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Biological analysis of adult rabbitfish (*Siganus guttatus* bloch, 1787) in seagrass and coral reef ecosystems at laikang bay, takalar regency

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Abstract. The rabbitfish (*Siganus guttatus*) is a fish which has a high economic value also became one of the most popular types of fish consumed by the Takalar people up to Makassar City. The high market demand makes the effort to catch fishermen become greater so that the pressure on this species also becomes greater. therefore this research is needed to provide information in the preparation of comprehensive and systematic management strategies by policy makers to maintain the sustainability and sustainability of *Siganus guttatus* resources in the waters. The scope of this research includes information on rabbitfish habitat, abundance, feeding habits, sex ratio, and gonad maturity level (GML), as well as to compare the distribution pattern, gut content and GML in seagrass and coral reef ecosystems. This research was carried out from March to June 2017 in Laikang Bay, Takalar Regency, South Sulawesi Province, Indonesia. Rabbitfish samples (N = 336) were collected, comprising 293 males and 43 females with the size ranges of 11.2 – 35.9 cm and 8.4 – 35.4 cm, respectively. GML ranged from I – V. The GML in coral reef ecosystem was generally higher than in seagrass. The GML and number of individuals from the coral reef ecosystem were: GML I (133 fish), GML II (84 fish), GML III (30 fish), GML IV (12 fish), GML V (8 fish); whereas from seagrass ecosystem, GML I (12 fish), GML II (11 fish), GML III (2 fish). Gut content analysis found 36 phytoplankton species; the taxa comprising the highest percentages were *Thalassiothrix* sp. (69.24%) in the coral reef ecosystem and *Oscillatoria* sp. (26.34 %) in seagrass.

1. Introduction

The rabbitfish (*Siganus guttatus*) is a fish with a high economic value both internationally and locally in the Takalar Regency, South Sulawesi Province, Indonesia. In the coastal seas of Takalar Regency, rabbitfish are caught using demersal fish traps made from bamboo. This fishing method involves placing the trap on the substrate in seagrass or coral reef ecosystems. Morphologically, the rabbitfish *Siganus guttatus* (Bloch, 1787) has yellow spot in the dorsal area close to the tail, a rounded body with small mouth, and a long digestive intestine. With incisors in each jaw, the molars develop perfectly, the stomach wall is rather thick, and the surface of the small intestine is long and wide. Rabbitfish (*Siganus guttatus*) are tropical herbivorous fish species such as the rabbitfish which feeds primarily on seaweeds and other benthic algae [1].



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In the marine environment, *Siganus guttatus* (Bloch, 1787) plays an important ecological role as a first-level consumer (herbivore) at trophic level II. Rabbitfish have several advantages, including being able to grow fast and high capacity to adapt to their environment. However, they are also sensitive to drastic changes in environmental conditions, for example changes in temperature, salinity and dissolved oxygen [2]. Usually adults occurs in small aggregations, but occasionally form large schools [3]. Habitats include coral reefs, seagrass meadows, mangroves, and river estuaries. Some rabbitfishes seek food in rocky areas and coral reefs [4]. Predominantly herbivorous, zooplankton and phytoplankton are the main foods in the larval phase whereas in the juvenile phase rabbitfishes eat small algae and epiphytes, while in the adult phase they mostly eat seaweed or macro algae [5].

The high market demand for the catch of Rabbitfish (*Siganus guttatus*) for the consumption of local people in Takalar Regency to Makassar is one of the utilization pressures that can threaten the sustainability of this organism if the management of available resources is not carried out comprehensively and systematically which is feared to have an impact on decreasing the population of Rabbitfish (*Siganus guttatus*) in the waters. Based on this overview, a study on *Siganus guttatus* was considered necessary to support the sustainable management of this species, through observing key biological parameters of the fish caught by fishermen in the seagrass and coral reef ecosystems in Laikang Bay, Takalar district, South Sulawesi Province. This study aimed to determine the fine-scale distribution pattern, especially from biological aspects such as the level of gonadal maturity and food habits in different ecosystems, i.e., seagrass and coral reef ecosystems. The scope of this study comprised: 1) the relative abundance of fish from these two ecosystems; 2) reproductive parameters; 3) fishing ground locations.

2. Materials and Methodology

2.1. Time and Place

The study was conducted over a six month period in Laikang Bay, Takalar Regency, South Sulawesi Province, Indonesia. The sampling coordinates can be seen on the site map (Figure 1). The total sampling period was divided into 2 time intervals: February, March, April 2017 and August, September, October 2017.

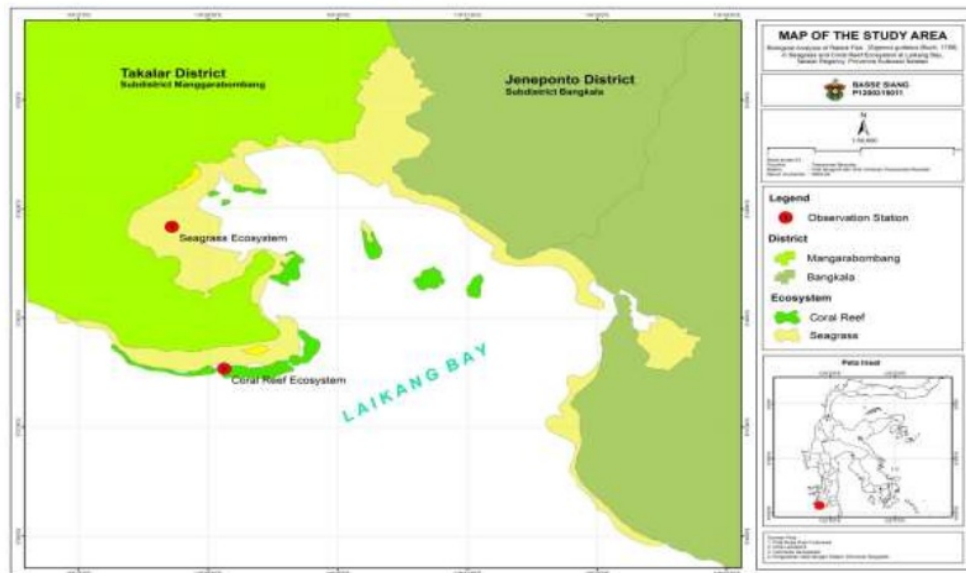


Figure 1. Map showing the sampling locations.

2.2. Data Collection

Sampling was carried out directly in the field, by participating with fishermen using demersal traps. All fish caught were euthanized then packed in styrofoam boxes containing crushed ice blocks so that the fish remained fresh until they arrived in the laboratory. Fish samples were separated by sex and capture site. In the laboratory, the fish were measured (total length, TL) and dissected to remove the gonads and gut, complete with the gut content. After removal, gonads were placed in a Gilson solution and guts (stomach and intestines) were placed in a formalin solution. After soaking in the respective preservative solutions, the gonads and the guts were stored in plastic sample containers. The gonads were observed visually with the naked eye to determine sex and maturity stage. There is no known external feature to distinguish the sexes of rabbitfishes except during the breeding season enumerated some criteria for differentiation in Siganid: (1) males are generally smaller than females; (2) abdomen of female is distinctly plump; (3) when the abdomen is pressed, whitish fluid (milt) comes out from males and orange-colored eggs from females; (4) genital aperture of female is larger; and (5) female is less active [6]. Another explanation state that during spawning season, mature siganid showed change in color. The male of *Siganus guttatus* became lighter and the female darker in ground color [7]. and for observations of samples that have been dissected the gonad maturity classification refers to the modification of the Cassie Gut contents (Table 1), were observed under a microscope with a magnification of 4 times to identify the organisms present. Species of organisms that have been observed are then identified based on the type of food using the identification book Yamaji (1976) and the identification book Newel and Newel (1963). Observation of these types of food aims to determine the composition of food eaten by rabbitfish (*Siganus guttatus*). The results of these observations are written based on the type and number of organism on the paper provided.

2.3. Data Analysis

2.3.1 *Sex Ratio*. The sex ratio of male: female *Siganus guttatus* was calculated and tested for difference from 1:1 using the chi-square test with continuity correction (X^2) [8] as follows:

$$x^2 = \frac{(|X - nP_0| - \frac{1}{2})^2}{nP_0(1 - P_0)}$$

where: X = male frequency;
n = male and female *Siganus guttatus* frequencies
 $P_0 = \frac{1}{2}$.

$$\chi^2 = \frac{(f - E_i)^2}{E_i}$$

where: f = observed male and female *Siganus guttatus* frequencies;
E_i = expected male and female *Siganus guttatus* frequencies.

Using the Chi – square formula based on Yates correction:

$$X^2 = \frac{n(|AD - BC| - \frac{1}{2}n)^2}{(a + b)(a + c)(b + d)(c + d)}$$

2.3.2 *Gonadal Maturity Level (GML)*. Observation of gonad maturity level (GML) was based on the observation of external morphological traits. The criteria in Cassie [9] were modified as shown in Table 1.

Table 1. Morphological criteria for determining Gonad Maturity Level (GML) modified from Cassie [9].

GML	Male	Female
I	The testicles are like threads, shorter with visible endings in the body cavity. Clear colour	Ovaries are like threads, long, reaching to the front of the body cavity. Clear colour and slippery surface.
II	Testes begin to become enlarged. Milky white colouring. More readily visible than in GML I	Ovary size begins to increase. Dark yellowish colouring. The eggs can not yet be seen clearly with the naked eye.
III	The surface of the testes appears convoluted. The colour becomes a more even white, the testes are larger and when preserved they break easily	Ovary colour is yellow. The eggs are visible to the naked eye.
IV	Similar to GML III but the features are more marked. Testes are even more easily split or broken	Ovaries are larger; the eggs are yellow and easily separated. The oil grains do not appear. The ovaries fill 1/2-3/4 of the abdominal cavity. The intestine is compressed
V	The testes appear flattened or deflated. Some parts may still retain sperm which can be released by pressing the testes	The ovaries appear corrugated, with thick walls. Some remaining mature eggs near the oviduct. Many eggs at a similar stage to those in level II

2.3.3 *Index of Preponderance (IP)*. Gut content data were analysed to evaluate the eating habits of the rabbitfish sampled using the largest Index of Preponderance (IP) according to Natarajan and Jhingran (1961) in [9] using the following formula

$$IP_i = \frac{V_i \times O_i}{\sum V_j \times O_j} \times 100 \%$$

where:

- V_i = percentage volume of the i^{th} or j^{th} food (in %)
- O_i = frequency of occurrence of the i^{th} or j^{th} food (in %)
- IP_i = Index of Preponderance of the i^{th} food
- Range of i and j : from 1 to the number of food items identified

The IP values were evaluated using the criteria in [10] as follows:

- $IP > 25 \%$ = Main food
- $IP 5\% - IP 25\%$ = Complementary food
- $IP < 5 \%$ = Additional food

3. Results and Discussion

3.1 Sex Ratio

The total sample size was 336 fish, consisting of 293 males and 43 females (Table 2). Based on the sex, the number of male samples caught was greater than the females.

Table 2. Sex Ratio of observed samples *Siganus guttatus* by ecosystem with Chi-square calculations

Chi-square calculation for Rabbitfish caught in the coral reef ecosystem				
Time of samples taken	Number (fish)		Sex ratio	
	Male	Female	Male	Female
February	46	4	1.0000	0.0870
March	57	7	1.0000	0.1228
April	41	9	1.0000	0.2195
August	23	-	1.0000	0.0000
September	30	19	1.0000	0.6333
October	70	-	1.0000	0.0000
Total	267	39	1.0000	0.1461
		306	X ²	147.54
			X _{Table}	11.07

Chi-square calculation for rabbitfish caught in the seagrass ecosystem				
Time of samples taken	Number (fish)		Sex ratio	
	Male	Female	Male	Female
February	16	3	1.0000	0.1875
March	9	1	1.0000	0.1111
April	1	-	1.0000	0.0000
Total	26	4	1.0000	0.1538
		30	X ²	0.35
			X _{Table}	5.99

The length (TL) of male fish ranged from 11.2 - 35.9 cm for individuals caught in the coral reef ecosystem and from 14.6 - 22.9 cm for those caught in the seagrass ecosystem. The length of female fish ranged from 15.7 - 35.4 cm for individuals caught in the coral reef ecosystem and from 8.4 - 26.6 cm for those caught in the seagrass ecosystem. The male and female fish caught in the coral reef ecosystem were, in general, larger than those caught in the seagrass ecosystem.

In Table 2, the highest number of male individuals caught in coral reef ecosystems was seen in March (57 individuals) and the lowest in August (23 individuals). Unlike male fish, the number of female individuals was highest in September (19 individuals), but in August and October there were no females found. However, samples from the seagrass ecosystem were only found in the first three months. In February, males dominated the catch (16 individuals) whereas females were much less dominant (only 3 individuals) in that month.

Observation of 306 samples obtained from the coral reef ecosystems resulted in an observed sex ratio of 1:0.1461, meaning that for every male fish there was only 0.1461 female fish, far from the expected balanced proportion (1:1). The chi-square X² value of 147.54 was much higher than X_{table} (11.07). This indicates that the number of males and females obtained at the coral reef station was significantly different and the sex ratio was strongly male-biased.

Observation of the 30 samples from the seagrass ecosystem gave a sex ratio of 1:0.1538, also indicative of a highly male-biased sex ratio. However, the chi-square X² value of 0.35 was lower than X_{table} (5.99). This indicates that observed male bias in the seagrass area was not statistically significant, most probably due to the small number of samples obtained from the seagrass ecosystem.

Significant differences in the number of male and female individuals during observation also occurred in previous studies in other areas. This was obtained based on samples of rabbit fish captured in Selayar Island waters [11]. From the samples obtained show that in each sampling, the number of female fish is less than male fish. Based on the Chi-square test results obtained comparisons of female and male fish in a population in an unbalanced condition, with male fish catches more dominant. catch of Rabbitfish from Tarakan obtained shows the sex ratio of male and female individuals is not

balanced because male 65,56% and female only 34,44% but which shows that there are more male fish than female fish [12]. Likewise with the catch of samples of rabbitfish in the waters of Oman, The male obtained is smaller than the female and the catch ratio has a ratio of 1: 0.81. The difference in sex ratio between male and female is considered as one of the organism's strategies in breeding in nature [10]. The sex ratio in nature is influenced by the amount and quality of food [13]. Differences in the number and size of fish in a population in the waters can also be caused by patterns of growth, migration, and the addition of new types of fish in existing populations. One factor that influences fish growth patterns is food which can also trigger migration in some fish species [14].

3.2 Gonad maturity level (GML)

The gonad maturity level (GML) represents the stage of gonadal development from before gonad maturation begins until after the fish have spawned [9]. The GML of *Siganus guttatus* sampled from coral reef and seagrass ecosystems varied over the six month study period for both male (Figure 2) and female (Figure 3) rabbitfishes.

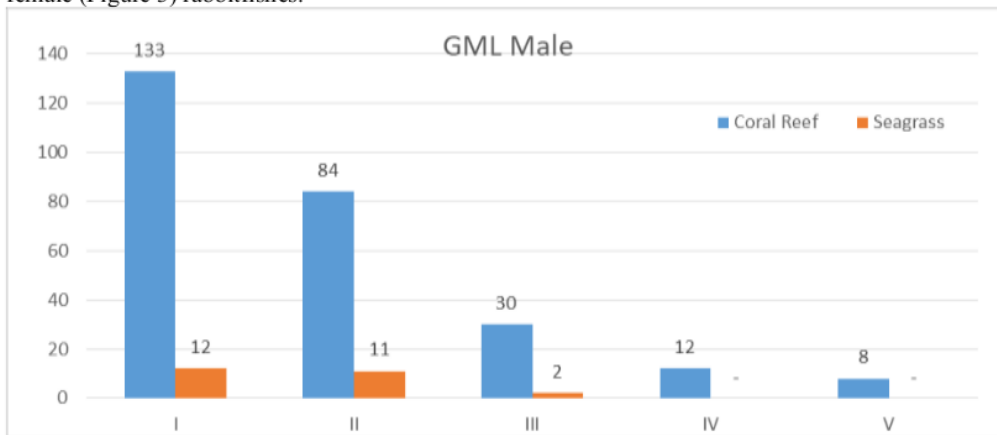


Figure 2. Gonad maturity level (GML) of male rabbitfishes from coral reef and seagrass ecosystems.

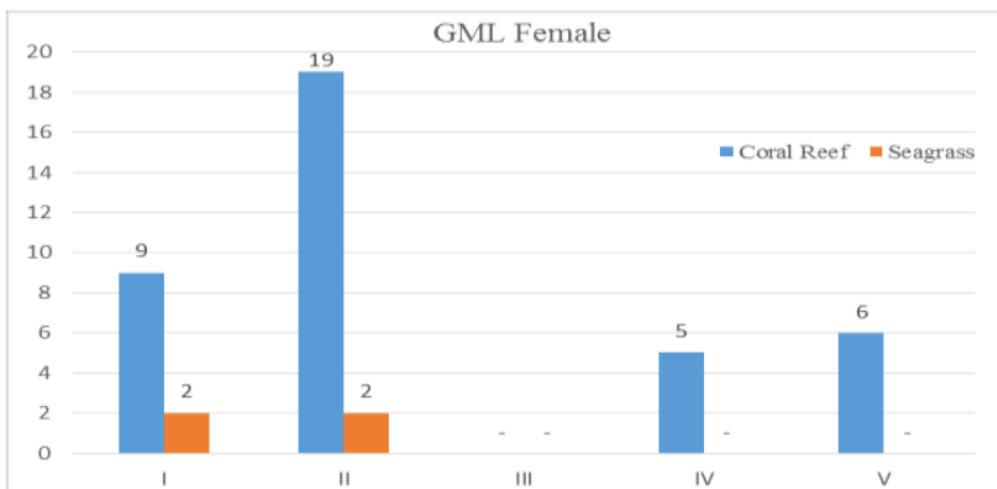


Figure 3. Gonad maturity level (GML) of female rabbitfishes from coral reef and seagrass ecosystems.

The gonad maturity level of the *Siganus guttatus* males caught in the coral reef ecosystem ranged from GML I - GML V (Figure 2). There were many (n = 133) fishes from the seagrass area in GML I, but only two individuals in GML III, with no fully mature or spent individuals. The gonad maturity level of females ranged from GML I – GML V. Most female fish (n = 19) from the coral reef ecosystem were in the GML II phase. From the seagrass ecosystem, however, of the 4 fish sampled there were just 2 individuals in each of the GML I and GML II phases.

The observed levels of gonadal maturity indicate that the level of *Siganus guttatus* gonad maturity is related to the ecosystem where the fish were caught. The gonads of individuals caught in coral reef ecosystems were, in general, more mature than those caught in seagrass ecosystems. This indicates that the higher the gonad maturity level, the more likely a fish would be in the coral reef ecosystem area.

3.3. Rabbitfish feeding habit

The examination of rabbitfish gut contents showed that, like other species in the family Siganidae, *Siganus guttatus* belongs to the guild of herbivores or plant-eating organisms. Index of Preponderance (IP) data showing the percentages of the five main species consumed by rabbitfish sex and ecosystem are shown in Figures 4 to 7.

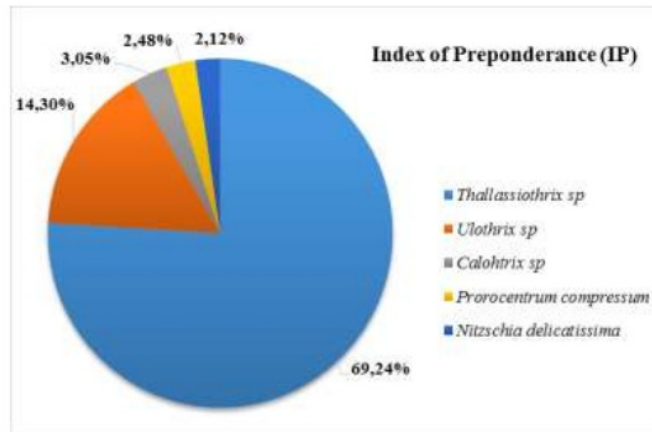


Figure 4. Index of Preponderance (IP) for male *Siganus guttatus* caught in the seagrass ecosystem (5 main food items).

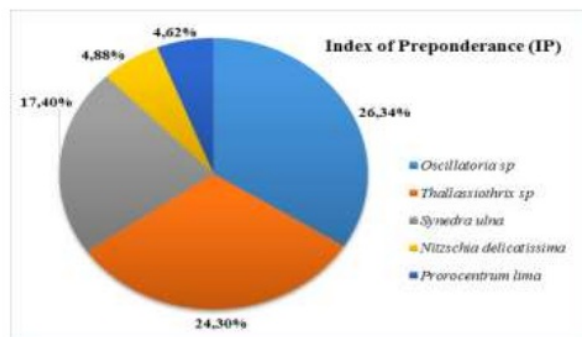


Figure 5. Index of Preponderance (IP) for male *Siganus guttatus* caught in the coral reef ecosystem (5 main food items).

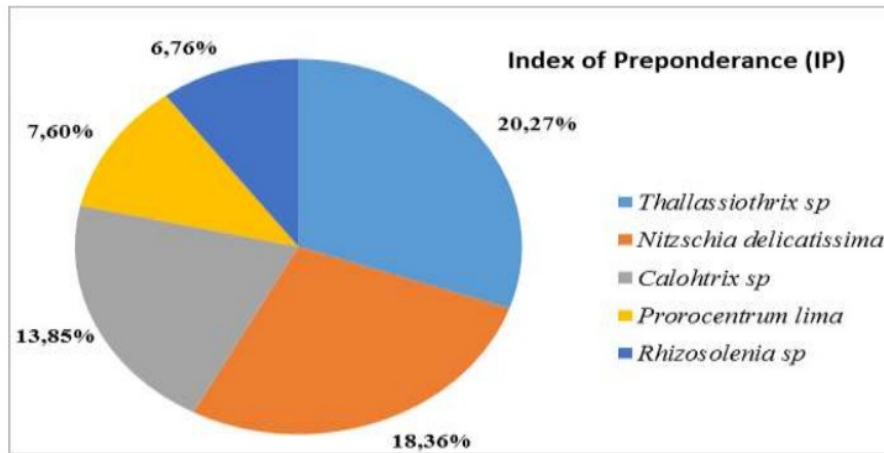


Figure 6. Index of Preponderance (IP) for female *Siganus guttatus* caught in the seagrass ecosystem (5 main food items).

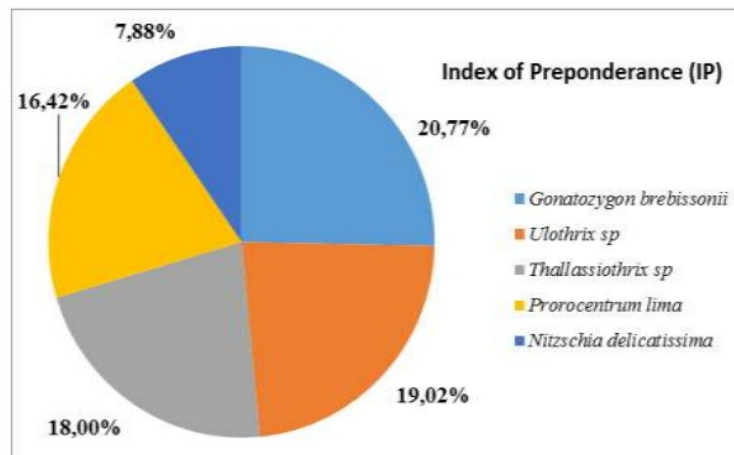


Figure 7. Index of Preponderance (IP) for female *Siganus guttatus* caught in the coral reef ecosystem (5 main food items).

The IP values obtained indicate that there were differences in the types of food between fish obtained from seagrass ecosystems and coral reef ecosystems, likely influenced by the availability of the different food types in each ecosystem. Fish populations are related to food quality and quantity and other environmental factors in the feeding habit area [15]. The changes in eating patterns that occur aims to adjust the type of food in the habitat with the mouth opening of the organism [16].

The gut contents of the sampled *Siganus guttatus* contained several phytoplankton and zooplankton taxa. The gut content of male *Siganus guttatus* obtained from seagrass ecosystems was dominated by *Thalassiothrix sp*. (IP = 69.24%), this taxon was still the most common but less dominant in the guts of female rabbitfishes (IP = 20.27%). For *Siganus guttatus* obtained from coral reef ecosystems, the most dominant taxon in the gut contents of males was *Oscillatoria sp*. (IP = 26.34%), while for female

rabbitfishes the most common food item was *Gonatozygon brebissonii* (IP = 20.77%). The food items identified in the guts of sampled *Siganus guttatus* were generally dominated by phytoplankton taxa, as would be expected for an herbivorous organism. Rabbitfish classified as herbivores that eat plankton, moss, algae and seagrass [17]. The same thing was explained that the main food of Rabbitfish was seagrass, macroalgae, and microalgae [18].

Habitat is considered extremely important for many (reef) fish species providing nursery-, foraging- and hiding places. Many types of epifauna are present in the diet. However, the type of food an organism consumes can also be affected by food availability and environmental conditions. Eating habits and ways to eat fish naturally cannot be separated from the environment in which fish live [19]. *Siganus guttatus* is given coconut during food changes during the maintenance process when it is cultivated [20]. In aquaculture, *S. guttatus* larvae are reared on rotifers, newly hatched brine shrimp nauplii and artificial diet [21]. and although rabbitfish in a natural environment feed primarily in algae both juvenile and adults are primarily herbivorous, exhibit omnivorous feeding habits as a variety of food items [22]. In gut content study of *Siganus guttatus* showed that majority feed of zooplankton and benthic animals According results from the another studies state of the reef fish intestines analysis of *Siganus guttatus* content indicate that most fish species prey on zooplankton and as a benthic organism [23].

4. Conclusion

The *Siganus guttatus* sampled from coral reef and seagrass ecosystems at the study site comprised a total of 293 males and 43 females, indicating a male-biased sex ratio for this rabbitfish population. The gonad maturity level of *S. guttatus* found in coral reef ecosystems was generally higher than in seagrass ecosystems. The types of food found in *S. guttatus* guts were dominated by algae/phytoplankton, in particular *Thalassiothrix* sp., *Oscillatoria* sp. and *Gonatozygon brebissonii*, but also *Synedra ulna*, *Nitzschia delicatissima*, *Calohrix* sp., *Prorocentrum compressum*, *Prorocentrum lima*, and *Rhizosolenia* sp.

References

- [1] Simora R M C, Traifalgar R F M and Legario F S 2015 Characterization of extracellular enzymes from culturable autochthonous gut bacteria in rabbitfish (*Siganus guttatus*) *Extrem. Life, Biospeology Astrobiol.* **7** 67–76
- [2] Zainuri M, Sudrajat S and Siboro E S 2011 Kadar Logam Berat Pb Pada Ikan Beronang (*Siganus* sp), Lamun, Sedimen dan Air di Wilayah Pesisir Kota Bontang-Kalimantan Timur J. *Kelaut. Indones. J. Mar. Sci. Technol.* **4** 102–18
- [3] Kuitert R H and Tonozuka T 2001 Photo guide to Indonesian reef fishes *Zoonetics. Aust. hal* 1–893
- [4] Allen G 1999 Marine Fishes of South-East Asia; A guide for anglers and divers *Periplus Ed. Singapore*
- [5] Ghufrani M and Kordi H 2005 Budidaya Ikan Beronang *PT. Rineka Cipta. Jakarta*
- [6] Duray M N 1998 *Biology and culture of siganids* (Aquaculture Department, Southeast Asian Fisheries Development Center)
- [7] Hara S, Kohno H and Taki Y 1986 Spawning behavior and early life history of the rabbitfish, *Siganus guttatus*, in the laboratory *Aquaculture* **59** 273–85
- [8] Sudjana P M. Sc. 1996. “*Metod. Stat. (Edisi ke enam)*”. *Tarsito Bandung*
- [9] Effendie M I 1979 *Metode biologi perikanan Yayasan Dewi Sri. Bogor* **112**
- [10] Al-Marzouqi A, Jayabalan N, Al-Nahdi A and Al-Anbory I 2011 Reproductive Biology of the White-spotted Rabbitfish, *Siganus canaliculatus* (Park, 1797) in the Arabian Sea coast of Oman *West. Indian Ocean J. Mar. Sci.* **10** 73–82
- [11] Omar S B A, Fitrawati R, Sitepu F G, Umar M T and Nur M 2017 Pertumbuhan Ikan Baronang Lingkis, *Siganus Canalicullatus* (Park, 1797), Di Perairan Pantai Utara Kabupaten Kepulauan Selayar, Sulawesi Selatan *Torani J. Fish. Mar. Sci.* **25**

- [12] Salim G 2014 Analisis Rasio Kelamin Dan Laju Mortalitas Pada Ikan *Siganus Javus* Yang Didapatkan Dari Hasil Tangkapan Nelayan Di Kota Tarakan *J. Harpodon Borneo* **7**
- [13] Tuegeh S, Tilaar F F and Manu G D 2012 Beberapa Aspek Biologi Ikan Beronang (*Siganus vermiculatus*) di Perairan Arakan Kecamatan Tatapaan Kabupaten Minahasa Selatan *J. Ilm. Platax* **1** 12–8
- [14] Dahlan M A, Omar A, Bin S, Tresnati J, Umar M T and Nur M 2015 Nisbah Kelamin Dan Ukuran Pertama Kali Matang Gonad Ikan Layang Deles (*Decapterus macrosoma* Bleeker, 1841) Di Perairan Teluk Bone, Sulawesi Selatan *J. Adm. dan Kebijak. Kesehat. Indones.* **25**
- [15] Gorospe J G and Demayo C G 2013 Population variability of the Golden rabbit fish (*Siganus guttatus* Bloch)(Pisces: Siganidae) in Northern Mindanao, Philippines. *Aquac. Aquarium, Conserv. Legis. J. Bioflux Soc. (AACL Bioflux)* **6**
- [16] Effendie M I 1997 Biologi Perikanan. Yayasan Pustaka Nusatama *Yogyakarta. Hal* 92–105
- [17] Ghufran M H K and Kordi K 2010 Nikmat rasanya, nikmat untungnya-Pintar Budidaya Ikan di Tambak secara Intensif *Yogyakarta Andi Offset*
- [18] Linh N Q, Ngoc T N and Huyen K T Nutritional Characteristics and Feeding of Rabbitfish (*Siganus guttatus*) in Tam Giang-Cau Hai Lagoon Systems
- [19] Rappe R A 2010 Struktur Komunitas Ikan Pada Padang Lamun Yang Berbeda Di Pulau Barrang Lompo Fish Community Structure In Different Seagrass Beds Of Barrang Lompo Island *J. ilmu dan Teknol. Kelaut. Trop.* **2** 63
- [20] Muslimin M, Usman U and Kamaruddin K 2011 Uji Coba Beberapa Jenis Pakan Pada Pembesaran Ikan Beronang (*Siganus Guttatus*) Dalam Kerama Jaring Apung *Prosiding Forum Inovasi Teknologi Akuakultur* vol 1 pp 399–405
- [21] Hara S, Duray M N, Parazo M and Taki Y 1986 Year-round spawning and seed production of the rabbitfish, *Siganus guttatus* *Aquaculture* **59** 259–72
- [22] El-Dakar A Y, Shalaby S M and Saoud I P 2011 Dietary protein requirement of juvenile marbled spinefoot rabbitfish *Siganus rivulatus* *Aquac. Res.* **42** 1050–5
- [23] Eya A A A, Lacuna D G And Espira A S 2011 Gut content analysis of selected commercially important species of coral reef fish in the southwest part of Iligan Bay, Northern Mindanao, Philippines

4._RAR_with_Parawansa-IOP2020-Rabbitfish-Giesed.pdf

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4 K Khairul, R Machrizal, A Harahap, M Gultom, RD Harahap, R Nazliah. " Biological aspects of fish indo pacific tarpon (Broussonet, 1782) at Belawan River ", IOP Conference Series: Earth and Environmental Science, 2019 % **1**
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11	www.elba.bioflux.com.ro	<% 1
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13	N Trisyani, N I Wijaya, I Yuniar. " Sex ratio and size at first maturity of razor clam sp. in Pamekasan and Surabaya coastal area, East Java, Indonesia ", IOP Conference Series: Earth and Environmental Science, 2019	<% 1
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14	www.bioflux.com.ro	<% 1
Internet Source		
15	Mohammad Mustakim, Sutrisno Anggoro, Frida	<% 1

Purwanti, Haeruddin. " Food habits and trophic level of in floodplain lake, Lake Semayang, East Kalimantan ", E3S Web of Conferences, 2020

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16

ir.kagoshima-u.ac.jp

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17

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18

Khoirul Fatah, Susilo Adjie. "STRUKTUR TINGKAT TROFIK KOMUNITAS IKAN DI WADUK WADASLINTANG KABUPATEN WONOSOBO, JAWA TENGAH", BAWAL Widya Riset Perikanan Tangkap, 2015

Publication

<% 1

19

S A Ali. " Maturity and Spawning of Flying Fish (Bleeker, 1852) in Makassar Strait, South Sulawesi ", IOP Conference Series: Earth and Environmental Science, 2019

Publication

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Ashraf Y El-Dakar. "Dietary protein requirement of juvenile marbled spinefoot rabbitfish *Siganus rivulatus* : Dietary protein requirement of *Siganus rivulatus*", Aquaculture Research, 06/2011

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