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Reef fishes in the marine protected area of Dampier strait, raja ampat islands, West Papua Province, Indonesia

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Abstract

Research to study reef fish was carried out at coastal water of eighteen station in the Marine Protected Area of Dampier Strait, Raja Ampat (MPA- DSRA) on November 2017. Reef fish in the area was observed by using underwater visual census method at a belt transect of 350 m² (70 m length, 5 m width). Primary data obtained reef fish found in this research consists of 240 species in 98 genera and 30 families. Coral Fish Diversity Index (CFDI) determined based on six main families indicated that relative diversity of reef fish in the area can be classified into very poor to poor. Categories. Based on CFDI value, the estimated number of reef fish in the Marine Protected Area of Dampier Strait, Raja Ampat was 474 species.

Keywords: reef fish, species composition, coral fish diversity index, radja ampat

1. Introduction

Marine waters in the Raja Ampat Islands are part of the "coral triangle" which is the center of the coral distribution. The results of research conducted by Conservation International's Marine Rapid Assessment Program (RAP), Fenner (2002) ^[1]; Wells (2002) ^[2]; Allen (2002) ^[3] in the waters of Raja Ampat found 456 species of hard corals, 699 species of mollusks and 972 species of reef fish in 45 observation locations.

Radja Ampat Islands has been visited by scientists since 18th century to study reef fish. For example Quoy and Gaimard (1824 and 1834) ^[4]; Lesson (1828 -1830) ^[4], Cuvier and Valenciennes (1828 – 1849) ^[4]. Furthermore, it was also reported that Weber and de Beaufort (1910-1940) ^[4] have successfully documented as many as 117 reef fish species from 748 fish specimens found on Waigeo Island, Saonek and Teluk Mayalibit, Raja Ampat Regency. Furthermore, Allen (2002) ^[3] report that reef fish in Radja Ampat Islands has also been studied by Myers, Randal *et al* and Kuiter. Hukom (2002) ^[5] in a study on Batang Pele Islands and Ayau Island in Radja Ampat waters found 336 species of reef fish, while in the research on Salawati and P. Batanta Island in Radja Ampat Islands Hukom (2015) ^[6] found 74 species can be categorized into target species and indicator species (20 species), while Rondonuwu (2017) ^[7] in the same location found indicator species (32 species). This research was conducted with the main objectives to study species composition and relative diversity of reef fishes in the Conservation Area of the Dampiers Strait, Radja Ampat Regency.

2. Materials and Methods

This research was carried out on November 2017 at 18 stations in the Conservation Area of the Waters of the Dampier Strait, Raja Ampat Regency (Figure 1) Collecting coral fish data was done by using Underwater Visual Census (UVC) according to English *et al.* (1994) ^[8], and that has been modified by Giyanto *et al.* (2014) ^[9] at 350 m² transect (70 m length and 5 m width). Coral fish data collection refers to the guidebook Kuiter (1992) ^[10], Allen (2000) ^[11], Kuiter and Tonzuka (2001) ^[12], Allen *et al.* (2003) ^[13], Kuiter and Debelius (2006) ^[14] and Allen and Erdmann (2012) ^[15] Total species of reef fish in the area was estimated by using Coral Fish Diversity Index (CFDI) for restricted small areas (< 2,000 km) proposed by Allen (1998) ^[16] and Allen and Erdmann (2012) ^[15]: Estimated total species (< 2,000 km) = (3.39 x CFDI) – 20.595. CFDI was also used to classify relative diversity of reef fish (Allen 1998) ^[16] and Allen and Erdmann (2012) ^[15] as presented in Table 1.

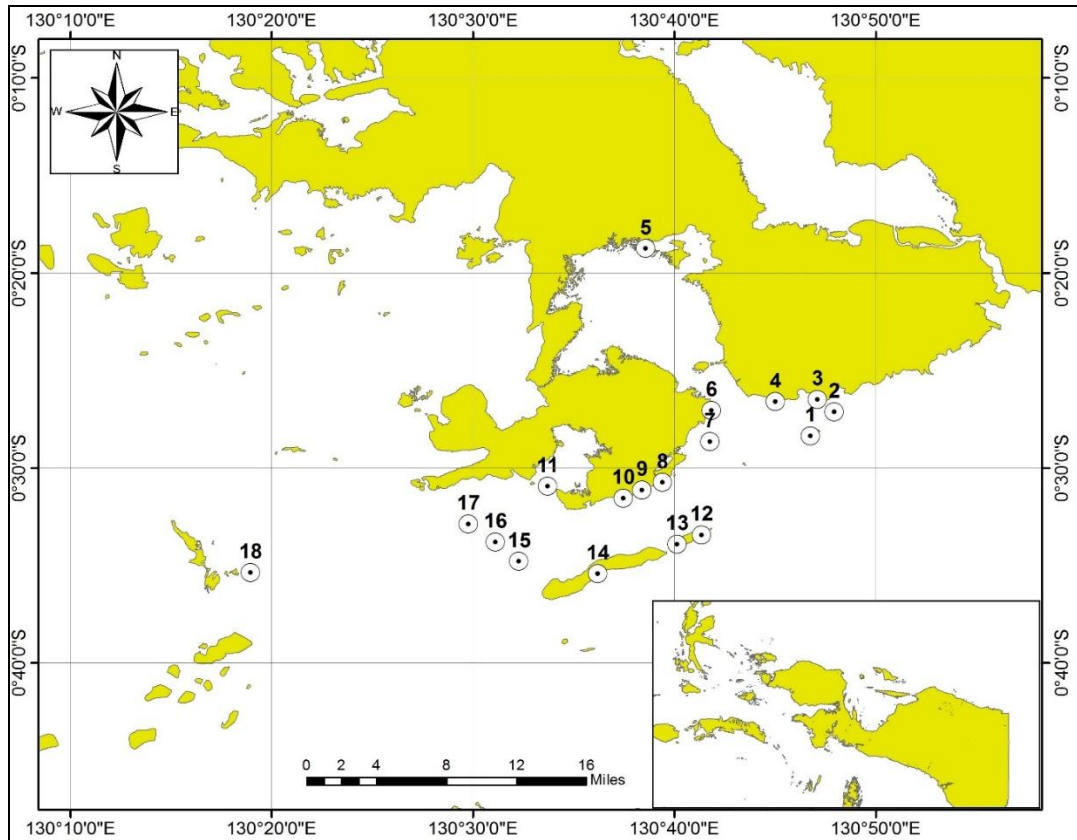


Fig 1: Map showing sampling sites

Table 1: Relative diversity of reef fish based on CFDI

Category	CFDI value		
	Sampling site	Local region	National region
Extraordinary	> 150	> 330	> 400
Excelent	130 – 149	260 – 329	330 - 339
Good	100 – 129	200 – 259	220 - 329
Moderate	70 – 99	140 – 199	160 - 219
Poor	40 – 69	50 – 139	80 – 159
Very poor	< 40	< 50	< 80

3. Results and Discussion

3.1 Biodiversity

The total reef fish of the Strait of Dampier reported herein of 240 species belonging to 98 genera, and 30 families were recorded during the present study. From 30 fish family found, five families with highest number of species, in decreasing order, are Pomacentridae (49 species), Labridae (28 species), Chaetodontidae (27 species), Acanthuridae (13 species), Pomacanthidae (12 species). Total number of species from those five families collectively contributes approximately 53,75 % of the total coral reefs fishes found in Radja Ampat Islands. Pomacentridae and Labridae are the two families with the highest number among 38 other families. These two families were found with high species diversity in the locations of Batang Pele and Ayau Islands in the waters of Ampat Radja [5], coral reef of Saparua Islands [17], coral reef of Tuhaha Bay [18], coastal area of southern Ambon Islands of Maluku Province [19], reef fishes in innner Ambon Bay [20]. According to Allen and Erdman (2012) [15] states that the two families are always found with a high number of species in the coral reef ecosystem.

There are two locations that are relatively high in number, namely Cape Kri (79 species) and Melisa Garden (79 species), while the positions of Kopisawar (33 species), Saonek village (42 species) and Kabui Bay (43 species) are

locations with low species diversity (Table 2). Allen (2002) [3] found that Cape Kri (283 species) and Melisa Garden locations (213 species) were the locations with the highest number of species while Kabui Bay (83 species) was the location with the lowest number of species.

Table 2: Biodiversity of reef fish in Strait Dampier in Raja Ampat Islands

No Station	Name of Station	Number of Species	Number of Genera	Number of Families
1	Saonek Island	51	34	13
2	Litle Saonek Island	54	33	13
3	Gurabessy Village	57	36	14
4	Saonek Village	42	29	13
5	Kabui Bay	43	31	14
6	Five Rock	76	50	17
7	Friwen Monda	71	49	18
8	S Gam Island	70	43	18
9	Friwen Jetti	69	42	15
10	Friwen NTZ	67	48	15
11	Kopisawar	33	24	10
12	Cape Kri, Kri Island	79	45	16
13	Yenbuba Village	64	43	17
14	Saundarek Vilage	63	37	14
15	Arborek NTZ	68	37	18
16	Arborek Jetti	52	33	11
17	Lalosi Reef	63	40	12
18	Melisa Garden	79	50	16
	Total	240	98	30

The number of species found in Allen study (2002) [3] in Radja Ampat Islands (828 species) is higher than number of species found in this study (240 species). The higher number of species found in Allen study could be due to more station observed (49 station) compare to 18 stations in this study. Limon *et al* (2018) [19] found a higher number of reef fish species compared to those found by Rijoly (2016) [21] in Ambon island waters, because the Limon *et al* study (2018)

^[19] could be due to more stations observed (19 stations) compare to 11 stations studied by Rijoly (2016) ^[21].

The results of a study conducted by Allen (2002) ^[3] at 4 locations are similar to this study found reef fish at the Cape Kri site as 283 species, Kabui Bay 89 species, S Gam 210 species and Melisa Garden 213 species. The high number of species of reef fish found by Allen compared to the results of this study was due to the different methods used. In this study transects were carried out at only one depth of 5 m with an observation area of 350 m² (70 m x 5 m), while Allen (2002) ^[3] did a free transect with depth up to 46 m so that the area of observation was estimated at 3, 220 m² (70 m x 46 m). According to Mulyadi & Rijoly as cited by Limon *et al* (2017) ^[19], observing reef fish using the free transect method (has a larger area of observation) will increase the number of reef fish species obtained.

3.2 Relative diversity

The results of the calculation of relative diversity (CFDI) in the eighteen research stations are listed in Table 3. Overall, the CFDI values for Marine Protected Areas of the Dampier Strait, Raja Ampat are 135 so that they can be classified as poor (see Table 1 for criteria). It can be seen in Table 3 that CFDI value for each station ranged from 22 (station 5) to 50 (station 10) and it can be categorized into very poor (9 stations) and poor (9 stations). The results of the CFDI obtained in this study did not differ significantly from the result found by Sahetapy *et al* (2018) ^[18] and Limmon *et al* (2017) ^[19]. Sahetapy *et al* (2018) ^[18] in the study at Tuhaha Bay found CFDI values ranged from 32 - 68 (categorized very poor to poor) and Limmon *et al*. (2017) ^[19] in a study at the Southern coastal waters of Ambon Island found that CFDI values ranged from 27 - 70 (categorized very poor to moderate)

Table 3: CFDI values, number of species and category of reef fish.

No Station	Name of Station	CFDI	Observed species	Estimated species	Category
1	Saonek Island	37	51	105	Very Poor
2	Litle Saonek Island	36	54	101	Very Poor
3	Gurabessy Vilage	35	57	98	Very Poor
4	Saonek Vilage	31	42	85	Very Poor
5	Kabui Bay	22	43	54	Very Poor
6	Five Rock	44	76	129	Poor
7	Friwen Monda	38	71	108	Poor
8	S Gam Island	44	70	129	Poor
9	Friwen Jetti	48	69	142	Poor
10	Friwen NTZ	50	67	149	Poor
11	Kopisawar	26	33	68	Very Poor
12	Cape Kri, Kri Island	43	79	125	Poor
13	Yenbuba Vilage	37	64	105	Very poor
14	Saundarek Vilage	47	63	139	Poor
15	Arborek NTZ	41	68	118	Very Poor
16	Arborek Jetti	40	52	115	Very Poor
17	Lalosi Reef	38	63	108	Poor
18	Melisa Garden	40	79	115	Poor
	Total	146	240	474	Poor

The total CFDI for the Marine Protected Area of Dampier Strait, Raja Ampat (MPA-DSRA) has the following components Pomacentridae (55), Labridae (29), Chaetodontidae (28), Acanthuridae (13), Pomacanthidae (12) and Scaridae (9) so that the total the value is 146 species of reef fish. It can be seen in Table 3, that the observations of reef fish in eighteen observation stations found 145 species of reef fish. Estimates using CFDI Allen (1998) ^[16] and Allen and Erdman (2012) ^[15] resulted in a predictive value of 474 species. This means that there are approximately 214 species of fish are still found in these waters. This statement is supported by the results of the study by Allen (2002) ^[3] who found as many as 446 species of fish in the waters of Raja Ampat in four stations namely Cape Kri station, Kabui Bay, S

Gam Island and Melisa Garden (Table 4). While in the present study only 156 species of reef fish in the same four locations. Observations in this study used the belt transect method only at a depth of 5 m with an area of 350 m² (70 m x 5 m), while Allen (2002) ^[3] using free transects on depth of 2 m - 46 m with an estimated area survey of 3,220 m² (70 m x 46 m). The area of observation led to differences in the number of fish species found by Allen (2002) ^[3] compared to those found in this study. Large or small area of observation in a reef fish research station will be affect the number of species of fish found.

Comparison of Allen's (2002) ^[3] observations with several locations of this study are listed in Table 4 below.

Table 4: CFDI results at four stations in Raja Ampat waters with a different area of observation. This StStudy (350 m²), Allen 2002 (4200 m²) ^[3]

No Station	Nama of Station	Coordinates	CFDI	Observed species	Estimated species	Category
1.a.	Cape Kri This study	0° 33.470' S 130° 41.362'	43	79	125	Poor
1.b	Cape Kri Allen (2002)	0° 33.470' S, 130° 41.362'	153	283	498	Excellent
2.a.	Kabui Bay This study	0° 18.761' S, 130° 38.581'	22	43	54	Very Poor
2.b.	Kabui Bay Allen (2002)	0° 18.761' S, 130° 38.581'	33	89	91	Very Poor

3.a.	S. Gam This study	0° 30.761' S, 130° 39.409'	44	70	129	Poor
3.b.	S. Gam Allen (2002)	0° 30.761' S, 130° 39.409'	116	210	373	Good
4.a.	Melisa Garden This study	0° 35.390' S, 130° 18.909'	40	79	115	Poor
4.b.	Melisa Garden Allen (2002)	0° 35.390' S, 130° 18.909'	118	213	379	Good
Total This study (4 station)			94	156	298	Moderate
Total study Allen (2002) (4 station)			195	446	641	Extra ordinary

This fact is the same as that presented by Rijoly (2015) [22] which states that conducting a visual census of reef fish using the free transect method will get more fish species than utilizing the Belt Transect Method. The observation between Allen (2002) [3] and this study in the same four locations if continued to be analyzed using linear regression can produce an estimate of Fish Species Diversity Estimation using the

Free Transect Method called Estimated Biodiversity by using Free Diving (EBFD) as follows :

$$Y = 3,0146 X - 17.024$$

By using the above equation, we can do the simulation with the following results as presented in Table 5.

Table 5: The results of the Estimation Biodiversity of Fish Species with the Free Diving Method (EBFD).

No Station	Name of station	Observed species	EBFD (species)	Observed species by Allen (2002) [3]
1	Saonek Island	51	137	-----
2	Little Saonek Island	54	146	-----
3	Gurabessy Village	57	155	-----
4	Saonek Village	42	110	-----
5	Kabui Bay	43	113	89
6	Five Rock	76	212	-----
7	Friwen Monda	71	197	-----
8	S Gam Island	70	193	210
9	Friwen Jetti	69	191	-----
10	Friwen NTZ	67	185	-----
11	Kopisawar	34	85	-----
12	Cape Kri, Kri Island	79	221	283
13	Yenbuba Village	64	173	-----
14	Saundarek Village	63	173	-----
15	Arborek NTZ	68	188	-----
16	Arborek Jetti	52	140	-----
17	Lalosi Reef	63	173	-----
18	Melisa Garden	79	221	213
Total		240	713	641

The results of observations using the Belt Transect Method, if analyzed by the formula presented in front, we will be able to estimate the number of species of fish that will be found when observing using the Free Transect Method. Examples can be seen as shown in Table 5 above.

The equation for assessing this estimation will get better results if done with a lot of repetition. For example, by researching 45 observation stations undertaken by Allen (2002) [3] in Raja Ampat or carried out in as many other locations as possible.

4. Conclusion

The results of observations of reef fish during this study in Marine Protected Area of Dampier Strait, Raja Ampat waters found 240 species consisting of 98 genera and 30 families. By using the Coral Reef Diversity Index, the diversity of reef fish species in this location can be predicted around 474 species.

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