

## Community structure of reef fish in the southern waters of Ambon Island, eastern Indonesia

<sup>1,2</sup>Gino V. Limmon, <sup>1,2</sup>Frederik Rijoly, <sup>1,2</sup>Ong T. S. Ongkers,  
<sup>1,2</sup>Sven R. Loupatty, <sup>1,2</sup>Jesaja A. Pattikawa

<sup>1</sup> Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia; <sup>2</sup> Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University, Ambon, Indonesia. Corresponding author: J. A. Pattikawa, boypattikawa@yahoo.com

**Abstract.** Ambon Island is one of the islands in Maluku Province which is well known for a long time for its beautiful sea scenery, being surrounded by coral reef which has variety of fish. This research was conducted in the southern waters of Ambon Island on November 2015 to study the community structure of reef fish. Data of reef fish were collected by using underwater visual census at coastal waters of seven villages namely Hutumuri, Rotong, Leahari, Hukurila, Seri, Pintu Kota and Lathalatu/Namalatu. Totally, there were 23155 individuals of reef fish found during the study with total density of 4.87 ind m<sup>-2</sup>. Shannon diversity index (H'), Simpson dominance index (D) and Shannon Evenness index (E) were 3.86, 0.06 and 0.68, respectively. Based on those indexes, it can be concluded that reef fish community in the southern waters of Ambon Island had high diversity, low dominance and stable condition.

**Key Words:** taxa composition, density, occurrence, diversity, Ambon Island.

**Introduction.** Maluku Province is well known as an archipelago province because it has 1394 islands in which most of them are small islands. It is not surprising that most of territorial of Maluku Province, i.e. about 93.5% is covered by sea water (Suryawati & Tajerin 2015). This province is well known as one of the main producer of marine fish and it is being considered as *Lumbung Ikan Nasional* (Center of National Marine Food Fish) in Indonesia.

Ambon Island is one of the islands in Maluku Province which is well known for a long time for its beautiful sea scenery, because it is surrounded by coral reef which has variety of fish. Sea water surrounding Ambon Island is influenced by Banda Sea and it is included in the center of Coral Reef Initiative because it has the highest variety of fish in the world (Kuitert & Tonzuka 2001). Estimated number of reef fish in Banda Sea including Maluku waters is about 28.8% of 6000 species of reef fish in the world (Allen 2008; Green et al 2008).

Limmon et al (2017a) stated that some international and national researchers have studied reef fish in Ambon Island and its surrounding waters. However, in order to manage fishery resource, recent information on reef fish is needed. For that reason, this research was conducted to study reef fish in Maluku waters by focusing on community structure of reef fish in the southern waters of Ambon Island.

**Material and Method.** This research was conducted in the southern waters of Ambon Island at coastal waters of seven villages on November 2015 (see Limmon et al 2017a for detail locations). Southern part of Ambon Island is an open water and it is directly affected by Banda Sea. Water temperature in the area ranges from 31.11 to 31.18°C (30.14±0.02°C) while salinity ranges from 32.01 to 32.03 ppt (32.02±0.01 ppt) (Rumahlatu & Leiwakabessy 2017). Clarity of the water in southern Ambon Island is more than 10 m during the sunny day. The formation of coral lifeform is determined mainly by hydrodynamic condition of the waters. As the area of southern Ambon Island is an open water, the wave action and wind exposure are high from Banda Sea especially

during east monsoon that influence occurrence of coral reef. Rijoly (2015) stated that hard corals in the area are dominated by massive, submassive, encrusting, digitate and coral branching forms which are more resistant to the wave action and wind exposure while *Acropora* branching and *Acropora* tabulate form only found in the shield area or in deeper waters. Based on percentage of cover, hard coral in the area can be categorized into poor (0-24.9%) to fair (25-49.9%) categories (Rijoly 2015).

Data of reef fish was collected by using Underwater Visual Census at the depth of 3 to 10 m according to English et al (1994) at 19 transects and identified to the species level as possible based on standard literature as listed in Limmon et al (2017a).

Density of reef fish in the southern waters of Ambon Island was analyzed based on Krebs (1985):

$$D \text{ (ind. m}^{-2}\text{)} = n/a$$

where: D = density;  
n = number of individual fish;  
a = sampling area.

Community structure of reef fish was determined by using ecological indexes proposed by Magurran (1991):

Shannon Diversity Index (H')

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

Simpson Dominance Index (D):

$$D = \sum \frac{n_i(n_i - 1)}{N(N - 1)}$$

Evenness Index of Shannon (E):

$$E = H' / \ln S$$

where: ln = natural logarithm;  
p<sub>i</sub> = n<sub>i</sub>/N;  
n<sub>i</sub> = number of individuals of the i<sup>th</sup> species;  
N = total number of individuals;  
S = number of species.

Data was processed by using PAST (Paleontological Statistic) (Hammer et al 2001) and Microsoft Excel 2010 programs.

## Results and Discussion

**Taxa composition of reef fish.** There were 42 families which consist of 116 genera and 293 species of reef fish found during the study (Table 1). There was a great variation in number of species found for each station, ranging from 59 species (Hukurila) to 185 species (Seri). The most common species belonged to family Pomacentridae (52 species), followed by families of Labridae, Chaetodontidae, Acanthuridae and Scaridae accounted for 54.60% of the total species of reef fish found in southern waters of Ambon Island (Figure 1). This figure is similar to the result of Sahetapy et al (2018) in Tuhaha bay, Saparua Island, Maluku Province. In general, sampling sites with more transect composed more families, more genera and more species. This result is in line with Randall & Kunzmann (1998) as cited by Peristiwady (2012) who stated that the number of species will certainly increase if more frequent and continuation of sampling is done in one location.

Table 1

Taxa composition and density of reef fish in the southern waters of Ambon Island

Station	Number of transects	Family	Genera	Species	n (ind.)	D (ind. m <sup>-2</sup> )
Hutumuri	1	24	47	76	1496	5.98
Rotong	6	33	78	154	7751	5.17
Leihari	3	31	75	154	4848	6.46
Hukurila	1	19	40	59	1634	6.54
Seri	6	32	87	185	5790	3.86
Pintu Kota	1	23	45	72	790	3.16
Namalatu/Latuhalat	1	19	44	75	846	3.38
Total	19	42	116	293	23155	4.87

Notes: n = number of individuals; D = density.

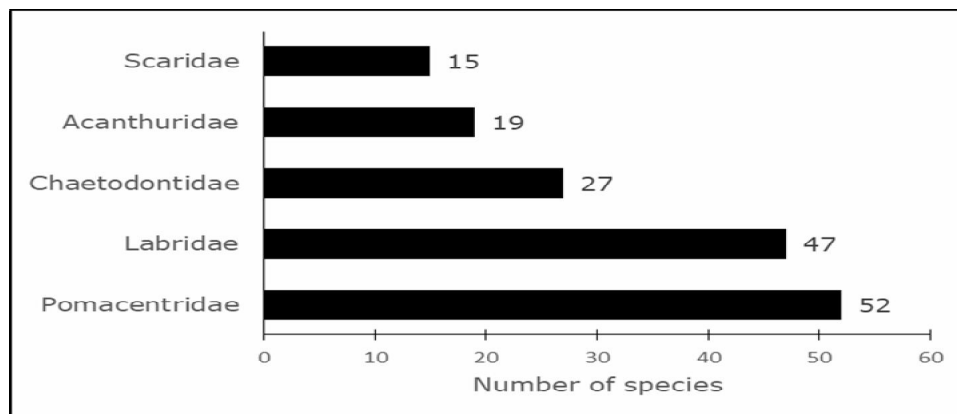


Figure 1. The most common families of reef fish.

The number of species of reef fish found in this study is higher compared to the number of species previously reported by other researchers in Ambon Island. As a comparison, Hukom et al (1987) found 122 species of reef fish in Ambon bay, while Syahailatua (2010) reported as many as 276 species of reef fish in Ambon Island and its surrounding waters. Species richness of reef fish found in this study is also higher than the number of species of reef fish at other regions in Indonesia as reported by Wibowo & Adrim (2013) in Prigi bay, Trenggalek, and Adrim et al (2012) in Kendari waters as well as Marasabessy (2010) in coastal waters of East Biak. However, the number of species found in this study is lower than the species of reef fish found by Limmon et al (2017b) i.e. 355 species. The number of reef fish found by Limmon et al (2017b) is higher than the present study because their study has covered not only southern waters of Ambon Island but also it has longer period of study. In addition Limmon et al (2017b) also included fish which are caught by all fishers around Ambon Island in the main fish market in the island.

**Occurrence and density of reef fish.** Occurrence of reef fish in the southern waters of Ambon Island varied, ranging from only in one transect to all the 19 transects. There were 88 species of reef fish occurred in 1 transect only and 6 species occurred in all transect (100% occurrence). Those species of reef fish that had the highest occurrence in this area were *Balistapus undulatus*, *Chaetodon kleinii*, *Ctenochaetus striatus*, *C. strigosus*, *Labroides dimidiatus* and *Paraupeneus multifasciatus*. Four species that had 100% occurrence namely *Chaetodon kleinii*, *Ctenochaetus striatus*, *C. strigosus* and *Labroides dimidiatus* belonged to 3 of 6 common families i.e., Chaetodontidae, Acanthuridae and Labridae which have been used by Allen (1998) and Allen & Erdmann (2012) to determine Coral Fish Diversity Index in order to estimate total number of species of reef fish in one area.

Density of reef fish in the southern waters of Ambon Island ranged from 3.16 to 6.54 ind. m<sup>-2</sup> with total density was 4.87 ind. m<sup>-2</sup> (Table 1). It can be seen in Table 1 that there are 3 locations namely Hutumuri, Leihari and Hukurila which have high density of reef fish. This high density occurs because of the presence of 5 species namely *Melichthys niger*, *Odonatus niger*, *Pterocaesio pisang*, *P. tile* and *Spratelooides* sp. which consist about 45.4% of 23155 individuals of reef fish found in the southern waters of Ambon Island during the research. Density of reef fish in the southern waters of Ambon Island is higher than density of reef fish in Pari Island, Kepulauan Seribu i.e 1.98 ind. m<sup>-2</sup> as reported by Dhahiyat et al (2003).

**Diversity of reef fish.** Diversity of reef fish in the southern waters of Ambon Island based on ecological indexes is presented in Table 2. Shannon diversity index ranged from  $H' = 1.45$  to  $H' = 4.06$  with total  $H' = 3.86$ . Totally, diversity value of Shannon in the southern waters of Ambon Island ( $H' = 3.86$ ) is higher than Shannon indexes of reef fish in Kepulauan Seribu ( $H' = 2.60$ ) (Dhahiyat et al 2003), Kendari waters ( $H' = 3.23$ ) (Adrim et al 2012) and in Prigi bay, Trenggalek ( $H' = 3.35$ ) (Wibowo & Adrim 2013).

Magurran (1991) stated that value of Shannon diversity index is influenced by the number of species in the area and distribution of individual belonged to each species. Furthermore, Mason (1981) stated that Shannon diversity index can be used to classify diversity of community in certain area by using following categories i.e., low diversity ( $H' < 1$ ), moderate diversity ( $1 \leq H' \leq 3$ ) and high diversity ( $H' > 3$ ). Based on those categories, diversity of reef fish at 7 locations in the southern waters of Ambon Island can be classified into moderate to high. Low value of Shannon index in 3 locations i.e., Hutumuri, Leihari and Hukurila is caused by unequal distribution of individual of some species especially high number of individual of *Spratelooides* sp. in those sites. For example, reef fish in Hukurila waters is dominated by *Spratelooides* sp. which consist as many as 73.4% of the total 1634 individuals of reef fish found in this area.

Table 2

Ecological indexes of reef fish in the southern waters of Ambon Island

<i>Location</i>	<i>H'</i>	<i>E</i>	<i>D</i>	<i>1/D</i>
Hutumuri	2.76	0.64	0.16	6.3
Rotong	3.29	0.66	0.08	12.5
Leihari	2.76	0.55	0.15	6.7
Hukurila	1.45	0.36	0.54	1.9
Seri	4.06	0.78	0.05	20.0
Pintu Kota	3.03	0.71	0.11	9.1
Namalatu/Latuhalat	3.41	0.79	0.06	16.7
Total	3.86	0.68	0.06	16.7

Notes:  $H'$  = Shannon index;  $E$  = evenness;  $D$  = Simpson dominance index.

Evenness index ( $E$ ) of reef fish in the southern waters of Ambon Island ranged from 0.36 to 0.79 with total value of  $E = 0.68$  (Table 2). Magurran (1991) stated that the value of  $E$  ranged from 0 to 1, in which  $E = 1$  means that each species in the community has equal number of individuals. According to Odum (1975), a community is in stable condition if the value of  $E \geq 0.6$ . Based on this statement, reef fish community in the southern waters of Ambon Island is in stable condition. However, there are two locations i.e., Hukurila and Leihari that have evenness value,  $E < 0.6$  which means that reef fish community at both areas are in unsteady condition. This unstable condition is caused by dominance of some species of reef fish in those location especially *Spratelooides* sp.

Dominance index of Simpson ( $D$ ) for reef fish in the southern waters of Ambon Island ranged from 0.06 to 0.54 (Table 2). The value of  $D$  ranging from 0 to 1 and dominance is high when its value is close to 1 (Magurran 1991). According to Legendre & Legendre (1983), domination of species in a community based on Simpson index can be classified into 3 categories i.e., low ( $D < 0.4$ ), moderate ( $0.4 > D < 0.6$ ) and high ( $D \geq$

0.6). Based on those criteria, community of reef fish in the southern waters of Ambon Island have low dominance except for reef fish community at Hukurila waters ( $D = 0.54$ ) that has moderate dominance. The high value of  $D$  at Hukurila is caused by high number of individual of *Spratelooides* sp. In relation to diversity, Magurran (1991) stated that reciprocal value of Simpson index ( $1/D$ ) is used more frequent because increasing of reciprocal value will increase diversity. It can be seen in Table 2 that the lowest of reciprocal value of Simpson index belonged to reef fish community at Hukurila while the highest represented by reef fish community at Seri waters. The lowest of reciprocal value of Simpson index indicates that diversity of reef fish community at Hukurila waters is lower compare to diversity of reef fish community at other locations in the southern waters of Ambon Island.

**Conclusions.** Totally, there are 23155 individuals of reef fish found during the study in the southern waters of Ambon Island with total density of  $4.87 \text{ ind. m}^{-2}$ . Based on ecological indexes, community structure of reef fish in the area has high diversity, low dominance and steady condition.

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Authors:

Gino Valentino Limmon, Pattimura University, Faculty of Fisheries and Marine Science, Department of Aquatic Resource Management, Indonesia. Jl. Mr. Chr. Soplanit, Kampus Poka-Ambon 97233; Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, e-mail: gino.limmon@gmail.com

Frederick Rijoly, Pattimura University, Faculty of Fisheries and Marine Science, Department of Aquatic Resource Management, Indonesia. Jl. Mr. Chr. Soplanit, Kampus Poka-Ambon 97233; Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, e-mail: nokerijoly@yahoo.com

Ong Tony Samuel Ongkers, Pattimura University, Faculty of Fisheries and Marine Science, Department of Aquatic Resource Management, Indonesia. Jl. Mr. Chr. Soplanit, Kampus Poka-Ambon 97233; Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, e-mail: ongkers\_tony@yahoo.co.id

Sven Robert Loupatty, Pattimura University, Faculty of Fisheries and Marine Science, Department of Aquatic Resource Management, Jl. Mr. Chr. Soplanit, Kampus Poka-Ambon 97233 Indonesia; Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, e-mail: svenloupatty@yahoo.co.id

Jesaja Ajub Pattikawa, Pattimura University, Faculty of Fisheries and Marine Science, Department of Aquatic Resource Management, Indonesia. Jl. Mr. Chr. Soplanit, Kampus Poka-Ambon 97233; Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, e-mail: boypattikawa@yahoo.com

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