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Some biological aspects of mackerel scad (*Decapterus macarellus*) in Ambon Island waters, Indonesia

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Abstract

Mackerel scads (*Decapterus* spp) are important small pelagic fishes in Ambon Island waters and dominate the catch of purse seine in term of number and volume. One of the species of mackerel scads that can be found all year round in the area is *Decapterus macarellus*, however, there is no biological information about this species from Ambon Island waters. This research was conducted to study some biological aspects which consist of size distribution, growth pattern and condition factor of mackerel scad (*D. macarellus*) in Ambon Island waters. Samples of mackerel scad were collected weekly from purse seine fishers at Hitu village, Ambon Island, Maluku Province on February to March 2018. Totally, there were 279 of mackerel scad collected during the study with the total length ranging from 11.0 to 24.5 cm (mean 17.22±2.48cm) while the weight between 13 and 136g (mean 50.4±23.8g). Analysis of length-weight relationship showed that mackerel scad in the area have isometric and positive allometric growth pattern with condition factor close to unity.

Keywords: *Decapterus macarellus*, size distribution, growth pattern, condition factor, Ambon

1. Introduction

Maluku is an archipelago province in Indonesia with about 92% of its territorial area is covered by sea water. One of the islands that belong to Maluku Province is Ambon Island. Even though the island is small but its seawater has great potential of marine resources especially reef fishes and small pelagic fishes [1, 2, 3, 4, 5].

Small pelagic fishes that dominate the catch and occur all year round in Ambon Island waters are mackerel scads (*Decapterus* spp) [3, 5]. There are four species of mackerel scads in Indonesian waters including Ambon Island waters namely *Decapterus kuroides*, *D. macarellus*, *D. russelli*, and *D. macrosoma* [6]. These species are mainly caught by using purse seine or locally known as *jaring bobo* [5].

Even though mackerel scads can be caught all year round, there is concern about their sustainability. There is an increasing of the number of purse seine in the area but it is not followed by significant increasing in total catch. In 2014, the number of purse seine almost doubled compared to the number in 2010 but their total catch only increased about 13% [7]. In addition, biological information on mackerel scads in Ambon Island waters is still lacking. There were some studies on mackerel scads in the area but its only covered the species of *D. macrosoma* and *D. russelli* [3, 5, 8, 9]. Therefore, this research was conducted study some biological aspects namely size distribution, growth pattern and condition factor of mackerel scad (*D. macarellus*) in Ambon Island waters.

2. Materials and Methods

2.1 Study area

This research was conducted at Hitu village (Figure 1), Northern Ambon Island, Maluku Province, Eastern Indonesia on February to March 2018.

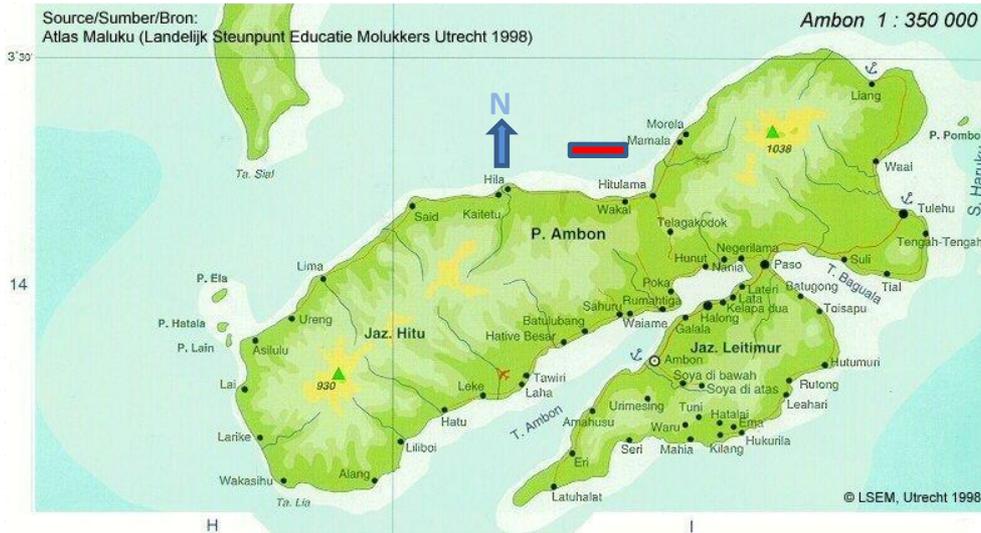


Fig 1: Sampling site (red square)

2.2 Data collection and analysis

Samples of mackerel scad were collected weekly from purse seine fishers and then brought to the laboratory to measure. Total length of fish was measured from tip of the mouth to tip of the tail by using plastic ruler to the nearest mm, whereas weight was weighted using a 5.0 kg blue LCD black light portable digital balance to the nearest gram. Data was processed with Microsoft Excel 2010. Length weight relationship was analysed by using power function [10]:

$$W = a L^b$$

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

Interval value of slope (b) at p=0.05 was calculated according to King (2007) [11]:

$$b \pm t \times sb$$

Where: t = t table (p=0.05; df=n-2);
 sb = standard deviation of b

Relative condition factor was estimated using formula proposed by King (2007) [11]:

$$CF = \hat{W}/W$$

Where: \hat{W} = observed weight

$$W = \text{predicted weight} = aL^b$$

3. Results and discussion

3.1 Size distribution

Totally, there were 279 individuals of mackerel scad (*D. macrosoma*) collected during six weeks period of study. Total length of mackerel scad ranged from 11.0 – 24.5 cm (mean 17.22 ± 2.48 cm) while the weight ranged from 13 – 136 g (mean 50.4 ± 23.6 g)(Table 1). It can be seen in Table 1 that there are the same trend in size distribution i.e. minimum length and weight occurred in periods I and VI, maximum sizes only found in period VI while the highest mean of length and weight found in period III.

The fish size found in this study was smaller than the size of mackerel scad reported in other areas in Indonesian waters. In North Maluku waters, total length of mackerel scad ranged from 21.1 – 31.5 cm with the weight ranged between 101.8 and 307.5 g [12], while in Kendari waters (Southeast Sulawesi) total length ranged from 18.2 – 31.7 cm with the weight ranged from 58 – 291 g [13]. It was also reported from Kendari waters that fork length of mackerel scad caught in the area ranged from 14 – 32 cm [14], whereas in Majene waters (West Sulawesi) fork length of mackerel scad ranged from 14 - 22 cm with the weight ranged from 70.1 – 187.6 g [15]. In addition, fork length of mackerel scad ranged from 16 – 32 cm in Banda Aceh waters (Western Indonesia) [16].

Table 1: Size distribution of *Decapterus macarellus* during the study period

Period	n (ind.)	Total length total (cm)				Weight (g)			
		Min	Max	\bar{X}	SD	Min	Max	\bar{X}	SD
I	51	11.0	21.0	17.08	2.22	13	98	46.3	19.6
II	45	12.0	24.0	17.22	3.07	19	132	52.8	32.3
III	39	14.0	22.5	17.15	2.08	24	107	51.3	22.5
IV	43	14.0	22.5	18.02	2.00	18	110	57.9	20.8
V	46	13.0	22.0	17.18	2.32	18	103	51.7	21.6
VI	55	11.0	24.5	16.82	2.84	13	136	47.0	25.5
Total	279	11.0	24.5	17.22	2.48	13	136	50.4	23.6

Notes: Min=minimum; max=maximum; \bar{X} = mean; SD=standard deviation

Length frequency distribution of mackerel scad in Ambon Island waters for the whole periods is presented in Figure 2. It can be seen in Figure 2 that mid-length 17.5 cm had the highest number of individual i.e. 24.43% of the total fish

collected while the lowest belonged to mid-length 23.5 cm with only 1 individual (0.36%). The modal found in this study is different compare to mackerel scad in Banda Aceh waters i.e. at mid-fork length of 28.5 cm [16].

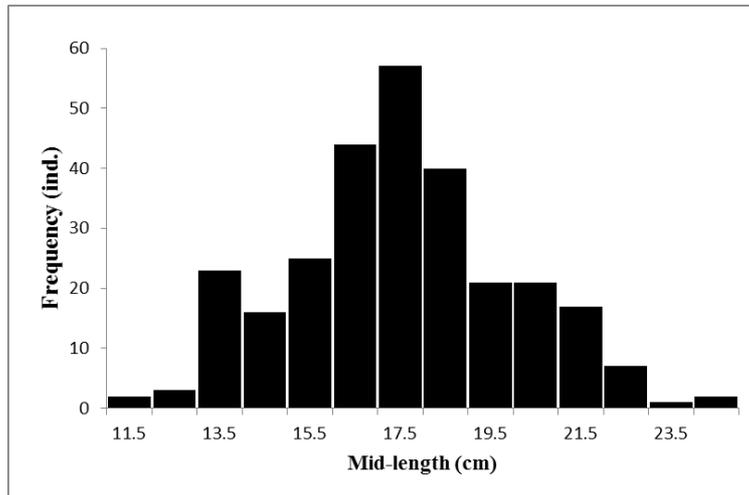


Fig 2: Length frequency distribution of *Decapterus macarellus*

Maturity of mackerel scad in Indonesian waters varies. In Banda Aceh waters, maturity of mackerel scad occurred at 24.9 cm in fork length [16] while in North Maluku at total length of 25.8 cm [16]. Based on those information and the maximum length of mackerel scad in Ambon Island waters (24.5 cm) (see Table 1 and Figure 3), it seems that fish caught by purse seine in this area consist of immature individuals. If this trend of exploitation still continues and occurs for long time, sustainability of mackerel scad population in Ambon Island waters is in danger. Effendie (1997) [17] stated that to ensure sustainability of marine resource, fish should be caught after it spawned at least once. According to Pauly (1984) [10], growth overfishing in an area occurs if the catch mostly consist of young fishes or immature ones.

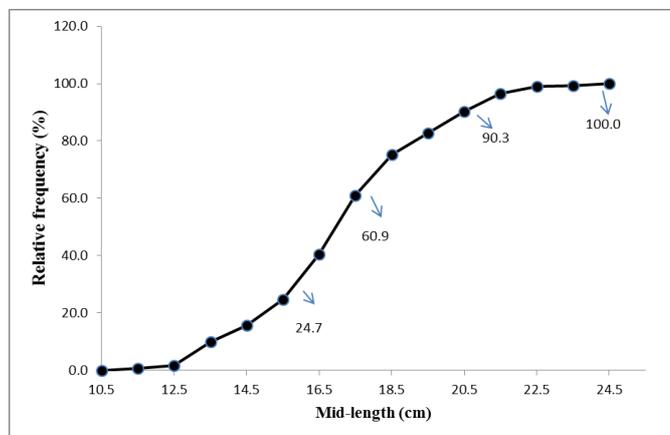


Fig 3: Cumulative relative frequency of *Decapterus macarellus*

3.2 Growth pattern

Length weight relationship of mackerel scad in Ambon Island waters are presented in Table 2 and Figure 4. The values of coefficient of correlation (r) shown in Table 2 ranged from 0.937 – 0.976 are larger than r table (critical value of r at $p=0.01$; $df=n-2$). These figures indicate that there are highly significant relationships between length and weight and those relationships can be used for further analysis. Contribution of length to weight as shown by determination coefficients (R^2) in Table 2 and Figure 4 ranged from 87.4 – 95.3%.

The values of slope (b) shown in Table 2 and Figure 4 ranged from 2.912 – 3.371. Table 2 also showed interval value of b at $p=0.05$ to test significance deviation of b from 3. According to King (2007) [11], b is not significantly different from 3 ($b=3$) if its interval value at $p=0.05$ includes 3.00. Furthermore, Sparre and Venema (1992) [18] stated that the value of b in length weight relationship can be used to determined growth pattern of fish. In addition Pauly (1984) [10] stated that if $b = 3$, growth pattern of fish is isometric i.e. length increment is proportional to weight while if $b \neq 3$ means length increment is larger than weight increment (negative allometric, $b < 3$) or weight increment is larger than length increment (positive allometric, $b > 3$). Based on those statements and the interval values of b at $p=0.05$ listed in Table 2, it seems that isometric growth pattern i.e. length increment has the same rate with weight increment occurred in periods I, II, V and VI while positive allometric growth pattern i.e. weight increment is faster than length increment found in periods III and IV.

Table 2: Length weight relationship and growth pattern of *Decapterus macarellus*

Period	$W = a L^b$	r	R^2	Interval of b $p = 0.05$	Growth pattern
I	$W = 0.005 L^{3.185}$	0.968	0.937	2.948 – 3.421	Isometric
II	$W = 0.011 L^{2.944}$	0.966	0.932	2.700 – 3.188	Isometric
III	$W = 0.005 L^{3.249}$	0.976	0.953	3.009 – 3.489	Positive Allometric
IV	$W = 0.003 L^{3.371}$	0.948	0.898	3.013 – 3.730	Positive Allometric
V	$W = 0.007 L^{3.129}$	0.973	0.947	2.903 – 3.355	Isometric
VI	$W = 0.012 L^{2.912}$	0.935	0.874	2.607 – 3.217	Isometric
Total	$W = 0.007 L^{3.092}$	0.954	0.911	2.978 – 3.206	Isometric

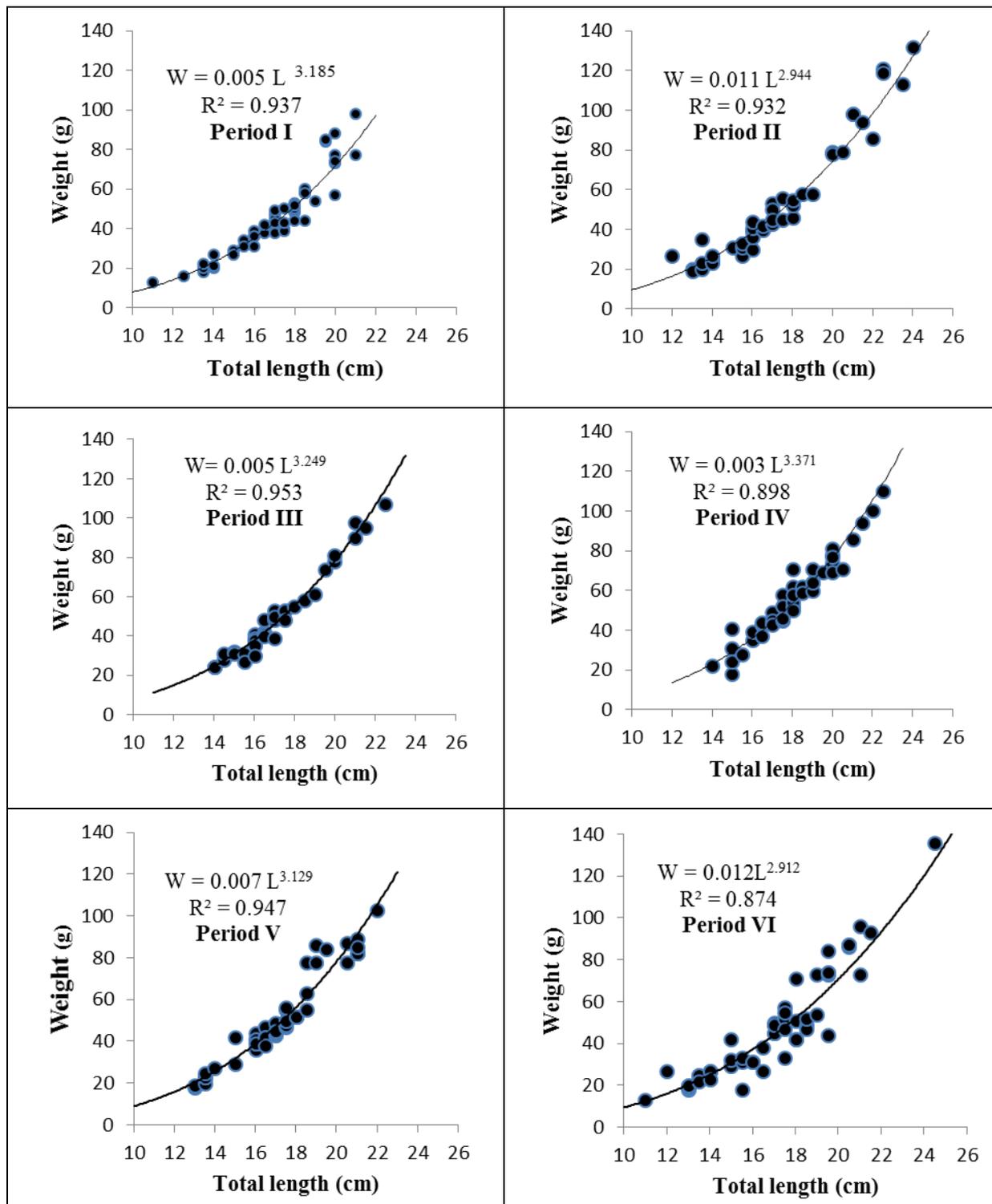


Fig 4: Length weight relationship of *Decapterus macarellus* during the study period

Study on length weight relationship mackerel scad in Indonesian waters is limited. Mackerel scad in Majene, West Sulawesi showed positive allometric growth pattern in July and negative allometric in April to June [15]. Negative allometric growth pattern also reported for male and female mackerel scad in North Maluku waters [12]. According to LeCren (1951) [19] and Froese (1998, 2006) [20, 21], variation in growth pattern of fish possibly due to sex, maturity, location, season and food availability. Effendie (1997) [17] stated that length weight relationship is very useful in fisheries research when there is requirement for statistical conversion from length to weight or *vice versa*.

Therefore, the result of this research should be useful for biomass evaluation of mackerel scad in Ambon Island waters.

3.3 Condition Factor

Length weight relationship can be used also to determine condition factor or well-being and fitness of fish in term of ability to survive and reproduce [15]. Condition factor used in this study is relative condition factor i.e. ratio between observed weight and predicted weight based on length weight relationship. The value of condition factor during the research is presented in Table 3.

Table 3: Relative condition factor of *Decapterus macarellus*

Period	Condition factor		
	Interval	Mean	SD
I	0.86 – 1.25	1.03	0.10
II	0.77 – 1.63	1.01	0.16
III	0.73 – 1.07	0.93	0.08
IV	0.65 – 1.48	1.05	0.13
V	0.83 – 1.25	0.98	0.10
VI	0.51 – 1.62	0.97	0.18
Total	0.54 – 1.78	1.01	0.14

It can be seen in Table 3 that the values of condition factor of mackerel scad in Ambon Island waters varies ranged from 0.54 – 1.78, however their average are close to unity during the period of study. According to Effendie (1997)^[17], an ideal condition of fish can be achieved if the value of relative condition factor is unity or close to unity in which length increment is proportional to weight increment or isometric growth pattern ($b = 3$). Furthermore, Le Cren (1951)^[19] stated that condition factor of fish is affected by environment, season, maturity and food. As condition factor found in this study is close to unity, it indicated that mackerel scad in Ambon Island waters can grow well and reproduce.

4. Conclusion and recommendation

Result of this study shows that mackerel scad caught by purse seine in Ambon Island are small in size and immature. Growth pattern of this species in the area show isometric and positive allometric with condition factor close to unity. Information of mackerel scad in Maluku waters is limited; therefore more research should be conducted to study other biological aspects such as reproduction and population dynamics of this species.

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