Mature fish was sampled using “apong net” and collected from fisherman. The reproductive stage of fish are examined. Samples of larvae were collected twice monthly, during the full moon and dark periods in daylight hours only, from Novembre 2005 to Septembre 2006. Each observation, samples were taken from ten stations in the lagoon. (Figure 1). Ichthyoplankton samples were preserved in the field with 4% buffered formaldehyde. In the laboratory the fish larvae were sorted with the aid of a stereomicroscope. Larvae were identified to the lowest possible taxon using the criteria of Leis and Rennis

(1983), Moser et al. (1984), Delsman (1926, 1932), Jayaseelan, (1998), Okiyama (1988) and Leis and Trnski (2001).

The status whether the resident or migratory fish was determined based on the occurence of fish both larvae or/and mature stage, bearing eggs or not, the origin of fish (freshwater or marine). The origin of marine fish is referred to the fisherman information (by showing the fish) and Kottelat & Whitten (1996), Axelrod *et al*. (1995), Setijanto *et al* (1999), Setijanto and Meinita. (2004). The fish is categorized of migratory fish (M) if the fish use SAL for spawning, nursery or feeding. The fish is determined resident species (R) if it is only found both larval and mature stage at SAL and not found at surrounded areas (freshwater or marine). The determination of migratory status is determined as follows: both larvae and bearing eggs fish are found at SAL while at the surrounded freshwaters mature fish only (spawning ground), larval stage only found at SAL (nursery ground), or not bearing eggs mature fish only (feeding ground). Fish is categorized resident species if all life stage are found at SAL and absent at surrounded area.

3. Results

3.1. Study area

SAL (51.700 ha; 1992) is an eastuarin ecosystem located at west of Cilacap, Central Java. It is situated between Java Island and a rocky 10. 300 ha barrier island (Nusakambangan). The estuary has 24.000 ha of mangrove forest. Many rivers (Citanduy, Cibereum, Cimeneng and Cikonde) end at the lagoon. It is estimated that the Citancuy River supplies 95% of water to the lagoon. S AL directly connected with Indian ocean through two canals namely west canal at Plawangan and east canal at Kembang Kuning. This topographical feature present a unique ecosytem. The lagoon is much inflenced by the tide and the freshwater input from the rivers. Thus, SAL is an ecosytem as a result of interaction of lagoon, mangrove forest, terestrial, and marine ecosytem. The study of Setijanto et al. (2003) reveals that based on physicochemical features (salinity, temperature, turbidity, nutrient, dissolved oxygen) there are 3 zonation at SAL. First, the zone that is associated with Indian ocean (Plawangan); second, the zone that is associated with Citanduy river (Majingklak and Karanganyar); and third, the the zone that is influenced by both Indian ocean and Citanduy river (Cibeurem, Muara Dua, Klaces). The 3 zones varied in salinity, nutrient, and turbidity. The first zone, which is directly connected with Indian ocean, is characterised by dramatic fluctuation of salinity (0 – 35 ‰). The second zone, where the river Citanduy ends at, is characterised by high nutrient and high turbidity, while the third zone which is far from the both Indian ocean and Citanduy estuary is more stable. Variation in salinity (Weinstein et al., 1980; Peterson and Ross, 1991 and water clarity (Blaber et al., 1994) can be a primary factor influencing fish distributional patterns along estuarine gradients. Based on this belief, the sites were located at first zone (2 sites), second zone (2 sites), and (4 sites).

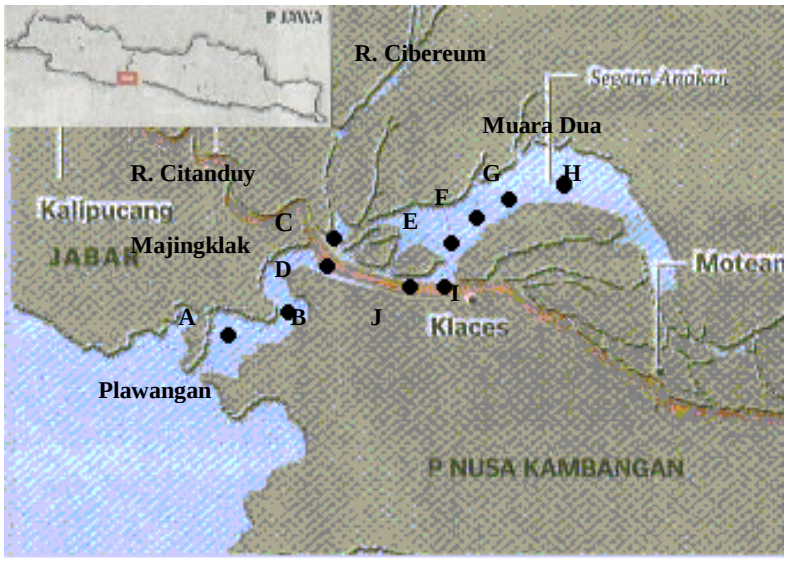

Figure 1. Segara Anakan Lagoon and the sites allocated (A – J)

3.2. Fish biodiversity and ecological role of SAL

Including fish reported by Sulistiono dan Kohno (1993) and Pemda Tk. II Cilacap-LPPM, (1998) there are 90 genera of 48 family (65 mature fish and 64 larvae) inhabit SAL. The species richness might be more than 90 as the fish particularly larval stage is not able identified down to species level. Numerically, the monthly larvae samples were dominated by Gobbidae (range between 67.3 – 72.9 %) and Engraullidae (16.7 – 19.3 %). Similar findings are also reported by Neira et. al. (1994) at Nornalup-Walpole Estuary (Gobiidae 39,4 % and Engraullidae 56,7%), by Jenkins (1986) at Port Phillip Bay, Victoria, Yamashita et.al. (1984) at Outsuchi Gulf, Japan and Ekau et al., (2001). Subiyanto et al. (2008) who conducted the study at Plawangan showed Pomacentridae (29.84%), Atherinidae (28.66%), Gobiidae (20.31%), Clupeidae (11.19%), while for other types of larvae found only in quantities little, i.e. less than 2%.

Of the fish, at least 40 genera belongs to 16 families are of resident species that inhabit SAL for whole their life cycles. In other hand, 50 genera belongs to 31 families use SAL as temporary habitat (migratory). It shows that SAL has important ecological role for those fish. List of the taxons found at SAL and their status in using SAL as habitat presented at Table 1. The resident species inhabit SAL for their entire life, using the SAL for spawning, nursery during larval stage, feeding ground and growth. The fish includes Apogonidae, Bothidae, Centropomidae, Chaetodontidae, Cynoglossidae, Gobiidae, Hemirhanphalidae, Legocephalidae, Leiognathidae, Platycephalidae, Scatophagidae, Sillaginidae, Sparidae, Synodontidae, Trypauchenidae and Engraulidae. It has been known that some of those are of economically important, Engrulidae for example. In addition most of the are of edible fish.

SAL play important ecological role for surounded area fish, whether from marine or freshwater habitats. It is shown that by the facts that many fish found are of those come from ocean or freshwater habitats (rivers) whether in larval stage or mature. Kohno et. al., (1993), found that there are many migratory fish caught by fisherman are economically important. Most marine origin fish are carnivores, feed on fish, crayfish, and oher crustacean. The fish use SAL, mainly as feeding ground. It has been estabilished that coastal area and estuary are used for nursey gound by some marine species (Neira et. al. ,1994). Marine fish which often caught at both the lagoon and open ocean are Serranidae, Carangidae, Lutjanidae, Haemulidae, Sparidae dan Scianeidae (Kohno et. al., 1993). This indicates that SAL is a nursey ground for those families.

SAL is also used as a transit habitat for migratory fish during their travel to the spawning ground. As an estuary, SAL is a transitional habitat from freshwater to marine environment, vice verca. Migratory fish may use the SAL for acclimatitation and adaptation to the salinity change. Some migaratory fish, such as Anguilla at all life stages are found at SAL (Setijanto et al., 2003). Anguilla is a catadromous fish that spawn at the open sea and migrate to the freshwater habitat when they are mature. In their return to the rivers, Anguilla uses the SAL for nursery ground. Apart from the food availability, SAL provide protective shelter for fish from bigger predator. There are some reports showing that fish at stage of post larvae, juvenile, and small mature fish are more abundant at the cranny and ditch of mangrove compared to the clear or open habitat (Duke et. al., 1977). Apart from marine fish, some fluviatile species Mugilidae and some spesies of Gobiidae for example, spawn and nurse at SAL. Mugilidae is targeted caught by fisherman as it has an important economical value.

Table 1. List of fish and inhabitant status at Segara Anakan Lagoon (SAL)

Familiy *Genus/Speces*	**Local name**	**Larvae**	**Mature**	**Status**	**Refference**
Anguillidae					
Anguilla	Sidat	+	+	M	
Apogonidae					
Apogon	Prempeng	+	+	R	
Ariidae					
Arius maculatus	Jahan	+	+	M	
Belonidae					

Tylosurus sp	Seroang	-	+	M	B
Bothidae					
Crossorhombus azureus	Tapel borok	+	+	R	
Carangidae					
Alectis indicus	Jemberet	-	+	M	B
Caranx melampygus		+	+	M	A
Alepes sp. *1*	Martaji	-	+	M	
Centropomidae					
Ambassis buruensis		-	+	R	A
Chaetodontidae					
Chaetodon aureofasciatus	Boso	+	+	R	
Chirocentridae					
Chirocentrus	Teri	+	+	R	
Clupeidae					
Sardinella	Teri	+	+	M	
Etrumeus	Teri	+	+	M	
Anchoviella	Teri	+	+	M	
Congeridae					
Conger sp		+	-	M	
Clariger		+	-	M	
Ariosoma		+	-	M	
Cynoglossidae					
Cynoglossus abbreviatus	Lendra	+	+	R	
Drepanidae					
Drepane longiman	Gedebeg	-	+	M	
Elopsidae					
Megalops		+	-	M	
Elops sp.		+	-	M	
Engraulidae					
Stelephorus	Teri	+	+	M	
Thryssa mystax	Bibiran	+	+	M	A, B
Engraulis	Teri	+	+	R	
Coilia nusus		+	+	R	
Setipina	Bilis	+	+	R	
Gerridae					
Gerres sp.	Kapasan	+	+	R	
Gobiidae					
Acantogobius		+	+	R	
Chaenogobius		+	+	R	
Glossogobius		+	+	R	
Pterogobius		+	+	R	
Boleoptalmus		+	+	R	
Rhinogobius		+	+	R	

Priolepsis		+	+	R	
Oxyurichthys		+	+	R	A
Apocryptodon		+	+	R	
Elostris		+	+	R	
Ctenotrypauchen		+	-	R	
Leucopsarion		+	-	R	
Luciogobius		+	+	R	
Parioglossus		+	+	R	
Pseudogobius		+	+	R	
Acentrogobius	Nyongo	+	+	R	
Hemirhamphidae					
Hemirhamphus georgii	Tracas	+	+	R	B
Hyporhampus		+	-	R	
Labridae					
Labridae		+	+	M	
Lagocephalidae					
Sphaeroides lunaris	Buntak pisang	-	+	R	
Leiognathidae					
Leiognathus dussumeri	Petek	+	+	R	
Lutjanidae					
Lutjanus	Tambalan	+	+	M	
Caesio		-	+	M	
Monachantidae					
Thamnaconus		+	-	M	
Mugilidae					
Moolgarda perusii		-	+	M	A
Mugil cephalus	Belanak	+	+	M	
Mullidae					
Upeneus tragula	Kajang	-	+	M	
Muraenesocidae					
Muraenosox	Remang	-	+	M	
Paralichthydae					
Paralichthys sp.		+	-	M	
Pseudorhambus		+	-	M	
Platycephalidae					
Platycephalus	Ipuh	+	+	R	
Polynemidae					
Eleutheronema		-	-	R	A
Polynemus	Baleng	-	+	R	B
Polydactilus		+	-	R	
Pomadasydae					
Plectorhynchus gibosus		-	-	M	A
Pomadasys hasta	Krekekan	+	+	M	

Ratabouridae					
Rataboura bicolor	Oleng	+	+	M	B
Scatophagidae					
Scatophagus	Kiper	+	+	R	
Sciaenidae					
Sciaenid sp.	Colomontok	-	+	M	
Johnius carutta	Tombol	-	+	M	
Nibea artiflora		-	+	M	A
Scombriidae					
Scomberomorus	Tengiri	+	-	M	
Scomber		+	-	M	
Scorpaenidae					
Scorpaenidae		-	+	M	
Serranidae					
Epinephelus tauvina	Kerapu balong	-	-	M	
Chalanthias		+	-	M	
Sillaginidae					
Sillago	Bojor	+	+	R	
Sparidae					
Spanus		+	-	M	A
Acanhtropagrus	Bekuku	-	+	R	A, B
Stromateidae					
Pampus	Dawah	-	-	M	B
Synanceiidae					
Inimicus japanicus		+	-	M	
Syngnathidae					
Parasyngnathus sp.		+	-	M	
Trachyrhamphus sp.		+	-	M	
Synodontidae					
Saurida tumbil	Bloso	+	+	R	
Thrachicephalus sp.	Susur wedi	-	+	R	
Tetraodontidae					
Tetraodon reticulatus	Buntak kelapa	-	+	M	
Arothron stelatus		-	+	M	A
Takifuga sp.		+	-	M	
Theraponiodae					
Therapon theraps	Terongan	-	+	M	
Trichiuridae					
Trichiurus	Layur	-	+	M	
Trygonidae					
Himanturas sp.	Pari/Pe	-	+	M	
Trypauchenidae					

Trypauchen sp.	Tungon	+	+	R
Uranoscopidae				
Urocampus		+	-	M
Total		64	65	

Note. A (by Sulistiono dan Kohno, 1993), B (Pemda Tk. II Cilacap- LPPM, 1998), M (Migratory), R (Resident)

4. Conclusion

Based on above, we may conclude that SAL has an ecological role for maintaining the biodiversity of fish as a lot of fish whether at the stage of larvae and mature or both found at the lagoon. SAL is used as nursery ground for small fish as SAL provide protective shelter to avoid the predator. In addition, SAL as an eastuary is rich of nutrient that are sufficient for both larvae and mature fish. For migratory fish SAL is a trantitional environment for aclimatitation and adaptation before return to the saline or freshwater. The ecological role of SAL might be taken as the causal explanation why the fish biodiversity of fish at SAL is relatively high.

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