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

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Received: 9 July 2010 Accepted: 20 September 2010

Abstract

Seagrass beds are found along the shore of Tanjung Merah (North Sulawesi, Indonesia). This ecosystem covers approximately 20 hectares, 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, decomposition, 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 McErlan, 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 collapses, even though not as bad as Petersen might have predicted. It
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 Hemirampus 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 macrocoma 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 hectares 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 | Σ Score | Rank | Σ 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   | 5    | 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 Pomadasyidae (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 occurred 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   | Platostus 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  | Rhambdium 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  | Abudefuf 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 pavaninus   | 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  | Petrusciates 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  | Sphareas 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 polynymus           | 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.  | Aluteris scriptus                  | 1     | 60   |
| 85. | Chelonodon patoca              | 5     | 56   | 119.  | Ambass 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 istigmus           | 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 polyphthalalus     | 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 lutanus                  | 1     | 60   |
| 98. | Cheilodipterus macrodon        | 3     | 58   | 132.  | Lutjanus sp.                      | 1     | 60   |
| 99. | Muraena sp.                    | 3     | 58   | 133.  | Oplophorus 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 leporensis         | 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                            | -             |
| Cheilinus 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.  | Ploetasus angularis             | 18   | 254  | 42   | 314   | 2.77    |
| 4.  | Pomacentrus tripectatus         | 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  | 17   | 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.
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.

ACKNOWLEDGMENT

Special thanks go to Coral Reef Rehabilitation and Management Program of LIPI who provided financial support for this study. We also would like to thank Yahmantoro, La Pay, Muchtar Jabar, Muhammad Herriman, Oscar, Sardi and Saida for their field and laboratory assistance.

REFERENCES

Allen, G. 1997. Marine Fishes of South-East Asia: A field guide for anglers and divers. Western Australia Museum, Perth. 292 p.

Allen, G.R. and R. Steene 1996. *IndoPacific Coral Reef Field Guide*. Tropical Reef Research, Ang Mo Kio Industrial Park 2, Singapore. 378 p.

Bell, J.D. and D.A. Pollard. 1989. Ecology of fish assemblages and fisheries associated with seagrasses. In: A.W.D. Larkum A.J. McComb, and S.A. Shepard (eds.), *Biology of Seagrass*. Elsevier New York, 565–609.

Burkholder, P. R., L. M. Burkholder and J.A. Rivero. 1959. Some Chemical Constituents of Turtle Grass, *Thalassia testudium*. Bull. Torrey. Bot. Club., 86(2): 88–93.

Den Hartog, C. 1970. *The seagrasses of the world*. North Holland Publ. Co., Amsterdam.

Hutomo, M. and Martosewojo. 1977. The fishes of seagrass community on the west side of Burung Island (Pari Island, Seribu Islands) and their variation in abundance. *Marine Research in Indonesia*, 17: 147–172.

Hutomo, M. and T. Peristiwady. 1996. *Diversity, abundance and diet of fish in the seagrass beds of Lombok Island, Indonesia*. In Kuo J, P. Seagrass Biology: Proceedings of an International Workshop, Rottnest Island, Western Australia. Faculty of Science, University of Western Australia, 205–212.

Hutomo, M. 1985. *Telaah ekologik komunitas ikan pada padang lamun (Seagrass, Anthophyta) di perairan Teluk Banten*. PhD thesis. Fak. Pasca Sarjana IPB.

Jenkins, G.P., H.M.A. May, M.J. Wheatly and M.G. Holoway. 1997. Comparisons of fish assemblages associated with seagrass and adjacent unvegetated habitats of Port Phillips Bay and Corner Inlet, Victoria, Australia with emphasis on commercial species. *Estuarine, Coastal and Shelf Science*, 44: 569–588.

Jordan, F., M. Bartolini, C. Nelson, P. E. Patterson and H.L. Soulen. 1996. Risk of predation affects habitat selection by the pinfish. *Lagodon rhomboides* (Linnaeus). *Journal of Experimental Marine Biology and Ecology* 208: 45–56

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                |             |      |      |

Source: Sum Square Degree of Freedom Mean Square F P
Krebs, O. J. 1989. *Ecological Methodology*. Harper Collins Publ., Canada.

Kuiter, R.H. 1992. *Tropical Reef Fishes of the Western Pacific: Indonesian and Adjacent waters*. Gramedia, Jakarta. 314 p.

Munro, I.S.R. 1967. *The fishes of New Guinea*. Dep. of Agriculture, Stock and Fisheries, Port Moresby, New Guinea. 651 p.

Peristiwady, T. 1992. *Komposisi dan struktur komunitas ikan-ikan di padang lamun Sulawesi Utara*. Laporan Kemajuan Triwulan III tahun anggaran 1992/1993. Balai Penelitian dan Pengembangan Sumberdaya Laut, P3O – LIPI, Ambon, p1–8.

Phillips, R.C. 1978. Seagrasses and the coastal marine environment. *Oceanus*, 21: 3040.

Pinto, L. and N.N. Punchihewa. 1996. Utilization of mangroves and seagrasses by fishes in the Negombo Estuary, Sri Lanka. *Marine Biology*, 126: 333–345.

Robblee, M.B. and Zieman J.C. 1984. Diel variation in the fish fauna of a tropical Seagrass feeding ground. *Bulletin of Marine Science*, 34: 335–345.

Rooker, J.R.S., M.A. Soto and G.J. Holt. 1998. Post settlement patterns of habitat use by sciaenid fishes in the subtropical seagrass meadows. *Estuaries*, 21 (2): 318–327.

Rooker, J.R. and S.A. Holt. 1997. Utilization of subtropical seagrass meadows by newly settled red drum Sciaenops ocellatus: patterns of distribution and growth. *Marine Ecology Progress Series*, 158: 139–149.

Schultz, L. P. 1958. Review of the parrot-fishes, family Scaridae. *Bull. U.S. Natl. Mus.*, 214:1–143.

Sogard S.M, G.V.N. Powell and J.G. Holmquist. 1989. Utilization by fishes of shallow, Seagrass covered banks in Florida Bay: 2. Diel and tidal patterns. *Environmental Biology of Fishes*, 24: 81–92.

Springer, V.G. and A.J. Mc Erlean. 1962. Seasonality of fishes on a south Florida Shore. *Bulletin of Marine Science Gulf of Caribbean*, 12(1): 39–60.

Syahailatua, A., N. Manik and K. Sumadhiharga. 1989. *Komunitas ikan di padang lamun (seagrass) pantai Suli, Teluk Baguala*. In: Praseno et al. (eds), Perairan Maluku dan Sekitarnya: Biologi, Budidaya, Geologi, Lingkungan dan Oseanografi, 32–28.

Weinstein, M.P. and K.L. Heck Jr. 1979. Ichthyofauna of seagrass meadows along the Caribbean coast of Panama and in the gulf of Mexico: Composition, Structure and community ecology. *Marine Biology*, 50: 97–107.