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**Ong TS Ongkers**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

**M Pattinasarany**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

**JAB Mamesah**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

**PR A Uneputty**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

**JA Pattikawa**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

**Correspondence**

**M Pattinasarany**

1) Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University Ambon, Indonesia

2) Maritime and Marine Science Center of Excellence, Pattimura University, Ambon, Indonesia

## Size distribution and growth pattern of *Holothuria atra* and *Holothuria scabra* in the coastal waters of Morella, Central Maluku Indonesia

Ong TS Ongkers, M Pattinasarany, JAB Mamesah, PR A Uneputty and JA Pattikawa

### Abstract

Research to study size distribution and growth pattern of sea cucumber was conducted in the coastal waters of Morella, Central Maluku Indonesia on April to September 2018. Sampling with replacement method was used in this study. Sea cucumber collected was let to relax about 10 minutes and then measured. Length was measured from the tip of the mouth to tip of the anus to nearest mm using plastic ruler while weight was weighted to nearest 0.1g by using digital balance. Totally, there were 114 individuals of *Holothuria atra* and 111 individuals of *H. scabra* collected during the research. Length of *H. atra* and *H. scabra* ranged from 9.6 to 31.6 cm and 7.5-28.0 cm, respectively while their weight ranged from 26.0 g to 201.0 g and 38.0 to 137.6 g, respectively. Analysis of length weight relationship showed that *H. atra* as well as *H. scabra* had negative allometric growth pattern.

**Keywords:** *Holothuria atra*, *H. scabra*, size distribution, length weight relationship

### 1. Introduction

Sea cucumber is one of the marine invertebrate which inhabit the bottom of coastal waters. This marine organism becomes primary commodities and in international market it is well known as teat fish or *beche-de-mer* [1, 2]. Depending on species, size and processing quality, price of sea cucumber in international market is up to USD300–500 per kg (dried) [3, 4]. This high price and growing demand has led to excessive harvesting and depletion of sea cucumber population worldwide including Indonesia [3, 5].

Indonesia is one of the largest exporter sea cucumber in world which has about 53 species in its territorial waters and most of sea cucumber occurs in eastern Indonesia, particularly in Sulawesi and Maluku [4, 6, 7]. Sea cucumber fishery in Maluku is traditional or small-scale and fishing operation is done mostly at shallow waters [4]. Even though small-scale, intensive exploitation by fishers is carried out without concerning species and size of sea cucumber caught. Recent study showed that there is tendency of declining population of sea cucumber in Maluku waters [8].

Exploitation of sea cucumber in Maluku has been done for long time, however, information of this resource is still lacking. Several researches had been conducted in Maluku, but mostly focused on community structure of sea cucumber in the area [9, 10, 11]. This research was conducted to fill the gap by investigating size distribution and growth pattern of two predominant species *Holothuria atra* and *H. scabra* at the coastal waters of Morella, Central Maluku Indonesia. Both two species *H. atra* and *H. scabra* are commercial species of sea cucumber. The price of *H. scabra* is more expensive than that of *H. atra*. Due to highly demand or harvesting, it could be expected that the size of these sea cucumber is getting smaller. Therefore, by studying size distribution and growth pattern, it could be expected to determine the size of both these two species in relation to harvesting or exploitation.

### 2. Materials and Methods

#### 2.1 Study site

Study on size distribution and growth pattern of sea cucumber was carried out at the coastal waters of Morella, Central Maluku Indonesia (Figure 1) for six months from April to

September 2018. Sand is predominant substrate in the study area while mud sand, gravel, crushed coral and coral reefs are

spotted in certain area. Seagrass in the study area are *Enhalus acoroides*, *Cymodocea rotundata* and *Halodule pinifolia*.



Fig 1: Map showing study site (Star)

2.2 Sample collection and analysis

Sample of sea cucumber was collected freely once at the beginning of the month for six months by using sampling with replacement method. Sample of sea cucumber collected was let to relax about 10 minutes and then measured. Length of sea cucumber was measured from tip of the mouth to tip of the tail (from anterior to posterior) by using plastic ruler to the nearest mm, whereas weight was weighted using a 5.0 kg blue LCD blacklight portable digital balance to the nearest 0.1g. After measurement, sea cucumber was returned into the seawater.

Microsoft Excel 2010 was used to process the data. Analysis of length-weight relationship was done by using power function of Pauly (1984) [12] cited in [4, 13, 14, 15, 16, 17].

$$W = a L^b$$

Where: W = weight (g);  
 L = Total length (cm);  
 a = intercept;  
 b = slope.

3. Results and Discussion

In preliminary observation, there were five species of sea cucumber found in the coastal waters of Morella namely *H. atra*, *H. scabra*, *H. leucospilota*, *Stichopus hermannii* and *S. variegatus*. However, only two predominant species i.e. *H. atra* and *H. scabra* were used for further analysis to study size distribution and length weight relationship while the other three species were discarded from the analysis because they had only a small number of individuals.

3.1 Size distribution

Totally, there were 114 individuals of *H. atra* collected during the research. The size of this species in term of length and weight is presented in Table 1. It can be seen in Table 1 that length of *H. atra* ranged from 9.6 to 31.6 cm (mean  $18.16 \pm 4.42$  cm) whilst its weight ranged from 26.0 g to 201.0 g (Mean  $64.53 \pm 37.12$  g). The size of *H. atra* found in this study is larger than the size reported by Panggabean *et al.* (2012) [18] from Datu Island (Scott Reef) Australia i.e. 12.0 – 13.5 cm and 20 – 55 g. On the contrary, mean size found in this study is smaller the average size of *H. atra* in the Western Central Pacific region reported by Kinch *et al.* (2008) [19].

Table 1: Size distribution of *H. atra* during the research

Period	N (Ind.)	Length (cm)				Weight (g)			
		Min	Max	Mean	SD	Min	Max	Mean	SD
April	36	10.7	21.0	16.00	2.77	27.0	101.0	58.89	27.98
May	9	14.0	21.0	16.46	2.43	34.5	103.0	58.98	23.30
June	35	9.6	30.2	18.76	4.91	26.0	162.0	65.04	38.80
July	7	15.5	24.6	20.40	3.80	42.0	105.0	78.28	31.80
August	19	18.5	30.7	20.75	4.74	28.0	201.0	88.58	4.65
September	8	12.5	31.6	21.2	8.75	32.0	198.0	95.00	57.68
Total	114	9.6	31.6	18.16	4.42	26.0	201.0	64.53	37.12

There were 111 individuals of *H. scabra* collected during the period of April – September 2018 with their length ranged from 7.5 – 28.0 cm (mean  $18.18 \pm 4.42$  cm) and their weight ranged from 38.0 to 137.6 g (mean  $64.53 \pm 37.12$ ) (Table 2). The minimum length of 7.5 cm never been reported for this species in Maluku waters by other researchers. In Tanjung Tiram Maluku eastern Indonesia, length of *H. scabra* ranged from 10.3 – 21.4 cm and weight ranged from 109.4 – 459.6 g [7]. Meanwhile, Natan *et al.* (2015) [4] found length of this species ranged from 9.5 – 23.3 cm and weight ranged from 80

– 450 g in Un Bay, southeast Maluku. Mean length of *H. scabra* found in this study is similar to the mean length of the same species from Toliara, south-west of Madagascar for the period of August to September but far lower than mean length for other months as reported by Rasolofonirina *et al.* (2005) [20]. In addition, mean size found in this study is also lower than mean size of the same species from Western Central Pacific region reported by Kinch *et al.* (2008) [19].

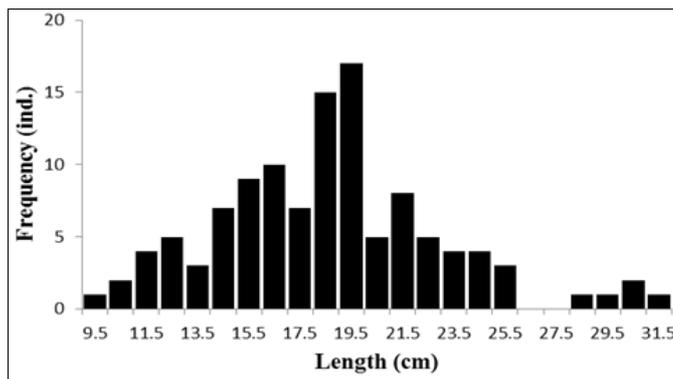
**Table 2:** Size distribution of *H. scabra* during the research

Period	n (ind.)	Length (cm)				Weight (g)			
		min	max	Mean	SD	min	max	mean	SD
April	9	8.4	11.0	9.66	0.90	39.0	65.5	49.17	8.65
May	24	7.5	15.4	10.75	1.90	38.0	76.0	55.42	13.67
June	49	7.5	16.7	11.44	2.05	39.0	83.0	57.64	12.49
July	8	8.5	11.9	10.60	1.32	41.6	74.4	59.20	14.12
August	11	11.5	25.9	20.86	3.03	43.0	103.0	70.66	12.49
September	10	11.5	28.0	19.34	5.08	48.0	137.6	75.82	31.45
Total	111	7.5	28.0	12.73	4.37	38.0	137.6	59.07	17.59

**3.2 Length frequency distribution**

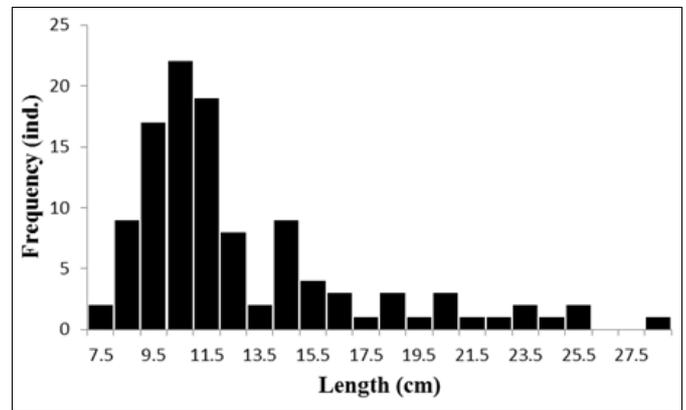
Length frequency distribution of *H. atra* is presented in Figure 2. The most abundance individual is represented by length class 19.5 cm with 17 individuals while the least is found in length classes 9.5, 28.5, 29.5 and 31.5 cm with only one individual each.

According to Dissanayake and Stefansson (2010) [21], length at first sexual maturity of *H. atra* occurs at 16.0 cm (total length). Data mean length in Table 1 and length frequency in Figure 2 show that most individuals i.e. 83 of 114 individuals *H. atra* collected belong to the length classes of 16.5 cm or more. This figure indicated that 72.81% of *H. atra* found in this study have achieved their first sexual maturity at the length  $\geq 16$  cm or have spawned at least one.



**Fig 2:** Length frequency distribution of *H. atra*

Length frequency distribution of *H. scabra* is presented in Figure 3. The most abundance individual is represented by length class 10.5 cm with 22 individuals while the least is found in length classes 17.5, 19.5, 21.5, 22.5, 24, and 28,5 cm with only one individual each. Al-Rashdi *et al.* (2007) [22] reported that mode of *H. scabra* from Mahout Bay Oman occurred at length class 18 cm whereas the least belonged to length clas of 32 cm.



**Fig 3:** Length frequency distribution of *H. scabra*

According to Connand (1990) [23], as well as Kithakeni and Ndaro (2002) [24] cited in Natan *et al.* (2015) [4], first gonad maturity of *H. scabra* occurs at  $\geq 16$  cm. Based on this statement, it can be concluded that most of *H. scabra* in this area consist of small individuals or juvenile i.e. 92 individuals (82.88%) with their length  $< 16$  cm. As far as economic value is concern, *H. scabra* is one of the most valuable sea cucumber that has high commercial value [23]. Local fishers in the area tend to catch *H. scabra* especially the larger size most often than other species.

**3.3 Length weight relationship**

Length weight relationship for sea cucumber is presented in Table 3 and Table 4. Correlation coefficients (r) shown in Table 3 and Table 4 ranged from 0.8751 – 0.9953 indicated significant relationship between length and weight and those relationships can be used for further analysis [4, 12, 13, 14, 15, 16, 17]. Contribution of length to weight which is shown by coefficient of determination (R<sup>2</sup>) ranged from 87.51 – 99.53% and from 90.26 – 96.42% for *H. atra* and *H. scabra*, respectively. It can be seen also in Table 3 and Table 4 that the values of slope (b) for both species ranged from 1.1381 – 2.6056.

**Table 3:** Length weight relationship of *H. atra* during the research

Period	W = aL <sup>b</sup>	r	R <sup>2</sup>	Growth pattern
April	W=0.6121L <sup>1.5613</sup>	0.8751	0.7658	Negative allometric
May	W=0.0511L <sup>2.5106</sup>	0.9621	0.9257	Negative allometric
June	W=0.5769L <sup>1.5841</sup>	0.8770	0.7703	Negative allometric
July	W=0.1189L <sup>2.341</sup>	0.9953	0.9908	Negative allometric
August	W=0.1494L <sup>2.6056</sup>	0.9106	0.8296	Negative allometric
September	W=0.2013L <sup>1.9856</sup>	0.9597	0.9211	Negative allometric

**Table 4:** Length weight relationship of *H. scabra* during the research

Period	W=aL <sup>b</sup>	r	R <sup>2</sup>	Growth pattern
April	W=1.1255L <sup>1.6618</sup>	0.9026	0.8268	Negative allometric
May	W=0.6864L <sup>1.8226</sup>	0.9662	0.9226	Negative allometric
June	W=0.0857L <sup>2.1974</sup>	0.9473	0.8974	Negative allometric

July	$W=0.4851L^{1.6688}$	0.9538	0.9098	Negative allometric
August	$W=2.6207L^{1.2814}$	0.9313	0.8675	Negative allometric
September	$W=3.5797L^{1.1381}$	0.9322	0.8691	Negative allometric

The value of slope (b) in length weight relationship can be used to determine growth pattern of marine organism. If the value of  $b=3$ , its growth pattern is called isometric in which increment of length and weight occurs at the same rate. On the contrary, if  $b \neq 3$  its growth pattern is allometric that can be divided into two categories namely negative allometric ( $b < 3$ ) length increment is faster than weight and positive allometric ( $b > 3$ ) weight increment is faster than length [4, 12, 13, 14, 15, 16, 17]. As all values of  $b < 3$ , growth pattern for both species is negative allometric which means that increment of length is faster than weight. Negative allometric growth pattern is common phenomenon for sea cucumber especially for *H. scabra* as reported by Natan *et al.* (2015) [4]; Yusron (1991) [7]; Dissanayake and Stefansson (2010) [21] and Al-Rashdi *et al.* (2007) [22].

#### 4. Conclusion

Totally, there were 114 individuals of *H. atra* and 111 individuals of *H. scabra* collected during the research. Length of *H. atra* and *H. scabra* ranged from 9.6 to 31.6 cm (mean  $18.16 \pm 4.42$  cm) and 7.5 - 28.0 cm (mean  $12.73 \pm 4.37$  cm), respectively while their weight ranged from 26.0 g to 201.0 g (mean  $64.53 \pm 37.12$  g) and 38.0 to 137.6 g (mean  $59.07 \pm 17.59$ ), respectively. Most of *H. atra* collected during the study consist of large or adult individuals while *H. scabra* mostly consist of small individuals or juvenile. Analysis of length weight relationship showed that *H. atra* as well as *H. scabra* had negative allometric growth pattern.

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