Variations in size and catch distribution of white spotted rabbit fish (*Siganus canaliculatus*) on bio-FADs from spatially and temporary point of view, at Luwu District, South Sulawesi, Indonesia

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Abstract. Biological-Fish Aggregation Devices which are called as living FADs used in this study two types of seaweed, namely: *Eucheuma cottonii* and *Gracilaria* sp., as attractors for fish. The objectives of the study are to analyze the distribution of catches and size variations of white spotted rabbit fish (*Siganus canaliculatus*) from spatially and temporarily point of view. This research was conducted in the Luwu waters, South Sulawesi, Indonesia from October 2014 to August 2015. Samples were collected using a scoop net on both types of the FADs installed in three different habitats (estuary, seagrass and coral reef) as location of observation. The results showed the distributions of *S. canaliculatus* on both FADs varied both spatially (habitats) and temporary (months). The size and distribution of the length of fish were not significantly different between habitats, however there was a significant temporary difference. The dominant sizes of *S. canaliculatus* were different between FADs. Meanwhile, the dominant size of *S. canaliculatus* among habitats showed the same contribution percentage for the length of the fish, with the size of 3.4-4.5 cm, occupying the highest contribution on the three habitats.
Key Words: Luwu district, living FADs, *Siganus canaliculatus*, size variations, habitat.

Introduction. Coastal waters area of Luwu Regency, South Sulawesi, Indonesia is located in the northern Gulf of Bone within the coastal and small islands spatial planning zonation of Bone Bay area (DKP of South Sulawesi 2006). The coastal area of Luwu district is relatively prolific because of various ecosystems such as estuaries, mangroves, sea grass beds and coral reefs that can be found there. These ecosystems have a very vital function for being a spawning area, sheltering and feeding area for a variety of fishes (Nibakken 1988).

One of the main fish families which is predominantly found in four of these ecosystems is Siganidae or commonly known as rabbit fishes. According to Nontji (1987), there are 12 species of Siganidae in Indonesia, while according to Sudradjat (2009) there are only 7 species of Siganidae in Indonesia. White spotted rabbit fish or S*iganus canaliculatus* spreads from West Indo-Pacific region, from the Arabian Gulf to the west of Australia and is also found in Hong Kong and Taiwan (Al-Marzouqi 2013). Rabbit fishes in Indonesia are broadly spread but the distribution of these species is very limited (Sewajo et al 1981).

The population of rabbit fish, especially for S. *canaliculatus*, is increasing with the increased area of sea grass cultivation. Sea grass which is cultivated by fishermen turns into alternative habitat for the juvenile of white spotted rabbit fish (Sudradjat 2009). But there is a problem for the juvenile which cause it to die due to sea grass harvesting period. If the juvenile were well managed, this will turn to be profitable in both economically and ecologically (Suardi et al 2016).

The utilization of *S. canaliculatus* juvenile in the comprehensive area of seaweed cultivation needs fish aggregation devices (FADs) technology which is considered to be effective to attract the juvenile. For that purpose, living FADs or biological-fish aggregation devices (Bio-FADs) with seaweed as the attractor is considered to be the most suitable. The use of seaweed as an attractor to lure juvenile fish is due to its attraction in seaweed which is cultivated by fishermen. FADs are a multi function fishing tools (Subani 1986; Samples & Sproul 1985; Yusfiandayani 2010).

Information on the attraction of living FADs on *S. canaliculatus* juvenile are still very limited, so that the research on the use of living FADs to analyze catch distribution and variability of size spatially and temporary are still needed. The objectives of this study are to determine the distribution of *S. canaliculatus* structure size and the distribution of catches in living FADs spatially and temporarily on the Uloulo coast, Luwu District, South Sulawesi, Indonesia.

Material and Method. The research was conducted in Uloulo coastal waters, Gulf of Bone, Luwu District (Figure 1) for 11 months (October 2014 - August 2015). The research was divided into four seasons: transitional season 1 (TS-1) from October to December 2014, west monsoon (WM) from January to March 2015, transitional season 2 (TS-2) from April to June 2015 and the east monsoon (EM) from July to September 2015 (Nontji 1987).

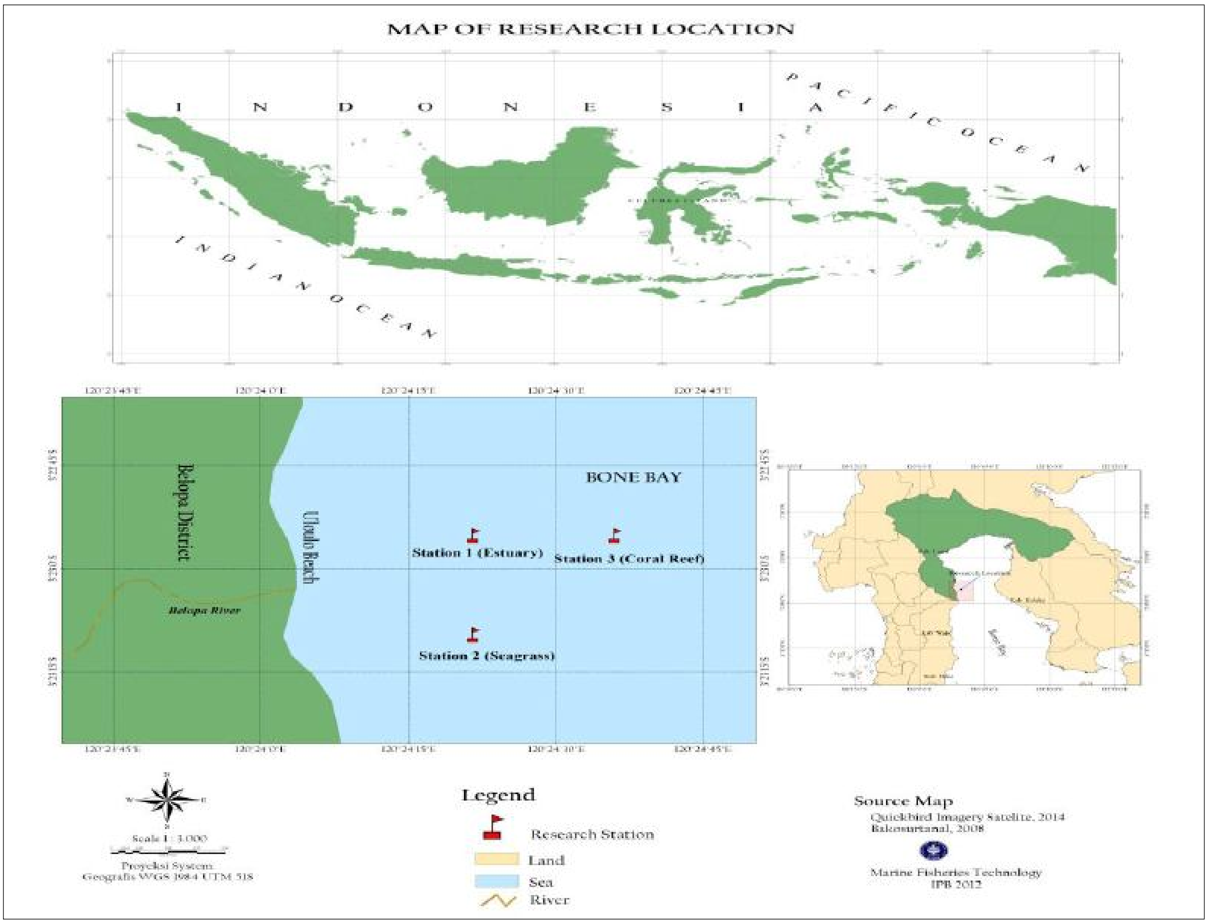

Figure 1. Research location and the sampling point representing different stations (St. 1 = estuary, ST. 2 = sea grass, and st 3 = coral reef).

Three locations are chosen as observation stations based on the habitat is shown in Table 1. The locations were determined by using the zonation method considering to the characteristics of water based on the difference of typology for each station. The determination of each research station as a location for FADs placement was based on the assumption: (1) the obtained fish samples will represent fish distribution spatially and temporary, (2) habitat in accordance with the distribution of the fish, and (3) differences in physical and chemical parameters of water. Based on the characteristics of habitat above, three locations (habitat) were then defined, as shown in Table 1.

Table 1

Characteristics of research location site at estuaries, sea grass and coral reefs habitats

No	*Characteristic*	*Habitat (location)*		
		Estuary	*Sea grass*	*Coral reef*
1	Geographical position	E 120°24'09.304" – L 3°22'37.064"	E 120°24'10.447" – L 3°22'56.243"	E 120°24'21.20" – L 3°22'36.140"
2	Depth (m)	3-10	3-10	5-15
3	The specificity of habitat	The supply of fresh water directly from the river, close to the settlement of fishermen, adjacent to transit routes for fishermen, low brightness level, high mixing intensity, high salinity fluctuations[a)]	The supply of fresh water from the mainland, overgrown by sea grass and macro algae, low brightness levels, salinity 10-35 ‰	Crystal clear waters, Overgrown by macro-algae, high current, salinity between 30-36 ‰ [b)]
4	Substrates	Mud and sand	Mud and sand	Rocks, sands and dead coral

Source: [a]) Widodo & Suadi (2006), and [b]) Nybakken (1988).

Bio-FADs used in this study were made by seaweed as attractor (Figure 2). Seaweed used were *Eucheuma cottonii* referred as cottonii FADs (CF) and *Gracillaria* sp. and also referred to gracillaria FADs (GF). Both FADs consisted of 3 CF and 3 GF. Two units of those living FADs, each type, were installed at the 3 stations. As for sampling of fish associated with FADs a scoopnet (local name: Bunde) was used (Figure 3). Materials used in bio-FADs and scoopnet (fish sampling tools) are presented in Tables 2 and 3.

Table 2

Materials used in the construction of FADs

No	*Component*	*Materials*	*Size*	*Quantity*
1	Buoy	Styrofoam	Width: 60 cm; height: 45 cm	6 units
		Net	Mesh size: 0.5 cm	12 m
2	FADs frame	Bamboo	Length: 180 cm; width: 2 cm	36 pieces
		Rattan	Length: 160 cm; Ø = 1.5 cm	24 pieces
3	Attractor	*Eucheuma cottonii*	1.4 kg/FAD	8.4 kg
		Gracillaria sp.	1.4 kg/FAD	8.4 kg
4	Ropes	Buoy line (PE) no. 8	4 m/FAD	24 m
	Stretching rope (PE) no. 6	24 m/FAD	15 m/FAD	90 m
	FADs adhesive line (PE) no. 6	12 m/FAD		144 m
		Strap (PE) no. 2.5	15 m/FAD	90 m
		Wire Ø 1.5 mm	5 m/FAD	30 m
5	Swivel	Iron	1 unit/FAD	6 units
6	Sinker	Anchor sinker	45 kg/FAD	270 kg
		FADs sinker	2.5 kg	15 kg

Table 3

Materials used in the construction of a scoop net (fish sampling tool)

No	*Component*	*Materials*	*Dimensions*	*Quantity*
1	Frame	Rattan	Length: 160 cm; Ø = 1.5 cm	1
		Net	Mesh size of 0.5 cm	4 m
2	Ropes	Rope hilt (PE) no. 10	0.5 m/scoop net	0.5 m
		Wire	1 m/scoop net	1 m

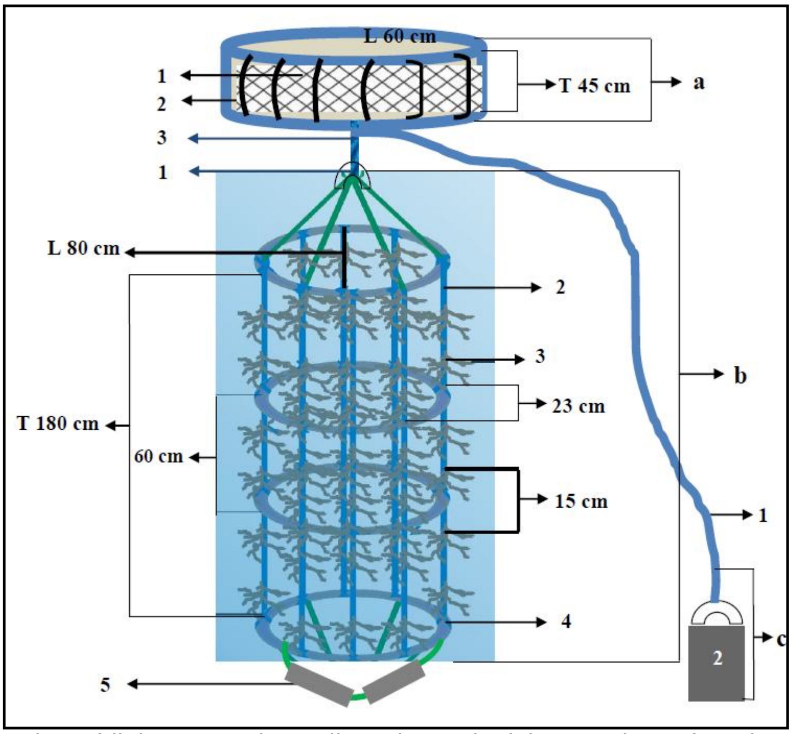

Figure 2. Construction of living FADs (Suardi et al 2016): (a) Buoy (styrofoam): 1 - net, 2 - ropes to tie on net, 3 - Buoy line; (b) FADs: 1 - swivel, 2 - frame (bamboo), 3 - attractor (sea grass), 4 - circle (rattan), 5 - sinker (cast); (c) Sinker: 1 - sinker line, 2 - main sinker.

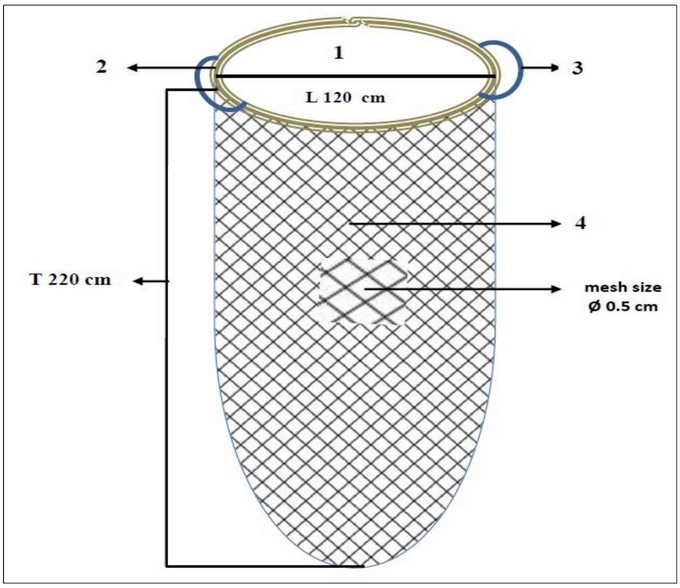

Figure 3. Construction of scoop net for collecting fish on FADs (Suardi et al 2016): 1 - mouth, 2 - frame (rattan), 3 - hilt (line nylon PE. no. 10), 4 - net.

The placement site of FADs in each location (habitat) was determined by considering the the characteristics of the location such as: 1) minimum depth of the water at lowest tide is 2.5 m; 2) safe from fishing boat traffic; 3) high current speed; 4) high water clarity. The position of bio-FADs in the water column was standing up straight (vertical), parallel to the coastline, the distance within the body of FADs with surface waters was 15 cm and the distance between the FADs of each station (habitat) was approximately 25 m.

Data collection. Sample fishes were collected by using scoop net from both types of bio-FADs installed on three study sites. Sampling was held 4 times in different seasons. Fish sampling on living FADs was performed by using a scoop net in several stages: 1) sampling was performed by two people who then dived simultaneously on the side of FAD; 2) after arriving at the lower end of FAD, then FAD was inserted into the scoop net by encasing it; 3) after FAD was entirely within the scoop net, it was then pulled up on the boat along with FAD; 4) the FAD was then shaken to make all the fish get into scoop net, 5) FAD was released from scoop net and then *S. canaliculatus* individuals caught were collected in a container, the calculation was grouped based on habitat and months. The fish was measured in total length by using Vernier caliper with a level of accuracy of 1 mm (Figure 4). The weight of the fish was measured by using an digital scale with a level of accuracy of 0.01 g.

Method of Siganus canaliculatus body length measurement. The method of fish measurement, such as total length (TL), standard length (SL) and fork length (FL), is shown in Figure 4 (Syamsuryani 2015). TL is measured between the end of the head to the tip of the most backward tail fin, SL is measured from the end of the head to the base of the fin and FL is measured from the end of the head to the curve of the tail fin. But in this study, only TL of *S. canaliculatus* is used to determine the distribution of size from a spatially and temporary point of view.

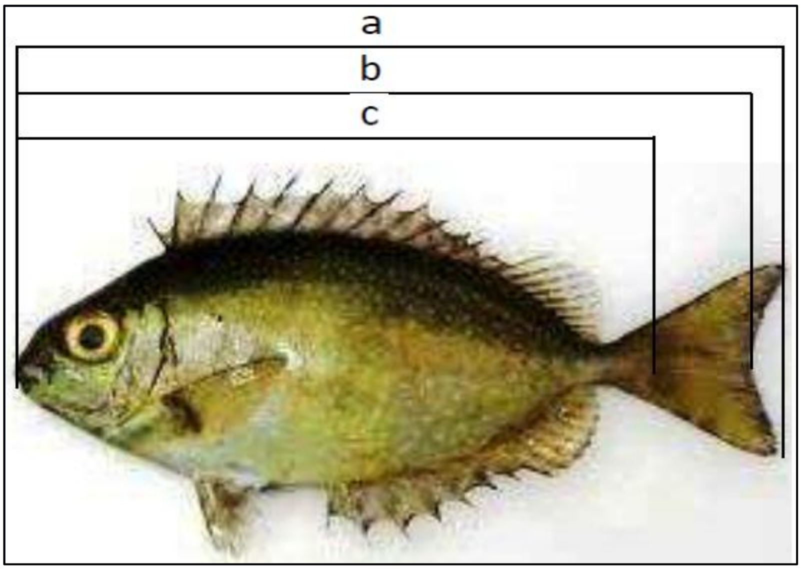

Figure 4. Measurement of *S. canaliculatus* length: a - total length (TL), b - fork length (FL), c - standard length (SL).

Data analysis. TL of *S. canaliculatus* associated with bio-FADs were grouped spatially (location/habitat) and temporary (months). Variations in the size of the fish were analyzed based on the number of occurrences (frequency) in the class interval. Multivariate statistics was analysed by means of a software of PRIMER 5.2 (Plymouth Routines in Multivariate Ecological Research) to analyze the correlation between parameters, characteristics and size distribution and similarity (Clarke & Gorley 2001; Taurusman 2011). Data analysis in detail, is described as following.

Cluster analysis. Cluster analysis was conducted to evaluate the relationships between distribution of catches and fish size variations of *S. canaliculatus* associated with FADs spatially and temporally. Bray-Curtis similarity index was used for making matrix similarity values between catch data (size distribution) based on the fish habitat and the month. Initial data were standardized (4^{th}-root transformed). Furthermore, the cluster analysis was plotted in the form of dendrogram and performing statistic test.

Analysis of similarities (ANOSIM). Similarity analysis was used to test the significance of spatial and temporal variations of the two bio-FADs spatially and temporary size of the fish. ANOSIM is a non-parametric analysis based on the rank value in the similarity matrix. ANOSIM is recommended to test the hypothesis about group differences in multivariate statistics (Taurusman 2011). Similarity relationship was calculated by change in the value of R Clarke as presented in the following equation:

$$R = \frac{aver.\ rb - aver.\ rw}{M/2}$$

$$M = \frac{n(n-1)}{2}$$

where: *aver. rb* = the average of rank similarities between groups, *aver. rw* = the average of rank similarity within the group (habitat, month/season), n = number of involved data in analysis.

Interpretation of R (Clarke's R) value describes the level of difference between the groups, with 0 scale (indistinguishable) to 1 (all similarities within groups are less than any similarity between groups).

Similarity percentage (SIMPER). This analysis was used to determine the class interval of fish TL contributing in the differences (dissimilarities) of classification for each FAD and habitat observations obtained from a comparison of the percentage value of each class interval within a group (class length) and between groups (habitat). Class interval of fish total length with the highest frequency of occurrence (dominant) is considered as key or typical size of *S. canaliculatus* for the group.

Result and Discussion

Distribution of S. canaliculatus caught in FADs by habitat. The catch distribution of *S. canaliculatus* on two bio-FADs, CF and GF, were varied spatially (habitat) and temporary (months). Total catch of *S. canaliculatus* during the study comprised 523 individuals. The highest catch on CF occurred on estuary habitat with 136 individuals, followed by coral reefs and sea grass habitats with 77 individuals and 69 individuals respectively. While the highest catch on GF occurred in sea grass habitat with 106 individuals (Figure 5).

S. canaliculatus were highly caught on CF in the estuary habitat was allegedly due to the migration to search for its natural habitat. *S. canaliculatus* in this study was already on juvenile phase with the maximum size range of 12.4-14.1 cm while in CF with highest contribution of 27.20% (Table 4). Rabbit fish or Siganidae on juveniles size are generally found in shallow waters, river mouth, estuaries, sea grass bed and even in the ponds of farmers Kordi (2005); Woodland (1990) and Gorospe & Demayo (2013).

Highest numbers of *S. canaliculatus* in GF were caught in sea grass habitats. The high availability of food on the sea grass habitat promoted the high abundance of the juvenile fish. The length of the *S. canaliculatus* juvenile, caught on sea grass habitat was ranged from 3.4-4.5 cm with highest contribution of 51.36%. Seagrass is the habitat for *S. canaliculatus* juvenile, while on adult phase they are moving back to coral reef as their natural habitat (Tomascik et al 1997). The populations of *S. canaliculatus* juvenile are abundant in sea grass beds and coral reefs area where they are caught by using fish traps (Jaikumar 2012). Sea grass and mangrove ecosystems are considered as main feeding and nursery area of the juvenile fishes (Fahmy & Zamroni 2011).

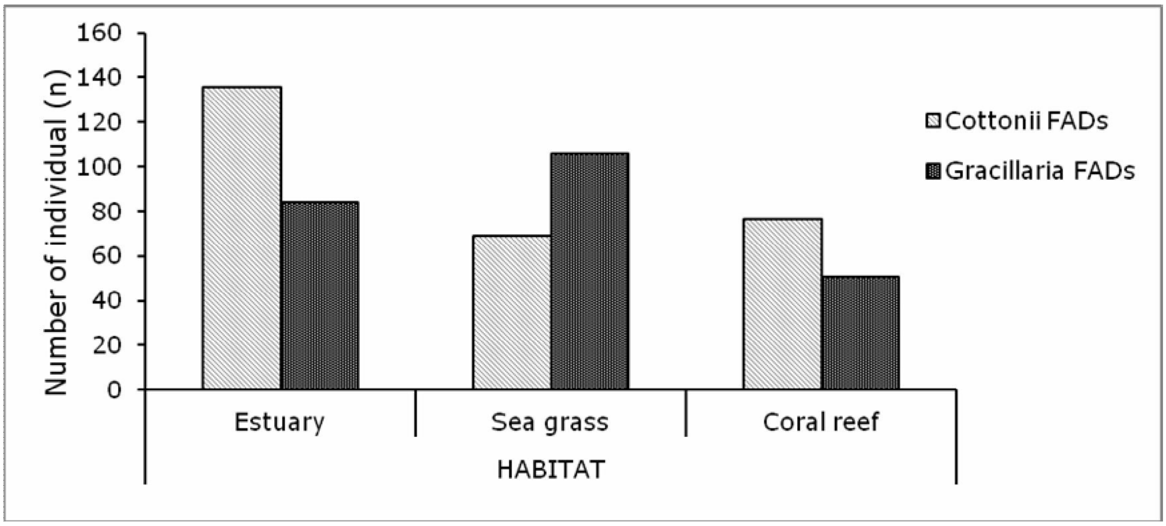

Figure 5. Comparison of the number of white spotted rabbit fish caught according to habitat in coastal waters of Uloulo, Luwu District

Distribution of *S. canaliculatus* catches on both bio-FADs (CF and GF) varied temporally (monthly) as shown in Figure 6. Highest catch on both FADs occurred in December and August, while the lowest was in January. Highest catch in December and August seems to be influenced by seasonal variation of environmental conditions. Related to study of Mayunar (1992), *S. canaliculatus* spawns twice a year from January-April and July-October. The number of *S. canaliculatus* individuals caught was high in December, due to its spawning season in mid-October (TS-1) and then being growing to juvenile in December that the fish has started to spread in shallow waters although with limited ability to find suitable habitat as shelter and foraging area.

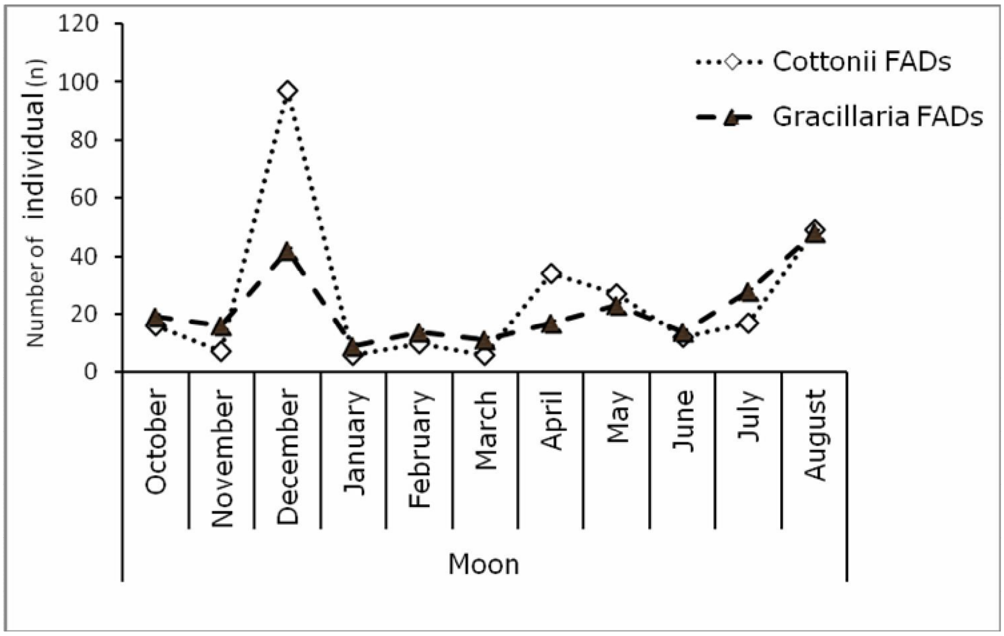

Figure 6. Temporal distribution (monthly) of *S. canaliculatus* caught in coastal waters of Uloulo, Luwu District.

S. canaliculatus with the size of 13.0 cm (TL), by using the length frequency calculation method, is estimated to aged between 3.24-4.24 months (Syamsuryani 2015). The size of *S. canaliculatus* which was predominantly found in this study ranged from 3.4-4.1 cm. The age of the fish is estimated between 1-1.5 months (Syamsuryani 2015). In

December (end of TS-1), the highest primary productivity in northern zone of the Gulf of Bone (Luwu district is included) are in the range of 13.25-15.90 g m^{-2} $month^{-1}$ (Jufri et al 2014).

The lowest catches of *S. canaliculatus* for the both FADs occurred in January due to the influence of seasonal factors. In January to April (west monsoon season and the beginning of the transition 2), *S. canaliculatus* begins to spawn and mostly are in larvae phase (planktonic) (Mayunar 1992). This condition makes it unable to find a substrate (habitat) as a place to live. The emergence of fish in the waters is closely related to seasonal pattern of fishing operation and fishing areas (Sumiono & Nuraini 2007).

Clustering size of S. canaliculatus*.* Data of *S. canaliculatus* size distributions, in each location (habitat) of bio-FADs placement as an observation station, were analyzed by using an index of similarity Bray Curtis. Sampling habitat was divided into two groups: the first group was a combination of estuary with sea grass and the second group was a coral reef habitat (Figure 7). The results of the analysis of similarity (ANOSIM) show that there was no significant difference in the total length based on location of bio-FADs placement (Global R = 0.009 and p = 0.28), even though the habitat characters are different in both physical and chemical.

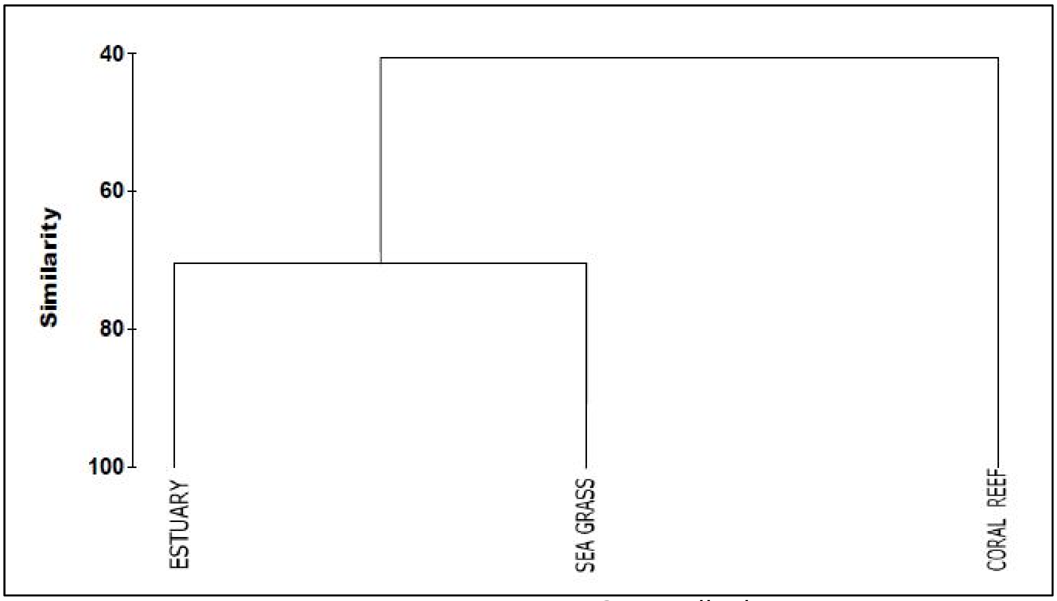

Figure 7. Dendrogram of grouping size similarity of *S. canaliculatus* catch spatial analysis.

The estuary habitat has a very high level of similarity with sea grass habitats (R = -0.033, p = 0.93), whereas the habitat between estuary and sea grass has lower levels of similarity with coral reef habitat with the value of R-statistic 0.036, p = 0.096. The relationship of high level of similarity between the estuary habitat with sea grass habitat are allegedly due to the location which is adjacent and located on the coastline that the limiting factors such as: brightness levels, salinity, pH and temperature tend to be similar in both habitats. The salinity between the two habitats varied between 20-29‰. This is different to the salinity of estuary waters on eastern coast of Kendari with variations in salinity between 6-29‰ (Fahmy et al 2011), *Siganus* sp. in coastal waters of Mandapam, India can tolerate salinity between 17-37‰ (Jaikumar 2012), while in the coastal waters of Pitumpanua, Gulf of Bone the salinity in estuary is 29.60‰ ±1.21 and the salinity in sea grass is 31.15‰ ±0.84 (Tenriware 2012).

Furthermore, size distributions on a monthly basis in bio-FADs were analyzed using Bray Curtis similarity index. Monthly sampling (temporal) was divided into four groups (Figure 8). The results of the analysis of similarity (ANOSIM) showed that the size distribution for total length of the fish, monthly, were significantly different with the value of Global R = 0.128 and p = 0.02.

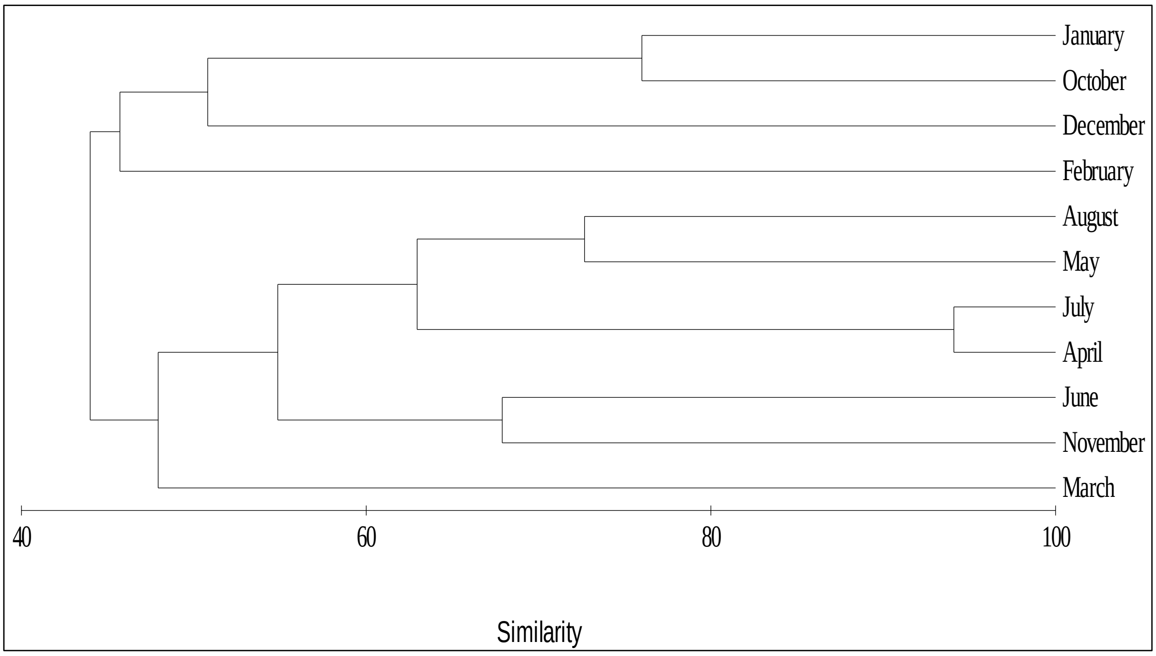

Figure 8. Grouping size similarity dendrogram of monthly catch of *S. canaliculatus*.

Based on Figure 8, monthly size of distribution was divided into four major clusters, which are characterized by differences in the size distribution of *S. canaliculatus* total length of the month. The first cluster was October, December, January and February. January and February are the first spawning season and July-October is the second spawning season of *S. canaliculatus* in the waters of Singapore (Duray 1998; Mayunar 1992). The second cluster was April, May, July and August. This group is characterized by the peak of spawning season of *S. canaliculatus* on April and May in Palau (Al-Marzouqi 2013), while in July and August, *S. canaliculatus* performs spawning in a small quantity in the waters of Singapore (Soh & Lam 1973; Duray 1998). The third cluster (June and November) is characterized by the spawning season during early phases of June (Hoque et al 1999), in November is characterized by the second spawning season of *S. canaliculatus* in Palau (Al-Marzouqi 2013) and the fourth cluster (March) is characterized by peak spawning season of *S. canaliculatus* in the coastal waters of Singapore (Duray 1998).

Furthermore, to determine the length characteristic (size of identifier) of *S. canaliculatus* catches in each FAD and the habitat, the analysis of SIMPER (similarity percentage) was then performed with the results as presented in Tables 4 and 5. There are 6 classes interval of fish length contributing on CF and 5 classes interval on GF. The percentage contributions of *S. canaliculatus* size class interval were then grouped by habitat and formed two groups of class interval characters. The first group is coral reef habitat with 6 contributions of class interval, while the second group habitats were estuaries and sea grass bed which contributed in 5 class interval each, analysis Simper is shown on Table 5.

The contribution percentage for both FADs, in the distribution of fish length as the dominant key size was quite varied. In CF, the size which contributes to the highest size of the identifier was 13.1-14.0 cm with a contribution of 27.20% (Table 4). The second dominant size was 4.5-5.7 cm with a contribution of 16.17% and the third dominant size was 3.4-4.5 cm with a contribution of 15.10%. Furthermore, the dominant length of *S. canaliculatus* on CF was 13.1-14.0 cm which is the largest size within ten class interval (Table 5). The largest size of class interval (13.1-14.0 cm) which is predominantly found in CF is allegedly due to the size of *S. canaliculatus* which is classified as juvenile where the fish is able to eat the attractor (*E. cottonii*). The size of *S. canaliculatus* which categorized as juvenile is measured based on the size of 12 cm in total length (Sudradjat 2009). The results of the analysis of stomach contents of fish in this study showed that about 40% of macro algae (seaweed) were found in the stomach of *S. canaliculatus*. Rabbit fish is categorized as one of the most ferocious macro pest which damaging seaweed (*Eucheuma* sp.) (Anggadiredja et al 2006). A lot of *E. cottonii* cultivation in the East Java was damaged by rabbit fish pest (Abdullah 2011).

Table 4

Characteristics of total length (TL) of *S. canaliculatus* on FADs and its contribution in Uloulo waters, Luwu District

No	*Class interval (cm)*	*FADs group (percentage contribution)*	
		Cottonii FADs (CF) (%)	*Gracillaria FADs (GF) (%)*
1	2.2-3.3	10.75	8.45
2	3.4-4.5	15.10	51.36
3	4.6-5.7	16.17	12.65
4	5.8-6.9	8.75	15.64
5	7.0-8.1	12.10	0
6	8.2-9.3	0	0
7	9.4-10.5	0	0
8	10.6-11.7	0	8.07
9	11.8-12.9	0	0
10	13.0-14.1	27.20	0

Table 5

Characteristics of the type of *S. canaliculatus* total length (TL) based on habitat and contribution in Uloulo coastal waters, Luwu District

No	*Class interval (cm)*	*Habitat group (percentage contribution)*		
		Estuary (%)	*Sea grass bed (%)*	*Coral reef (%)*
1	2.2-3.3	10.17	20.56	0
2	3.4-4.5	31.83	35.06	30.72
3	4.6-5.7	31.47	20.49	0
4	5.8-6.9	16.39	10.35	9.49
5	7.0-8.1	0	0	16.44
6	8.2-9.3	0	7.73	0
7	9.4-10.5	0	0	0
8	10.6-11.7	0	0	8.28
9	11.8-12.9	0	0	7.72
10	13.0-14.1	3.67	0	23.33

Furthermore, the dominant size of *S. canaliculatus* on GF was 3.4-4.5 cm with a contribution of 51.36%. The second dominant size was 5.8-6.9 cm with a contribution of 15.64% and the third dominant size was 4.6-5.7 cm with a contribution of 12.65% (Table 4). The high contribution of *S. canaliculatus* within the size of 3.4-4.5 cm, in GF, was still in a juvenile phase, this was presumably due to the FADs purpose as a shelter from predators and foraging fish. GF with its long and dense growth becomes a shelter for juvenile fish to hide from predators. This result is in accordance with Simbolon et al (2011), who states that fish abundance in FADs with denser attractor is higher than the one with less density.

The results of the SIMPER analysis showed that the distribution size of *S. canaliculatus* TL on bio-FADs in three habitats, estuary, seagrass beds and coral reefs (Table 5), which categorized as typical size was 3.4-4.5 cm. All three of these habitats contribute on the first dominant order within ten class intervals. However, among the three habitats, sea grass habitat had a highest contributor equal to 37.06% of catch, while estuary habitat and coral reef habitat were contributed to 32.83% and 30.11% respectively.

The high contribution of the class interval 3.4-4.5 cm on sea grass habitats is due to its functions as nursery area, feeding area, and sheltering area for various types of juvenile fish. Rabbit fish, on juvenile phase, lives in sea grass but after maturity it is partially returned to coral reef as its natural habitat (Tomascik et al 1997). Sea grass is functioning as nursery area, shelter and feeding area for various types of fish juvenile (Nybakken 1988). *S. canaliculatus*, within the size of juvenile, contributes in 20% of sea grass and mangrove habitats in eastern coast waters of Kendari (Fahmy & Zamroni 2011).

Table 5 shows that, in the coral reef habitats, the dominant size of the fish was 3.4 4.5 cm with a contribution of 30.72%. Furthermore, the second dominant size was 13.0-14.1 cm with a contribution of 23.33%, and the third dominant size is in class interval of 7.0-8.1 cm with a contribution of 16:44%. However, the class interval categorized as young fish (juvenile) was acquired in coral reefs habitat. Those class intervals and its contribution were in the range of 13.0-14.1 cm (23:33%), 11.8-12.9 cm (8.28%) and 10.6-11.7 cm (7.72%). The size of *S. canaliculatus* which is categorized as juvenile is 12 cm length (Sudradjat 2009).

The existence of *S. canaliculatus* juvenile in coral reef habitats seems to be due to its instinct to search for its natural habitat. The juvenile of *S. canaliculatus*, on its life cycle, lives in sea grass but when it enters to its mature phase, a portion of its population returns to coral reef as its natural habitat (Tomascik et al 1997). It stays in coral reef habitats until its ready to breed (Agus et al 2012). There are various kinds of fish species interact directly with coral reef habitats, especially the juvenile and young fish (Djunaedi 2011).

Conclusions. The distribution of *S. canaliculatus* catches on both bio-FADs were varied in term of spatial (habitat) and temporal (months) aspects. The highest catch of *S. canaliculatus* on the CF was on the estuary habitat, while the highest catch on GF was on sea grass habitat. Temporal variation of length size distribution of the fish was significantly different, while there was no variation between habitats. The dominant size of *S. canaliculatus,* with high contribution, were different between FADs, while based on habitat showed the same percentage contribution on the length of the fish, with the size of 3.4-4.5 cm, occupying the highest contribution on the three habitats.

Acknowledgements. The authors thank General Directorate of Higher Education, Indonesia for their support on this research.

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Received: 20 August 2016. Accepted: 30 September 2016. Published online: 28 November 2016.
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How to cite this article:
Suardi, Wiryawan B., Taurusman A. A., Santoso J., Riyanto M., 2016 Variations in size and catch distribution of white spotted rabbit fish (*Siganus canaliculatus*) on bio-FADs from spatially and temporary point of view, at Luwu District, South Sulawesi, Indonesia. AACL Bioflux 9(6):1220-1232.