FISH SPECIES COMPOSITION IN SEAGRASS BEDS OF TANJUNG MERAH (NORTH SULAWESI), INDONESIA

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Abstract

Seagrass beds are found along the shore of Tanjung Merah (North Sulawesi, Indonesia). This ecosystem covers approximately 20 hectars, and are well known to support local fisheries. *Thalassia hemprichii* was the dominant seagrass species at the study site. This study in the given area was aimed to monitor any changes in fish assemblage structure, and examine the function of seagrass beds for marine fish. Fishes were sampled using the small beam trawl in March 2003, April 2004 and September 2005. A total of 137 species belonging to 34 families were identified. Twenty four species were found abundantly in terms of individual numbers, however *Apogon margaritophorus* and *A. hartzfeldii* were the most dominant. These two species were permanent resident, indicated by a catch of large number in different stages of life cycle. We also noticed that many adults of *A. margaritophorus* kept fertilized eggs in their mouths. This evidence also confirmed that seagrass beds function as both spawning and nursery ground for marine fishes. During three years' monitoring, there was a slightly seasonal variety in fish assemblage structures.

Keywords: fish**,** seagrass, species composition, north Sulawesi, Indonesia

INTRODUCTION

One of the marine ecosystems with a high productivity is seagrass beds, which usually grow on the coast. Various studies have highlighted the role of seagrass beds as habitat for a multitude of fish and invertebrate species in tropical, subtropical and temperate coastal regions of the world (Bell and Pollard, 1989; Pinto and Punchihewa, 1996). Seagrass beds have several functions, including supporting primary production, decomposetion, substrate extension and sediment stabilizations (Den Hartog, 1970; Phillips, 1978). Seagrasses serve as a site for settlement of fish larvae (Rooker and Holt, 1997; Rooker *et al*., 1998) and are used by fish from a wide range of age category. This includes juveniles of innumerable species (Jenkins *et al.*, 1997). Seagrass provides their inhabitants with food, protection and shelters toward predators and physical disturbances (Jordan *et al.*, 1996). Therefore, marine biologists are attracted to study those environments and their associated organisms.

One important function of seagrass beds is nursery grounds. Most of the fishes in seagrass beds are juvenile or young individuals. As they grow, they migrate to other places. Example is various reef fishes (Springer and McErland, 1962; Den Hartog, 1970). Petersen reported in 1918 that fish abundance in Denmark was due to eelgrass (Phillips, 1978). In addition, fish populations fall off sharply when the seagrass collaps, even though not as bad as Petersen might have predicted. It

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is now believed that the rich organic sediment is supported by the eelgrass ecosystem over the years. Then, the nutrients come into the water mass, thus they have an immediate impact on the fisheries.

Reasons generated the movement of fish into the vegetated habitats areas are probably to forage, rest (Robblee and Zieman, 1984), seek refuge to avoid predators, as well as in response to tidal phase (Sogard *et al.*, 1989). In subtropical regions, especially in the Caribbean, two species from the family Scaridae are known as seagrass feeders: *Scarus* sp. and *Sparisoma* sp. (Schultz, 1958), and *Hemiramphus brasiliensis* in Puerto Rico (Burkholder *et al.*, 1959). Whilst, in Banten Bay (West Java, Indonesia), Hutomo (1985) found *Siganus canaliculatus*, *S. javus*, *S. guttatus* and *Moncanthus mylii* fed on seagrasses.

The components of fish communities also depend on their migratory pattern. Hutomo and Martosewojo (1977) divided the fish communities on the western side of Burung Island (Seribu Islands) into four groups. First, resident species which spawns and spends the greater part of their life cycle in the given habitat. Examples are *Apogon margaritophorus* and *Congrogadus subducen*. Second, species which spends most of their life in the area but migrate to other places for spawning. Examples are *Syngnathoides biaculeatus*, *Gerres macrosoma* and *Pranesus duodecimalis*. Third, species which is present in the area only during their juvenile stage, like *Siganus canaliculatus*, *Upeneus tragula* and *Scarus* spp. Fourth, species which is present in the area only occasionally.

Information on seagrass fish assemblages in North Sulawesi is very limited. In September 1992 and March 1993, fish sampling was conducted on the seagrass beds in the area using a beach seine. Sixteen locations were selected as the sampling sites, and a total of 160 species belonging to 48 families was identified (Peristiwady, 1992). The largest families were Apogonidae (12 species), Tetraodontidae (10 species), and Balistidae (9 species), whereas the highest number of species were found at Talise (51 sp), Lembeh Is. (43 sp) and Manado Bay (40 sp).

A study to record fish composition in seagrass beds and observe their annual variation has been conducted during period of 2003−2005. The results are presented here, and are expected to support the seagrass bed conservation program in North Sulawesi, especially in Tanjung Merah, Bitung.

METHODS

Study site

Tanjung Merah is situated in the vicinity of Lembeh Strait, and open to Maluku Sea. The area supports marine transportation, fishing, tourism and sports which bring consequences of disturbances on coastal ecosystems and marine life. Seagrass beds are found along the shore of Tanjung Merah, together with their neighbour coral habitat. These two types of habitat cover approximately 20 hectars of area, and are well known to support fisheries. *Thalassia hemprichii* was the dominant seagrass species in the study area, and *Acropora* spp. were the major coral taxa.

For this study, we designed three sites for fish sampling along the shore of Tanjung Merah (Table 1 and Figure 1).

Fish sampling

This study was conducted on 18−31 March 2003, 12−18 May 2004 and 3−8 September 2005. Samples of fishes were collected in seagrass beds using a beam trawl (½ and ¾ inches mesh net) with 0.40 x 1.00 m² opening.

This net was towed by a small boat (7 m length) with a speed of 2−3 knots. Every sampling tow took 5 minutes, two times for each sampling site. Trawls were carried out parallel or perpendicular of the coastline, depending on the topography or seagrass coverage, during high tide due to the sea water level for boat operating safety. Water temperature at sampling sites ranged 28.05−29.4°C and water transparency was 20 m.

After the trawl net pulling, fish samples were collected and placed in the basket with seawater in order to keep the fish alive as long as possible. The fish were then quickly sorted, counted and released back into the water. All specimens were identified to species level following Munro (1967), Kuiter (1992), Allen and Steene (1996) and Allen (1997). The basic statistics and diversity index were

applied to demonstrate the overall community structure of the seagrass fishes (Krebs, 1989).

Table 1. Geographical position of the the sampling sites in seagrass beds of Tanjung Merah, North Sulawesi.

Sites	Longitude (E)	Latitude (N)
1.	125°07′36.3′′ – 125°07′29.8′′	01°25′01.6′′ – 01°25′05.2′′
2.	125°07′14.2′′ – 125°07′03.3′′	01°24′13.2′′ – 01°24′00.9′′
3.	125°06′12.4′′ – 125°07′08.1′′	01°23′09.5′′ – 01°23′00.7′′

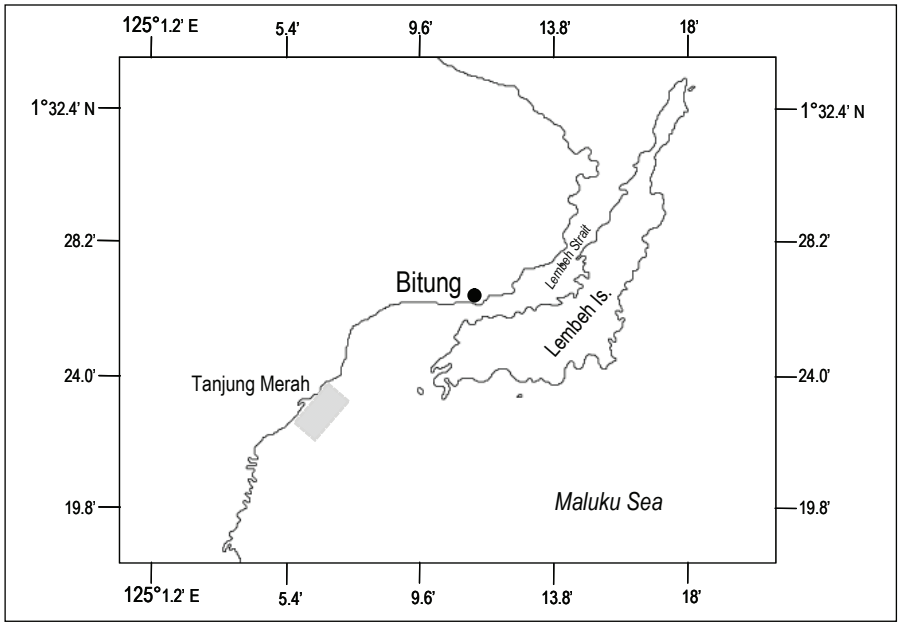

Figure 1. Location of fish sampling at Tanjung Merah (North Sulawesi). The sampling site is denoted in grey.

Table 2. The most abundant fish observed during the study.

Families	No. of Ind.			Scores			Relative Abundance		Total Abundance	
	2003	2004	2005	2003	2004	2005	∑ Score	Rank	∑ Ind.	Rank
Apogonidae	**3762**	**1087**	**817**	**10**	**10**	**9**	**29**	**1**	**5666**	**1**
Labridae	**407**	**157**	**1048**	**8**	**8**	**10**	**26**	**2**	**1612**	**2**
Syngnathidae	**754**	**122**	**185**	**9**	**7**	**7**	**23**	**3**	**1061**	**3**
Plotosidae	25	254	42	0	9	5	14	4	321	5
Pomacentridae	**394**	**38**	**20**	**7**	**6**	**1**	**14**	**4**	**452**	**4**
Siganidae	164	20	52	3	5	6	14	4	236	8
Lethrinidae	249	18	21	6	3	2	11	5	288	6
Engraulidae	0	0	221	0	0	8	8	6	221	9
Monacanthidae	98	20	36	0	4	3	7	7	154	12
Centriscidae	102	18	39	0	2	4	6	8	159	11
Teraponidae	235	12	2	5	0	0	5	9	249	7
Serranidae	**195**	**7**	**17**	**4**	**0**	**0**	**4**	**10**	**219**	**10**
Scorpaenidae	111	3	5	2	0	0	2	11	119	13
Mullidae	107	4	5	1	0	0	1	12	116	14
Parapercidae	95	15	3	0	1	0	1	12	113	15

RESULTS AND DISCUSSION

Family Composition

A total of 34 fish families were found in this study, however only 15 families had very significant individual number. We ranked and scored the dominant families (in terms of individual numbers), and only five families: Apogonidae, Labridae, Syngnathidae, Pomacentridae and Serranidae were similar in relative and total abundance (Table 2). It indicated that these five families occurred consistently during the three periods of sampling, and contributed significantly to the fish assemblage. The component of the major families was slightly different from a fish study of the seagrass beds of the Pari Islands (Hutomo and Martosewojo, 1977) which reported Apogonidae, Atherinidae, Labridae, Gerridae, Siganidae and Monacanthidae. There were only two families present in both studied locations, which were Apogonidae and Labridae, (Table 2). In Caribbean Coast of Panama, the most dominant families were Pomadsyidae (Haemulidae), Lutjanidae, Sciaenidae, Apogonidae and Muraenidae (Weinstein and Heck, 1979). Although similar gear was used in fish sampling, this difference was suggested that seagrass composition and latitude play significant role in family composition.

Species Composition

There were 137 species of seagrass fishes collected during this study. According to the list of all species identified and their ranks (in terms of individual numbers), there were two most abundant species; *Apogon margaritophorus* and *Corythoichthys intestinalis* (Table 3).

We also noted that the most abundant fishes (rank 1−10) consisted of 11 species, and made up more than 69% of total individual samples. However not all of the abundant species were sampled during each sampling period, for example, *Halichoeres miniatus* and *Halichoeres papilionaceus* were found only in 2005 (Table 4). This could indicate that a shift in species diversity occured in different sampling months.

The species richness recorded was also different in each sampling period of this study. In March 2003, we identified 105 species, whereas in April 2004 and September 2005, we had 50 and 60 species, respectively. The less species number in April 2004 and September 2005 may be due to the fewer number of sampling days, compared to March 2003. During the sampling period in March, we had 10 days in the field, whereas in April 2004 and September 2005, we were in the field only three days each. Possibly, more days of field work could increase the number of net tows and enhance the number of specimens collected. It confirmed of the seagrass fish observation in Burung Island (the Pari Islands, Indonesia) that there was a positive correlation between the number of individuals caught and the number of species recorded (Hutomo and Martosewojo, 1977).

Every seagrass bed may have a specific fish composition. We compared number of species found with that of previous studies in Indonesian waters; the Pari Islands has 78 species (Hutomo and Martosewojo, 1977), Ambon Island with 59 species (Syahailatua *et al.*, 1989), and Kuta, Lombok with 85 species (Hutomo and Peristiwady, 1996). It showed Tanjung Merah has more species number. The lower number of species may due to the sampling gear used. Our study was a beam trawl, while the previous studies used a beach seine. Differences in gear used for sampling might contribute to the differences in the 10 most abundant species (Table 4).

Besides the most abundant species, we noticed that only 21 of 137 species occurred in every sampling period (Table 5). These 22 species ranged between 4−4247 individuals, and made a significant contribution in species composition of more than 69% of the total individuals. In 2003, they made almost 68% of the total individuals, and in 2004 and 2005, they were about 87% and 51%, respectively. These species may use the seagrass beds quite frequently as residents, temporary residents during larval stages, residents during juvenile stages or occasional residents.

Table 3. Fish species sampled using beam trawl and ranked based on individual numbers caught.

No.	Jenis	Total	Rank
1.	*Apogon margaritophorus*	4247	1
2.	*Corythoichthys intestinalis*	794	2
3.	*Halichoeres miniatus*	577	3
4.	*Halichoeres papilionaceus*	314	4
5.	*Plotosus lineatus*	314	4
6.	*Cheilodipterus quinquelineatus*	287	5
7.	*Halichoeres melanurus*	284	6
8.	*Pomacentrus tripunctatus*	262	7
9.	*Apogon hartzfeldii*	261	8
10.	*Syngnathoides biaculeatus*	244	9
11.	*Pelates quadrilineatus*	239	10
12.	*Nematalosa japonica*	221	11
13.	*Centrogenys vaigiensis*	215	12
14.	*Siganus canaliculatus*	190	13
15.	*Apogon kallopterus*	165	14
16.	*Cheilio inermis*	164	15
17.	*Aeoliscus strigatus*	159	16
18.	*Apogon cooki*	158	17
19.	*Lethrinus ornatus*	151	18
20.	Acreichthys tomentosus	142	19
21.	*Fowleria* sp.	141	20
22.	*Lethrinus harak*	137	21
23.	*Rhabdamia* sp.	124	22
24.	*Parapercis cylindrical*	113	23
25.	*Apogon aureus*	105	24
26.	*Pentapodus trivittatus*	63	25
27.	*Parupeneus barberinus*	62	26
28.	*Cheilinus chlorurus*	59	27
29.	*Ctenogobius* sp.	56	28
30.	*Scarus* sp.	43	29
31.	*Stethojulis strigiventer*	40	30
32.	*Upeneus tragula*	40	30
33.	*Apogon multilineatus*	38	31
34.	*Archamia* sp.	35	32
35.	*Nectamia savayensis*	32	33
36.	*Siganus doliatus*	31	34
37.	*Abudefduf sexfasciatus*	29	35
38.	*Gymnothorax* sp.	29	35
39.	*Ablabys taenianotus*	27	36
40.	*Gerres oyena*	27	36
41.	*Parascorpaena picta*	26	37
42.	*Dendrochirus zebra*	25	38
43.	*Hippocampus kuda*	23	39
44.	*Dascyllus trimaculatus*	22	40
45.	*Amblygobius* sp.	21	41
46.	*Stegastes nigricans*	21	41
47.	*Nectamia fusca*	20	42
48.	*Canthigaster bennetti*	20	42
49.	*Saurida gracilis*	20	42
50.	*Leptoscarus vaigiensis*	19	43
51.	*Pardachirus pavoninus*	19	43
52.	*Dischistodus prosopotaenia*	18	44
53.	*Arothron manillensis*	17	45
54.	*Dascyllus aruanus*	17	45
55.	*Scolopsis trilineata*	17	45
56.	*Stethojulis interrupta*	17	45
57.	*Hemiglyphidodon plagiometopon*	16	46
58.	*Diagramma labiosum*	14	47
59.	*Dischistodus perspicillatus*	14	47
60.	*Pseudorhombus* sp.	14	47
61.	*Parupeneus trifasciatus*	13	48
62.	*Pomacentrus* sp.	13	48
63.	*Petroscirtes* sp.	12	49
64.	*Scolopsis ciliata*	12	49
65.	*Scorpaenopsis venosa*	12	49
66.	*Tetraroge barbata*	11	50
67.	*Callionymus* sp.	11	50
68.	*Halichoeres* sp.	11	50
69.	*Salarias sp.*	11	50
70.	*Sphaeramia orbicularis*	11	50

Table 3. (Continued).

No.	Jenis	Total	Rank	No.	Jenis	Total	Rank
71.	*Canthigaster compressa*	10	51	105.	*Amblyglyphidodon curacao*	2	59
72.	*Dascyllus melanurus*	10	51	106.	*Amphiprion ocellaris*	2	59
73.	*Atherina* sp.	10	51	107.	*Apogon sangiensis*	2	59
74.	*Apogon melas*	9	52	108.	*Sardinella sp.*	2	59
75.	*Cynoglossus sp.*	8	53	109.	*Fowleria variegata*	2	59
76.	*Monacanthus chinensis*	8	53	110.	*Herklotsichthys quadrimaculatus*	2	59
77.	*Pterogogus sp*	8	53	111.	*Lutjanus fulvus*	2	59
78.	*Amphiprion perideraion*	7	54	112.	*Neoglyphidodon melas*	2	59
79.	*Zoramia leptacantha*	7	54	113.	*Plectorhinchus orientalis*	2	59
80.	*Chromis viridis*	7	54	114.	*Pteragogus enneacanthus*	2	59
81.	*Amphiprion polymnus*	6	55	115.	*Taeniura lymma*	2	59
82.	*Scolopsis bilineata*	6	55	116.	*Thalassoma* sp.	2	59
83.	*Siganus virgatus*	6	55	117.	*Acentrogobius* sp.	1	60
84.	*Arothron immaculatus*	5	56	118.	*Alutera scriptus*	1	60
85.	*Chelonodon patoca*	5	56	119.	*Ambassis* sp.	1	60
86.	*Sphyraena pinguis*	5	56	120.	*Apogon* sp.	1	60
87.	*Siganus spinus*	5	56	121.	*Bothus pantherinus*	1	60
88.	*Apogon nigrofasciatus*	4	57	122.	*Canthigaster coronata*	1	60
89.	*Chaetodon auriga*	4	57	123.	*Canthigaster solandri*	1	60
90.	*Choerodon anchorago*	4	57	124.	*Cheilodipterus isostigmus*	1	60
91.	*Grammistes sexlineatus*	4	57	125.	*Dischistodus chrysopoecilus*	1	60
92.	*Halichoeres argus*	4	57	126.	*Fistularia petimba*	1	60
93.	*Platax orbicularis*	4	57	127.	*Grammatobothus polyophthalmus*	1	60
94.	*Amphiprion clarckii*	3	58	128.	*Gymnothorax richardsonii*	1	60
95.	*Arothron hispidus*	3	58	129.	*Istigobius* sp.	1	60
96.	*Canthigaster* sp.	3	58	130.	*Lutjanus fulviflamma*	1	60
97.	*Cheilinus fasciatus*	3	58	131.	*Lutjanus lutjanus*	1	60
98.	*Cheilodipterus macrodon*	3	58	132.	*Lutjanus* sp.	1	60
99.	*Muraena* sp.	3	58	133.	*Oplopomus* sp.	1	60
100.	*Platycephalus* sp.	3	58	134.	*Paracentropogon vespa*	1	60
101.	*Pterois volitans*	3	58	135.	*Petroscirtes variabilis*	1	60
102.	*Scorpaena* sp.	3	58	136.	*Plectorhinchus lineatus*	1	60
103.	*Sphyraena obtusata*	3	58	137.	*Saurida micropectoralis*	1	60
104.	*Taeniatus triacanthus*	3	58				

Table 4. The most abundant species from this study and there other previous (Malikuworo and Martosewojo, 1977; Syahailatua *et al.,* 1989; Malikusworo and Peristiwady, 1996).

Species	Hutomo and Martosewojo (1977)	Syahailatua *et al.,* (1989)	Hutomo and Peristiwady (1996)	Present study
Apogon margaritophorus	*v*	-	-	v
Apogon hartzfeldii	-	-	-	*v*
Halichoeres leparensis	*v*	-	-	-
Halichoeres miniatus	-	-	-	*v*
Pranesus duodecimalis	*v*	-	v	-
Halichoeres papilionaceus	-	-	-	*v*
Paramia quinquelineata	*v*	-	-	-
Gerres macrosoma	*v*	-	-	-
Gerres kapas	-	v	-	-
Monacanthus tomentosus	*v*	-	-	-
Siganus canaliculatus	*v*	-	-	-
Stethojulis strigiventer	*v*	-	-	-
Halichoeres argus	*v*	-	-	-
Halichoeres melanurus	-	-	-	*v*
Lethrinus spp	*v*	-	-	-
Arothron immaculatus	-	v	-	-
Aeoliscus strigatus	-	v	-	-
Synangthoides biaculeatus	-	v	v	v
Caranx sexfasciatus	-	v	-	-
Corythoichthys intestinalis	-	v	-	v
Pranesus sp.	-	v	-	-
Bothus pantherinus	-	v	-	-
Fistularia petimba	-	v	-	-
Parupeneus macronemus	-	v	-	-
Plotosus anguilaris	-	-	*v*	-
Plotosus lineatus	-	-	-	*v*
Zenarchopterus dunckeri	-	-	*v*	-
Cheilio inermis	-	-	*v*	-
Cheilodipterus quinquelineata	-	-	-	*v*
Archamia fucata	-	-	*v*	-
Trisocles setirostris	-	-	*v*	-
Sphyraena jello	-	-	*v*	-
Secutor ruconius	-	-	*v*	-
Trissina kamalensis	-	-	*v*	-
Pomacentrus tripunctatus	-	-	-	*v*

Table 5. List of fish occurring every sampling period in seagrass beds of Tanjung Merah, North Sulawesi.

No.	Species	2003	2004	2005	Total	% Total
1.	*Apogon margarithophorus*	2511	989	747	4247	37.45
2.	*Corythoichthys intestinalis*	627	93	74	794	7.00
3.	*Plotosus anguilaris*	18	254	42	314	2.77
4.	*Pomacentrus tripunctatus*	237	22	3	262	2.31
5.	*Apogon hartzfeldii*	183	59	19	261	2.30
6.	*Syngnathoides biaculeatus*	120	29	95	244	2.15
7.	*Centrogenys vaigiensis*	191	7	17	215	1.90
8.	*Siganus canaliculatus*	135	4	51	190	1.68
9.	*Cheilio inermis*	17	10	137	164	1.45
10.	*Aeoliscus strigatus*	102	18	39	159	1.40
11.	*Lethrinus ornatus*	133	8	10	151	1.33
12.	*Monacanthus tomentosus*	87	19	36	142	1.25
13.	*Lethrinus harak*	116	10	11	137	1.21
14.	*Parapercis cylindrica*	95	15	3	113	1.00
15.	*Parupeneus barberinus*	55	2	5	62	0.55
16.	*Cheilinus chlorurus*	51	7	1	59	0.52
17.	*Leptascarus vaigiensis*	12	3	4	19	0.17
18.	*Pardachirus pavoninus*	14	1	4	19	0.17
19.	*Arothron manillensis*	1	3	13	17	0.15
20.	*Arothron immaculatus*	3	1	1	5	0.04
21.	*Platax orbicularis*	2	1	1	4	0.04
Total individual of 21 species		4710	1555	1313	7158	
Total individual of the whole sample		6932	1812	2596	11340	
Percentage of the 21 species		67.9	85.8	50.6	66.8	

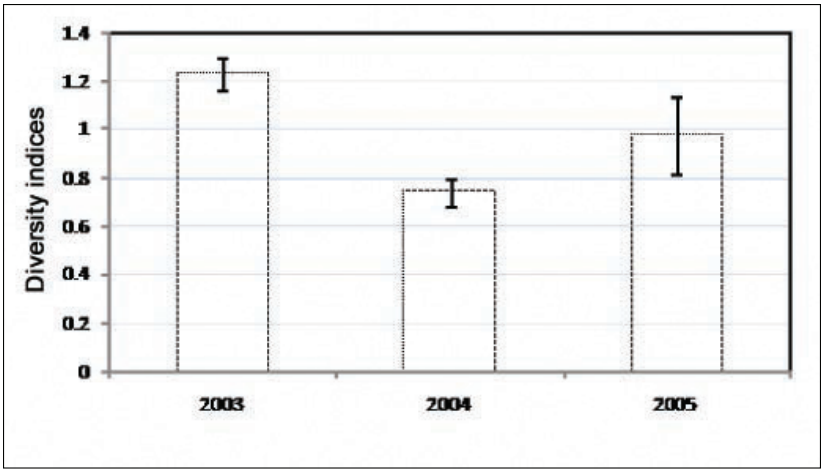

Figure 2. Diversity indices of seagrass fish from Tanjung Merah, North Sulawesi.

Table 6. The ANOVA Results of diversity indices of seagrass fish from Tanjung Merah, North Sulawesi.

Source	Sum Square	Degree of Freedom	Mean Square	F	P
Periods	0.3553	2	0.1776	16.67	0.0035
Residual	0.0639	6	0.0107		
Total	0.4192	8			

Species Diversity

Temporal variation in species assemblages during this study was recorded based on diversity indices. We found that there was a significant difference among sampling periods ($p<0.05$) indicating seasonal variation in the fish species composition of seagrass beds in Tanjung Merah (Table 6, Fig. 2).

CONCLUSION

This study only focused on family and species compositions of seagrass fishes. There were three families categorized as the dominant fishes, namely Apogonidae, Labridae and Sygnathidae, whereas for species level, we found two species were abundant and occurred regularly; *Apogon margaritophorus* and *Corythoichthys intestinalis*. This study also indicated that the seagrass beds in Tanjung Merah had large individual and species number compared to several previous study sites in Indonesia. We suggested that this study may be extended to monitor the seagrass ecosystem in Tanjung Merah, and also to study any changes in this ecosystem related to human activities and climate change. In addition the location needs to be protected as an important site to support the local fishery.

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