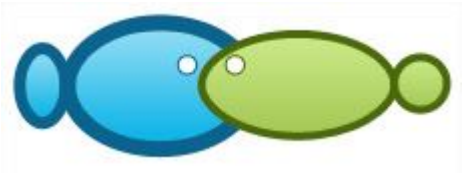

Fisheries resources of mangrove ecosystem in Demta Gulf, Jayapura, Papua, Indonesia

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Abstract. The mangrove ecosystem in Demta Gulf is vastly rich and distinctive, it is directly connected to the Pacific Ocean and tropical forest of the Papua Island. Mangrove ecosystems are the main ecosystems which provide ecological services such as habitat, nursery ground, feeding ground, and spawning grounds for various fish species in Demta Gulf. This study was conducted from April to June 2018 in the mangrove ecosystem of Demta Gulf, Demta District, Jayapura Regency of the Papua Province, Indonesia. Fish data were collected using gill net with 3 catching attempts/transects. There were 3 stations, 3 transect/station, and in total there were 9 transects and 27 fish-catching attempts. Mangrove data collected using transects (50 m) and plots (10 m x 10 m), there were 4 transects/stations and 3 plots/transects, in total 12 transects and 36 plots. The data were analyzed with Shannon-Wiener diversity index (H), evenness index (E), abundance analysis. Density analysis was used to analyse mangrove health status test. The result indicated that the mangrove ecosystem in Demta Gulf was categorized as healthy. The target fish are consisted 17 species were are found with moderate diversity in the Station Ambora, and high diversity in Yougapsa and Ambora-Tarfia, the total population or abundance for three Stasiun is about 3,558 individual ha-1.. The major fish species are found 7 species, is classify as moderate diversity in Ambora (1.8), Yougsa (1.5) and Ambora-Tarfia (1.7), the total population or abundance for three Stasiun is about 533 individual ha-1. The indicator fish were found 6 species with the moderate level of diversity in Ambora (1.5), Yougapsa (1.2) and Ambora-Tarfia (1.4), and the total population for three locations is about 2,517 individual ha-1. Fish resources and productivity will increase and reach its peak if mangrove productivity is high, the total area of mangrove increase, and the mangroves have greater physical complexity.
Key Words: biological, ecological, fish, diversity, physical complexity.

Introduction. The mangrove ecosystem in Demta Gulf is vastly rich and distinctive since is directly connected to the Pacific Ocean and the tropical forest of Papua Island. The morphological, ecological, and biological condition on Demta Gulf forms an ecosystem zone consisting of coral reefs ecosystem, seagrass ecosystems, and mangrove ecosystems. The combination of three major coastal ecosystems, with mangrove ecosystems as the main buffer, provides ecological and biological services for fishery resources in Demta Gulf. Mangrove ecosystem services play an important role as the habitat, nursery ground, feeding ground, and spawning ground for various marine fish species (Kathiresan & Bingham 2001; Macintosh et al 2002)

The global mangrove ecosystems are in critical condition and of concerns since reportedly the world has lost 20-35% of mangrove forests since 2000 (Valiela et al 2001; FAO 2007; Polidoro at al 2010). In addition, mangrove areas are reportedly disappearing at the rate of approximately 1-2% per year (Alongi 2015) with other estimates as high as 2-8% per year (Polidoro at al 2010), Indonesia alone has lost 40% of its mangroves, mainly as a result of aquaculture development (Murdiyarso et al 2015). It is estimated that 26% of mangrove forests worldwide are degraded due to over-exploitation for fuelwood and timber production (Valiela et al 2001; Polidoro at al 2010), shrimp farming

contributes 38% to the global mangrove loss, with other aquaculture accounting for 14% (Ellison 2008; Polidoro at al 2010). While similar problems are also found in Papua, it is estimated that the remaining mangrove forest ecosystem in Papua Province is 1.3 million ha, compared to West Papua Province with 0.5 million ha (KKP 2017), Indonesia with 3.6 million ha (KKP 2017) and 13.7 million ha in the world (Giri et al 2010). This condition is very alarming and threatening because the island of Papua has the largest mangrove area and diversity of mangrove species in the world and they are important habitat for wildlife (Giri et al 2010).

The mangrove ecosystem fisheries have been extensively studied in the past decade to discribe the value of fisheries resources and ecological services for coastal communities. Aburto-Oropeza et al (2008) found that the mangrove in the Gulf of California, USA increased fishery yields, mangrove-related fish and crab species account for 32% of the small-scale fisheries landings in the region and the annual economic median value of these fisheries is US $ 37,500 per hectare of mangrove fringe. Honda et al (2013) found 47 fish species and 2426 individuals in seagrass and mangrove habitats in the western and eastern side of Manila Channel, Puerto Galera Bay in the Philipines. Redjeky (2013) identified 9 families of fish in the mangrove ecosystem at the Bedono waters in Sayung Demak, Indonesia. Moreover, Wahyudewantoro (2009) also discovered that the mangrove ecosystem in the Ujung Kulon National Park Pandeglang-West Java had high level of fish diversity, with 58 species and 34 families.

Many fishermen depend on the fish availability in the waters of the Demta Gulf. The fish stock in the Demta Gulf is strongly correlated with the local seasons; wavy sea season and rainy season. These seasons occur in January-March (affected by West Wind) and April-May (affected by East Wind). In June until December, the conditions of sea waves and rain are relatively low. Therefore, this research is crucial to determine the health status of the mangrove ecosystem at the Demta Gulf, Jayapura and to support fisheries in this area.

Material and Method. The study was conducted from April to June 2018 in the mangrove ecosystem of Demta Gulf, Demta District, Jayapura Regency of the Papua Province (Figure 1). Data collection of fish and mangrove trees was carried out at the same 3 research stations. The first station is Ambora, this location is very close to the local settlement. The mangrove ecosystem in this location consists of Rhizophoracea and Sonneratiaceae. The second station is called Yougapsa, there are two small rivers in this mangrove ecosystem, and are dominated by Rhizophoracea. The third station is Ambora-Tarfia which is located between two villages (Ambora Village and Tarfia Village), only Rhizophoracea is dominant in this location.There were 3 transects per station so in total there were 9 transects and 27 fish-catching attempts. Fish data were collected using gill net with 3 catching attempts per transects. There were 3 transect per station, and in total there were 9 transects and 27 fish-catching attempts. Mangrove data collected using transects (50 m) and plots (10 m x 10 m), there were 4 transects per station and 3 plots/transect, in total 12 transects and 36 plots.

The physico-chemical parameters measured in this study were the water temperature, salinity, dissolved oxygen (DO), and substrate. The measurements were carried out using in-situ technique with several devices such as the Portable EC/Temp Meter AD310, Handheld Dissolved Oxygen Meter YSI 550A, and Handheld Optical Portable Salinity Refractometer THE01510-Yieryi.

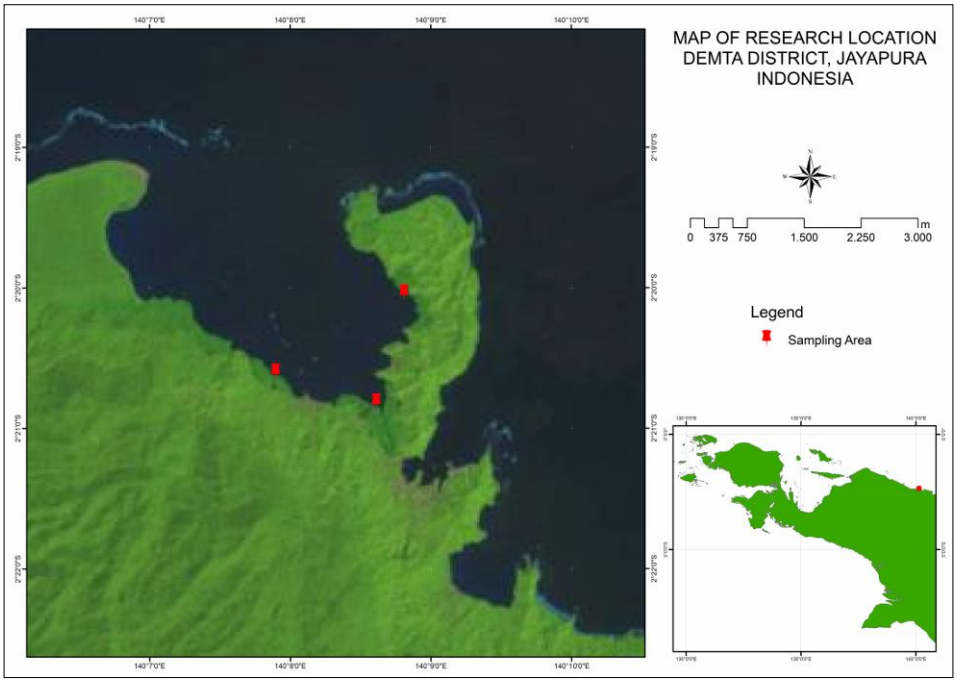


Figure 1. The research location Demta Gulf, Jayapura.

The data analysis for mangrove trees diversity and fish diversity are using the Shannon-Wiener index (H') formula. This formula considers both the number of species and the distribution of individuals among species. The Shannon-Weiner diversity index was calculated by the following formula (Magurran 1988; Jorgensen et al 2005):

$$H' = -\sum pi \ln pi$$

where: pi = ni/N;
N = total number of individuals;
ni = total of individual-species.

The analysis of evenness (E), according to Magurran (1998) is:

$$E = \frac{H^i}{\ln(S)}$$

where: H^i = diversity index;
S = numbers of species.

If E' < 0.3 indicates evenness is low, E' = 0.3-0.6 evenness is moderrate and E' > 0.6 evenness is high.

The abundance analysis, according to Odum (1971), is:

$$D = (Ni/A) \times 10000$$

where: D = abundance (ind ha^{-1});
Ni = numbers of individuals;
A = sampling area (m^2), conversion values m^2 to hectare = 10.000.

The mangrove density, according to Fachrul (2007), is:

$$\text{Density} = \frac{\text{Total number of individuals of a species}}{\text{Total area}}$$

The health status test of mangrove ecosystem is using the density criteria (Table 1).

Table 1

The criteria of closure and density of mangrove (Kalor et al 2018)

Criteria		*Closure (%)*	*Density (tree ha^{-1})*
Good	Hight density	≥ 75	≥ 1500
	Medium	≥ 50 - < 75	≥ 1000 - < 1500
Demaged	Rarely	< 50	< 1000

Result and Discussion

The condition of mangrove ecosystem at Demta Gulf. This study found that the condition of mangrove ecosystem of the Demta Gulf was as follows: (1) semi-opened to the Pacific ocean, (2) dominated by 3 ecosystems i.e. mangrove ecosystem, seagrass ecosystem, and coral reef ecosystem, (3) low human negative impact. The results of measurement of chemistry and physics components of waters were found (1) salinity 45-47 ‰ , (2) temperature 31.3-36.7°C, (3) DO 5.3-8.2 mg L^{-1}, (4) substrate type of muddy sand and muddy.

Demta Gulf had 6 families and 9 mangrove species spread over 3 locations i.e. 8 species with diversity level 1.9 (medium) and density 3820.9 individual ha^{-1} in Ambora, 7 species with level of diversity 1.7 (medium) and density 3089.6 individual ha^{-1} in Yougapsa and in Ambora-Tarfia there were 8 species discovered with medium diversity level (1.6) and density 3593.8 individuals ha^{-1}.

In general, the level of mangrove diversity was considered moderate (H = 1.6-1.9). The level of mangrove diversity was suspected to be high, in accordance with the diversity of habitats and ecosystems in Demta Gulf, including (1) river mangrove ecosystems, (2) coastal mangrove ecosystems, and (3) terrestrial mangrove ecosystems. Do to high density (3089.6-3593.8 individuals ha^{-1}) and ecological status of mangrove ecosystem of Demta was found and classified as a healthy ecosystem (Table 2). Thus, it had the ideal physical and chemical status of water to support coastal fisheries in this area. According to Hutchison et al (2014), fish resources and productivity will increase and reach its peak if mangrove productivity is high, the total area of mangrove is at increase, and the mangroves have greater physical complexity.

Table 2

Diversity and density of mangrove ecosystem in Demta Gulf

Scientific name	*Family*	*Ambora*			*Yougapsa*			*Ambora-Tarfia*		
		N	*H*	*D*	*N*	*H*	*D*	*N*	*H*	*D*
Bruguiera gymnorhiza	Rhizophoraceae	77	0.3	641.7	63	0.3	525.0	126	0.4	1050.0
Bruguiera cylindrica	Rhizophoraceae	58	0.3	483.3	84	0.3	700.0	87	0.3	720.8
Derris trifoliata	Fabaceae	40	0.2	333.3	81	0.3	675.0	26	0.2	216.7
Rhizophora apiculata	Rhizophoraceae	140	0.4	1166.7	5	0.1	41.7	68	0.3	564.6
Rhizophora mucronata	Rhizophoraceae	91	0.3	754.2	53	0.3	439.6	103	0.3	858.3
Rhizophora stylosa	Rhizophoraceae	30	0.2	250.0	84	0.4	700.0	-	-	-
Xylocarpus moluccensis	Meliaceae	15	0.1	125.0	1	0.0	8.3	2	0.0	16.7
Sonneratia caseolaris	Lythraceae	8	0.1	66.7	-	-	-	3	0.0	25.0
Avicennia marina	Acanthaceae	-	-	-	-	-	-	17	0.1	141.7
	Total	459	1.9	3820.9	371	1.7	3089.6	432	1.6	3593.8

N = total number of species; H = the diversity value; D = density.

Fisheries resources of mangrove ecosystem in Demta Gulf. The mangrove ecosystem in Demta Gulf has diverse habitat characteristics, being suitable for many fish

species; moreover, the mangrove ecosystem here provides good water quality, moderate slope on the edge, slow flow, hanging vegetation that provides nuance and protection provided by mangrove canopy and root systems. This condition is available and observed in mangrove ecosystems in the bay of Demta, and this shows mangroves in good and healthy ecological conditions. The mangrove of Demta Gulf would enhance three ecological services, such us: First, mangroves as fish habitat, such as nursery ground, feeding ground, and spawning ground for fish species. Second, mangrove nurseries as the sanctuary for the younglings, increasing their survival chance from predators (Laegdsgaard & Johnson 2001). Third, these ecosystems are extremely important for the food webs for the neighboring ecosystems, because at an intermediate scale mangrove structure capture invertebrate food preyed by many fish and piscivorous predators (Laegdsgaard & Johnson 2001; Kathiresan & Bingham 2001).

Efflux detritus and nutrients enriched primary production in the neighboring ecosystem, large amount of leaves drop from the mangrove trees and were quickly decomposed by fungi and bacteria (Kathiresan & Bingham 2001). The fisheries resources of mangrove ecosystem of Demta Gulf consist of 21 families and 30 species of fish. A total of 11 species was widespread in the Gulf of Demta, i.e. *Pristiapogon fraenatus, Apogonichthyoides melas, Chaetodipterus faber, Nuchequula gerreoides, Photopectoralis aureus, Hyporhamphus quoyi, Macolor macularis, Crenimugil buchanani, Cephalopholis boenak*, *Terapon theraps* and *Toxotes jaculatrix*. Other 5 fish species which had comparatively narrow distributions are *Strongylura leiura, Myripristis adusta, Neoniphon sammara, Lutjanus boutton* and *Siganus guttatus* (Table 3).

Table 3

Fish resources in mangrove ecosystem in Demta Gulf

Scientific name	*Family*	*Yowari tribes name*	*Common name*	*Station*
Pristiapogon fraenatus	Apogonidae	Dakai tipir	Bridled cardinalfish	1, 2, 3
Apogonichthyoides melas	Apogonidae	Dakai tipir	Cardinal fish	1, 2, 3
Sphaeramia nematoptera	Apogonidae	Dakai tipir	Cardinal fish	2, 3
Strongylura leiura	Belonidae	Gaji	Banded needlefish	3
Gnathanodon speciosus	Carangidae	Awara	Golden trevally	2, 3
Nematalosa come	Clupeidae	Pylair	Western Pacific gizzard	2, 3
Chaetodipterus faber	Ephippidae	Dakitipir	Atlantic spadefish	1, 2, 3
Ophiocara sp.	Eleotridae	Warpam	Mud gudgeon	1, 2
Exyrias puntang	Gobiidae	Warpam	Puntang goby	1, 3
Hyporhamphus quoyi	Hemiramphidae	Jungun	Quoy's garfish	1, 2, 3
Myripristis adusta	Holocentridae	Kator	Shadowfin soldierfish	2
Neoniphon sammara	Holocentridae	Naukator	Sammara squirrelfish	2
Pomadasys argyreus	Haemulidae	Karus	Bluecheek silver grunt	2, 3
Lethrinus atkinsoni	Lethrinidae	Tama	Pacific yellow tail	2, 3
Nuchequula gerreoides	Leiognathidae	Awara	Golden ponyfish	1, 2, 3
Photopectoralis aureus	Leiognathidae	Awara	Golden ponyfish	1, 2, 3
Leiognathus equulus	Leiognathidae	Awara	Common ponyfish	2, 3
Lutjanus fulviflamma	Lutjanidae	Puraytir	Blackspot snapper	2, 3
Lutjanus boutton	Lutjanidae	Puraytir	Moluccan snapper	1
Lutjanus goldiei	Lutjanidae	Puraytir	Papuan black snapper	2, 3
Macolor macularis	Lutjanidae	Nauwkator	Midnight snapper	1, 2, 3
Upeneus vittatus	Mullidae	Marep	Yellowstriped goatfish	1, 3
Crenimugil buchanani	Mugilidae	Amakai	Bluetail mullet	1, 2, 3
Siganus guttatus	Siganidae	Uwga	Golden rabbitfish	1
Siganus canaliculatus	Siganidae	Uwga	White-spotted spinefoot	1, 2
Cephalopholis boenak	Serranidae	Padamuw	Brownbarred grouper	1, 2, 3
Synanceia verrucosa	Synanceiidae	Boydup	Reef stonefish	1, 3
Chelonodon patoca	Tetraodontidae	Dakaitipir	Gangetic pufferfish	2, 3
Terapon theraps	Terapontidae	Kambijau	Largescaled terapon	1, 2, 3
Toxotes jaculatrix	Toxotidae	Kwngor	Banded archerfish	1, 2, 3

1 = station Ambora; 2 = station Yougapsa; 3 = station Ambora-Tarfia.

Redjeki (2013) explained that mangrove ecosystem under ecological damage will directly or indirectly affect the marine and estuary organisms, including fish that live around mangrove ecosystem waters area, but mangrove ecosystem with a better ecological condition or a healthy condition will provide maximum services for marine creatures include mangroves fisheries.

Our findings suggest that changes, exchanges, and combinations of related components among the different ecosystems are the main reason for the species of each community in this area blend dynamically and form the variation of intra-species and inter-species relationships. As the ecotonic zone between mangrove ecosystems, seagrass ecosystems, and coral reef ecosystems in Demta Gulf, this combination and ecosystem relationships presented a large number of fish species in the mangrove ecosystem in Demta Gulf, and they are grouped into target fish, major fish, and fish indicators.

The target fish species of mangrove ecosystem in Demta Gulf. This study found 17 species of target fish in the waters of mangrove ecosystem at the Demta Gulf (Table 4). Target fish is the primary species predominantly caught by local fishermen. Based on the comparison of the number of individuals, the abundance, and the distribution of species in the study sites, there are two extremely dominant species namely *Crenimugil buchanani* and *Hyporhamphus quoyi* (Table 4). Both species had social behavior indicates that while they often gather and migrate in large schools, sometimes they are also found in small groups. Fish derive many benefits from shoaling behavior including defense against predators (through better predator detection and by diluting the chance of individual capture), enhanced foraging success, and higher success in finding a mate, also likely that fish benefit from shoal membership through increased hydrodynamic efficiency (Pavlov & Kasumyan 2000).

Table 4

Target fish species of mangrove ecosystem in Demta Gulf

Target fish species	*Ambora*			*Yougapsa*			*Ambora-Tarfia*		
	N	*H*	*D*	*N*	*H*	*D*	*N*	*H*	*D*
Crenimugil buchanani	42	0.4	350.0	40	0.4	333.3	57	0.4	475.0
Macolor macularis	2	0.1	16.7	10	0.2	83.3	4	0.1	33.3
Cephalapholis boenak	1	0.0	8.3	2	0.1	16.7	1	0.0	8.3
Siganus canaliculatus	32	0.4	266.7	12	0.2	100.0	-	-	-
Siganus guttatus	14	0.3	116.7	-	-	-	-	-	-
Lutjanus fulviflamma	2	0.1	16.7	5	0.1	41.7	1	0.0	8.3
Lutjanus boutton	2	0.1	16.7	-	-	-	-	-	-
Hyporhamphus quoyi	19	0.3	158.3	20	0.3	166.7	24	0.3	200.0
Lutjanus goldiei	-	-	-	4	0.1	33.3	5	0.1	41.7
Lethrinus atkinsoni	-	-	-	9	0.2	75.0	6	0.1	50.0
Leiognathus equulus	-	-	-	9	0.2	75.0	4	0.1	33.3
Gnathanodon speciosus	-	-	-	11	0.2	91.7	14	0.2	116.7
Pomadasys argyreus	-	-	-	6	0.1	50.0	12	0.2	100.0
Myripristis adusta	-	-	-	1	0.0	8.3	-	-	-
Neoniphon sammara	-	-	-	2	0.1	16.7	-	-	-
Nematalosa come	-	-	-	14	0.2	116.7	30	0.3	250.0
Strongylura leiura	-	-	-	-	-	-	10	0.2	83.3
Total number of individuals (N)	114			145			168		
Total number of species (S)	8			14			12		
Diversity index (H)	1.5			2.3			2.0		
Eveness index (E)	0.7			0.9			0.8		
Abundance index (D)	950.0			1208.3			1400.0		

N = total number of species; H = the diversity value; D = density.

Based on the diversity level analysis (H), evenness (E) and abundance (D) obtained from the calculation of the number of species and the number of individuals, it was found that diversity of fish in Ambora locations was moderately categorized (1.5) with evenness of species (0.7) and individual abundance 950 individual ha^{-1}. Yougapsa was categorized high (2.3) with high species evenness (0.9) and fish abundance is 1208.3 individual ha^{-1}, while Ambora-Tarfia was categorized high (2.0) with high species evenness (0.8) and fish abundance is 1400 individual ha^{-1}. According to Yulianto et al (2016), the existence of mangrove yields provisioning services to coastal fisheries by increasing in the catch effort and maximum sustainable yield (MSY), and maximum economic yield (MEY).

Almost 90% of the world's fishery catches come from oceans and seas, including mangrove waters. Most marine fisheries bases are located nearby the coast, because fish are much more abundant near the coastal ecosystems following mangrove ecosystem, sea grass, and coral reef. Nutrients, mollusks, crustaceans, and echinoderms are provided by the coastal ecosystems in abundance (McCook et al 2010).

Major fish species of mangrove ecosystem in Demta Gulf. There were 6 major fish species has identified in these research stations, regarding to the data in Table 5, it found that there were no major fish groups dominant in mangrove ecosystems in Demta Gulf. Major fish is fish species that often migrate to mangrove waters but is not included in the target fish category. The level of diversity (H) of major fish in Ambora water was categorized as moderate (1.8) with evenness of species (E) high or evenly distributed species (1.0) and abundance (D) of 125 individual ha^{-1}. Yougapsa water had moderate diversity level (1.5), high species evenness (0.9), and abundance of 150 individual ha^{-1}, whereas Ambora-Tarfia water was categorized with moderate diversity (1.7) with high species evenness (0.8) and individual abundance 233.3 individual ha^{-1}.

Table 5

Major fish species of mangrove ecosystem in Demta Gulf

Major fish species	*Ambora*			*Yougapsa*			*Ambora-Tarfia*		
	N	*H*	*D*	*N*	*H*	*D*	*N*	*H*	*D*
Synanceia verrucosa	1	0.2	8.3	-	-	-	6	0.3	50.0
Upeneus vittatus	1	0.3	8.3	-	-	-	3	0.2	25.0
Terapon theraps	4	0.4	33.3	6	0.4	50.0	4	0.3	33.3
Chaetodipterus faber	3	0.3	25.0	5	0.4	41.7	4	0.3	33.3
Nuchequula gerreoides	4	0.4	33.3	3	0.3	25.0	6	0.3	50.0
Photopectoralis aureus	2	0.3	16.7	3	0.3	25.0	6	0.1	50.0
Chelonodon patoca	-	-	-	1	0.2	8.3	2	0.2	16.7
Total number of individuals (N)	15			18			31		
Total number of species (S)	6			5			7		
Diversity index (H)	1.8			1.5			1.7		
Eveness index (E)	1.0			0.9			0.9		
Abundance index (D)	125.0			150.0			258.3		

N = total number of species; H = the diversity value; D = density.

Indicator fish species of mangrove ecosystem in Demta Gulf. Five species of indicator fish were found (Table 6), with 2 dominant species; *Toxotes jaculatrix* and *Pristiapogon fraenatus*. Indicator fish is a group of fish used as an indicator of the health of ecosystem water. If the abundance of indicator species is high then mangrove ecosystem is healthy. The level of diversity (H) of indicator fish in Ambora was categorized as moderate (1.5) with evenness of species (E) relatively or evenly distributed species (0.8) and abundance (D) of 1,175 individual ha^{-1}. The water of Yougapsa was categorized medium diversity (1.2), high species evenness (0.8), and individual abundance 450 individual ha^{-1}. Ambora-Tarfia water was categorized medium diversity (1.4), high species evenness (0.9) and individual abundance of 891.7 individual ha^{-1}.

Table 6

Indicator fish species of mangrove ecosystem in Demta Gulf

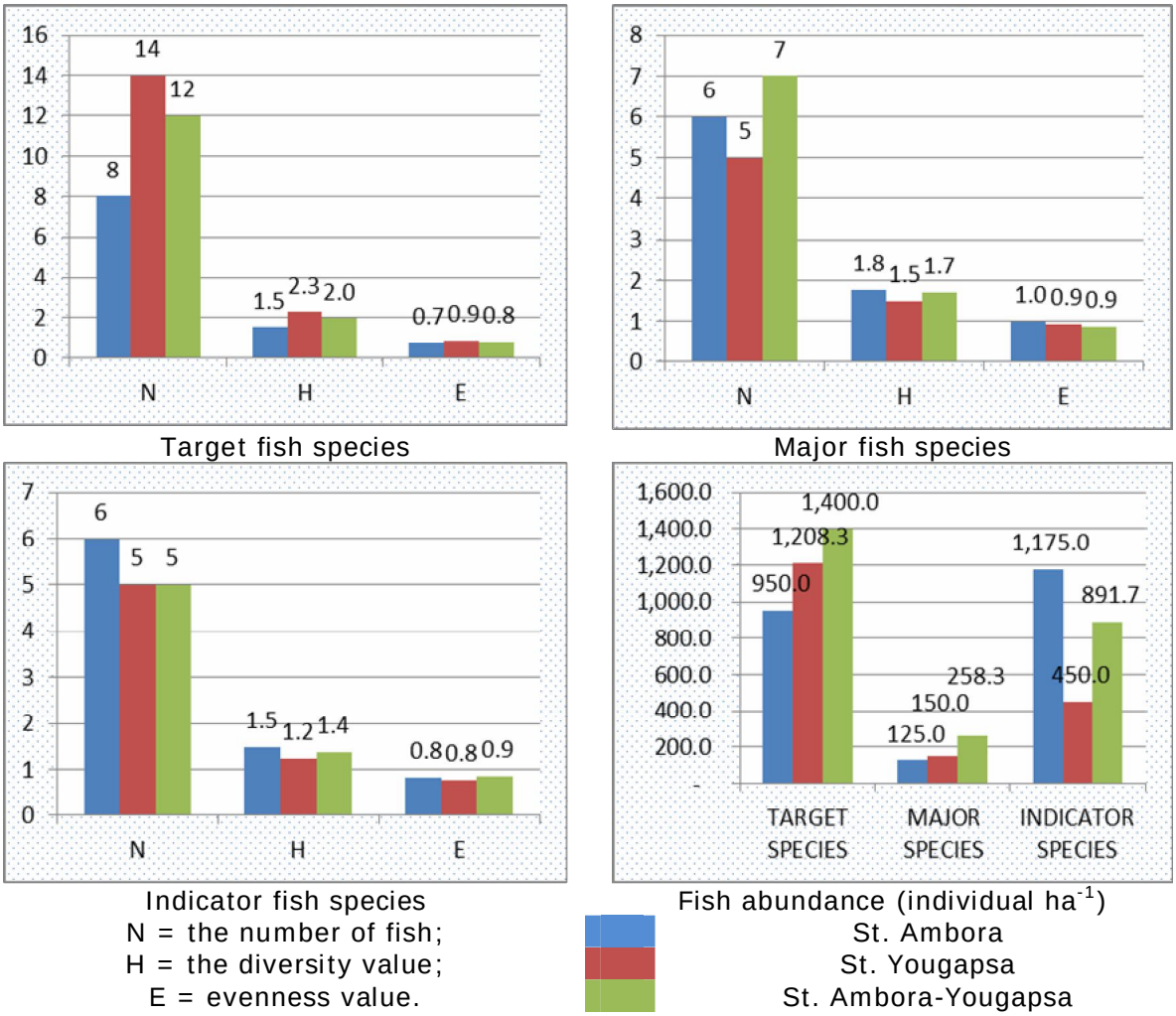
Indicator fish species	*Ambora*			*Yougapsa*			*Ambora-Tarfia*		
	N	*H*	*D*	*N*	*H*	*D*	*N*	*H*	*D*
Toxotes jaculatrix	62	0.4	516.7	18	0.4	150.0	39	0.4	325.0
Exyrias puntang	28	0.3	233.3	-	-	-	21	0.3	175.0
Pristiapogon fraenatus	26	0.3	216.7	8	0.3	66.7	10	0.2	83.3
Apogonichthyoides melas	12	0.2	100.0	24	0.4	200.0	34	0.4	283.3
Ophiocara sp.	1	0.2	100.0	1	0.1	8.3	-	-	-
Sphaeramia nematoptera	0	0.0	8.3	3	0.2	25.0	3	0.1	25.0
Total number of individuals (N)	129			54			107		
Total number of species (S)	6			5			5		
Diversity index (H)	1.5			1.2			1.4		
Eveness index (E)	0.8			0.8			0.9		
Abundance index (D)	1,175.0			450.0			891.7		

N = total number of species; H = the diversity value; D = density.

An indicator fish is any fish species or group of species whose function, population, or status reveals the quality of the environment. The species indicator or biological indicator is an organism response that reveals the presence of the pollutants by the occurrence of typical symptoms or measurable responses (Landres et al 1988; Carignan & Villard 2002; Holt & Miller 2011). These fish communities indicate alterations in the environment or the quantity of environmental pollutants which change them physiologically, chemically or behaviourally (Holt & Miller 2011).

Although mangroves are critical to the lives of many fish species, these values have rarely been definitively quantified. Despite this, claims such as “an estimated 75% of commercially caught fish depend directly on mangroves”, investigating the "75% rule" baseline has not been scientifically traceable due to lack of data (Sheaves 2017). Nevertheless, our research finds quantitative evidence that the numbers of fish species were highly dependent on the mangrove ecosystems. This research clearly reveals that target fish were the largest in fish population and fish diversity in Demta Gulf (Figure 2). This mangrove fisheries observation found that the fish population in Table 4 shows 950 individuals in Ambora, 1208 individuals in Yougapsa, and 1,400 individuals in Ambora-Tarfia, this is an important fishery resource for the survival of coastal communities in Demta Gulf. According to Aburto-Oropeza et al (2008) and Vincentius et al (2018), fisheries resources were positively related to the local abundance of mangrove, to the productive area in the water mangrove ecosystem that functions as the nursery and feeding ground by many commercial fish species in California Gulf. Yulianto et al (2016) reported that approximately 70% of the catch with the fishing gear are fish associated with mangrove in Indramayu Regency, West Java.

This study proved that healthy mangrove ecosystems are important for target fish, major fish, and indicator fish species. If mangrove ecosystems are healthy, then they will function as spawning, breeding, feeding, and protecting land for fish. We found more fish in mangrove waters in Demta Gulf, with several species that have not been included in this data. Therefore, further research is needed. This study proves that a healthy mangrove ecosystem will guarantee fisheries resources in the sea and coast.



N = the number of fish;
H = the diversity value;
E = evenness value.

St. Ambora
St. Yougapsa
St. Ambora-Yougapsa

Figure 2. The graphic of target fish group, mayor fish, indicator fish, and fish abundance.

Conclusions. The Mangrove ecosystem in the Demta Gulf was categorized as healthy, with high fishery resources consisting of 21 families and 30 species. The target fish are consisted 17 species were are found with moderate diversity in the Station Ambora, and high diversity in Yougapsa and Ambora-Tarfia, the total population or abundance for three Stasiun is about 3,558 individual ha^{-1}. The major fish species are found 7 species, is classify as moderate diversity in Ambora (1.8), Yougsa (1.5) and Ambora-Tarfia (1.7), the total population or abundance for three Stasiun is about 533 individual ha^{-1}. The indicator fish were found 6 species with the moderate level of diversity in Ambora (1.5), Yougapsa (1.2) and Ambora-Tarfia (1.4), and the total population for three locations is about 2,517 individual ha^{-1}. Fish resources and productivity will increase and reach its peak if mangrove productivity is high, the total area of mangrove increase, and the mangroves have greater physical complexity.

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