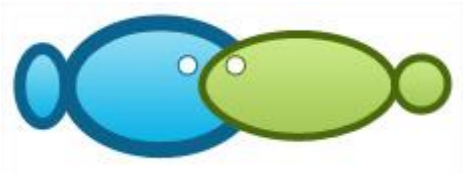

Size distribution and growth pattern of shortfin scad (*Decapterus macrosoma*) from Banda Islands, Indonesia

[1,2,3]Jesaja A. Pattikawa, [4]Friesland Tuapetel, [5]Tjameria La Ima

[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; [3] Collaborative Research Center for Aquatic Ecosystem of Eastern Indonesia; [4] Department of Utilization of Fishery Resources, Faculty of Fishery and Marine Science, Pattimura University, Ambon, Indonesia; [5] Marine and Small Islands Resource Management Study Program, Postgraduate Program of Pattimura University, Ambon, Indonesia. Corresponding author: J. A. Pattikawa, boypattikawa@yahoo.com

Abstract. Banda Sea in Maluku Province, Eastern Indonesia has numerous marine resources especially large and small pelagic fishes. One of the small pelagic fishes which is captured all year round is shortfin scad, *Decapterus macrosoma*. Research to study size distribution and growth pattern of shortfin scad, *D. macrosoma* was conducted in the waters of Banda Islands from June to September 2022. Samples of shortfin scad were collected at fish landing sites and traditional fish market in Banda Neira, the capital of Banda Islands District. Total length of fish collected was measured using plastic ruler to the nearest 0.1 cm and weighed to nearest gram using digital balance. Totally, there were 915 individuals of shortfin scads collected during the study with total length of fish ranging from 11.5 to 29.0 cm (mean 20.13 cm) and weight ranging from 13.0 to 249.0 g (mean 83.30 g). The smallest mean for length and weight was found in June while the largest occurred in August. Regression analysis showed that there is significant relationship between length and weight with the b values ranging from 2.708 – 3.475 which indicate that shortfin scads in the area have isometric, negative allometric and positive allometric growth pattern.
Key Words: allometric, isometric, length-weight relationship, small pelagic fishes.

Introduction. Banda sea in Maluku Province, Eastern Indonesia is one of most productive waters in Indonesia teritory. It is included in WPP (Fisheries Management Area) 714 which is rich of small and large pelagic fishes. One of the small pelagis fishes which is captured all year round belongs to genus *Decapterus* of family Carangidae. Currently, there are 11 valid species of *Decapterus* worldwide (Froese & Pauly 2022) and 8 of those species have been reported occur in Indonesia waters (Dahlan et al 2015; Ongkers et al 2016; Pattikawa et al 2017; Baweleng et al 2018; Pattikawa et al 2018; Lahumeten et al 2019; Silooy et al 2019; Umar et al 2019; Firdaus et al 2020, Manginsela et al 2020). *Decapterus* spp. or commonly known worldwide as round scads are economically important fishes for traditional fishers in Indonesia. These fishes are mostly captured by traditional fishers using purse seine around fish aggregating device, locally known as rumpon, during the night.

Information on round scads in Indonesia waters including Maluku waters is widely available. However, that information mostly come from the research in the northern part of Maluku waters such as from Ambon Island and Seram Island (Syahailatua & Sumadhiharga 1991; Ongkers et al 2016; Pattikawa et al 2017; Pattikawa et al 2018; Purnama 2020; Silooy et al 2021), while information from southern part such as from Banda Islands, Kei Islands, Tanimbar Islands and Aru Islands is rare. î Therefore, this

research was conducted to get information on size distribution and growth pattern of of shortfin scad, *Decapterus macrosoma* from Banda Islands which can be used as baseline data to manage this resource in the area.

Material and Method

Sampling. Samples of shortfin scad were collected at fish landing sites and traditional fish market in Banda Neira, the capital of Banda Islands District from June to September 2022. Total length of fish collected was measured using plastic ruler to the nearest 0.1 cm and weighed to nearest gram using a digital balance.

Data analysis. Length-weight relationship was analyzed using the following formula (Pauly 1984):

$$W = a\ L^{b}$$

The power function of this formula can be converted to linear regression as follow:

$$\log W = a + b \log L$$

where: W = weight (g)
L = length (cm)
a = intercept
b = slope

The value of b was used to determine growth pattern of fish whether isometric (b = 3) or allometric (b ≠ 3). Deviation of b from 3 was analyzed using t-Student test (Pauly 1984):

$$t = \left(\frac{sd\ (x)}{sd\ (y)}\right)\left(\frac{|b-3|}{\sqrt{1-r^2}}\right)\left(\sqrt{n-2}\right)$$

where: sd (x) = standard deviation of log L
sd (y) = standard deviation of log W
r^2 = coeficient of determination
n = number of samples

The value of b at 95% confidence interval (p=0.05) was determined according to Sparre and Venema (1992) formula:

$$b = b \pm t \times sb$$

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

Results and Discussion

Size distribution. There were 915 fishes collected during the study period (June to September 2022) with the total length of fish collected ranging from 11.5 – 29.0 cm (mean 20.13 cm) and the weight ranging from 13.0 – 249.0 g (mean 83.30 g) (Table 1). Mean length of shortfin scad (*Decapterus macrosoma*) in this study is lower than the mean length reported by Pattikawa et al (2017) in Ambon Island but higher than mean length of shortfin scad (*D. macrosoma*) in Java Sea (Widodo 1988) and Makassar Strait

(Ahmadi 2020). Data in Table 1 also shows that the largest mean for length (23.00±2.12 cm) and weight (116.65±36.30 g) were found in August while the smallest occurred in June for mean length (18.62±2.87 cm) and mean weight (62.02±36.22 g) respectively.

Table 1

Descriptive statistic of shortfin scad for the period of June-September 2022

Period	*n*	*Length (cm)*				*Weight (g)*			
	(ind.)	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*	*Mean*	*SD*
June	215	14.0	29.0	18.62	2.87	25.0	249.0	62.02	36.22
July	400	11.5	29.0	19.59	4.24	13.0	242.0	82.86	50.46
August	100	18.0	28.0	23.00	2.12	51.0	227.0	116.65	36.30
September	200	17.0	25.5	21.41	1.84	32.0	174.0	90.38	28.32

Senen et al (2011) reported that total length of shortfin scad (*D. macrosoma*) in the waters of Banda Neira ranged from 7.5 – 31.5 cm, Suwarni et al (2015) found total length ranging from 12.1 – 29.5 cm of shortfin scad (*D. macrosoma*) in Bone Bay, while Widodo (1988) found the range 13.0 – 25.3 cm of shortfin (*D. macrosoma*) in Java Sea. The minimum size (11.5 cm) found in July might be young fish (recruit) that are just entering the fishing grounds in the waters of Banda Island. Senen et al (2011) reported that recruitment of shortfin scad (*D. macrosoma*) in the waters of Banda Neira occurs in July.

Size frequency distribution of shortfin scad (*D. macrosoma*) was presented in Figure 1. Data in Figure 1 shows that fish length in the area is mostly distributed in the middle size classes i.e., 16.5 – 25.5 cm, as many as 85.8%. This phenomenon is common in marine biota because middle class usually consist of faster growth of young individuals and slower growth of old individuals (Pauly 1984).

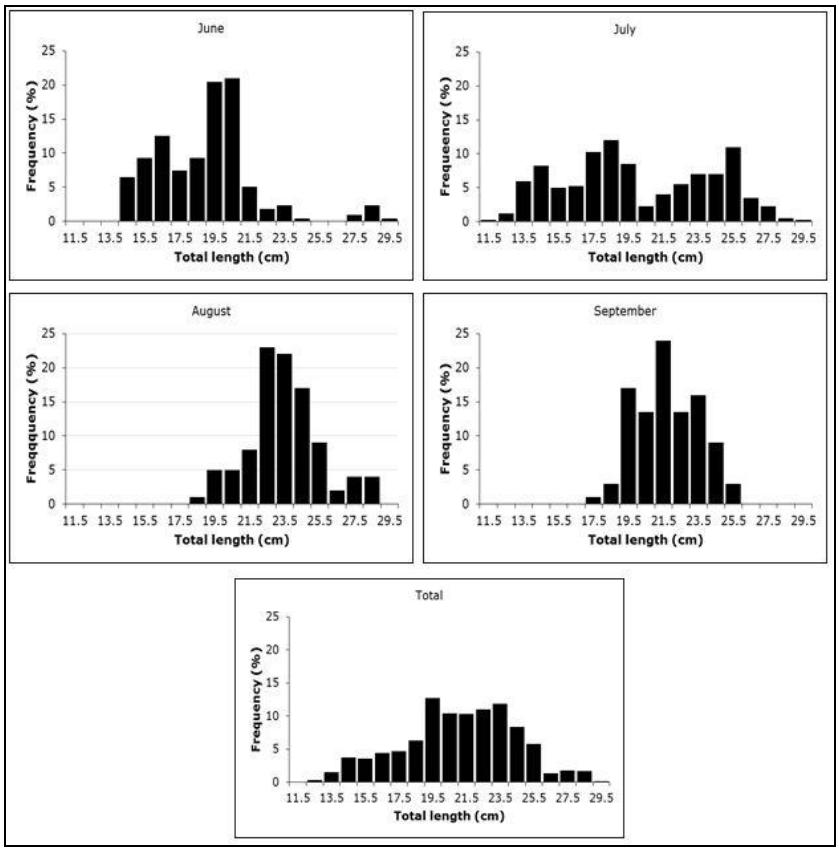

Figure 1. Size frequency distribution of shortfin scad for the period of June to September.

Information on length at first maturity of shortfin scad (*D. macrosoma*) in Banda Island waters is rare. Some researcher reported that this species spawns for the first time at total length of 16.28 cm in the Java Sea (Widodo 1988) and at 16.3 cm in Ambon Bay (Syahailatua 2004). Based on this information and data of relative cumulative frequency in Figure 2, it can be stated that 86.4% of shortfin scad (*D. macrosoma*) captured in Banda Island waters is mature or adult fish that spawned at least once. This figure is similar to shortfin scad (*D. macrosoma*) in Ambon Island waters as reported by Pattikawa et al (2017).

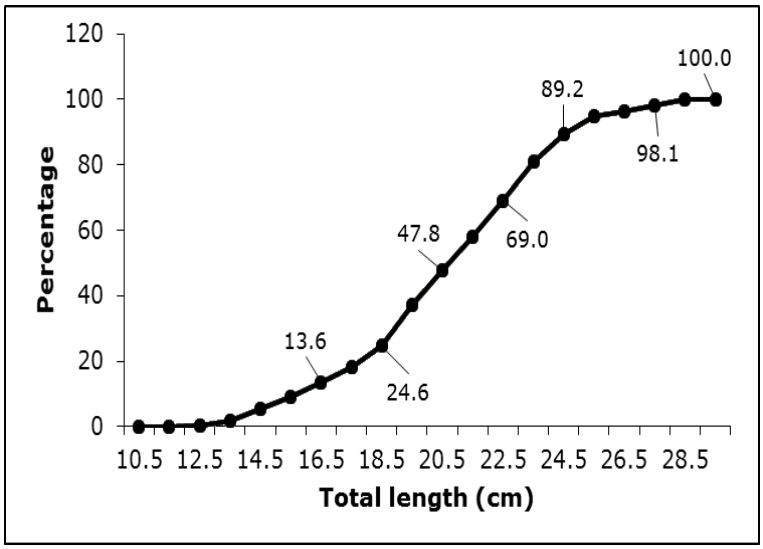

Figure 2. Relative cumulative frequency of shortfin scad.

Growth pattern. Growth pattern of shortfin scad (*D. macrosoma*) in Banda Island waters is determined by using the value of b (slope) in the linear regression of length-weight relationship. Results of the analysis of length-weight relationship are presented in Figure 3 and Table 2. Data on Figure 3 and Table 2 showed that there is significant relationship between length and weight and the contribution of length to weight as shown by coefficient of determination (R^2) ranging from 87.9 – 93.9%.

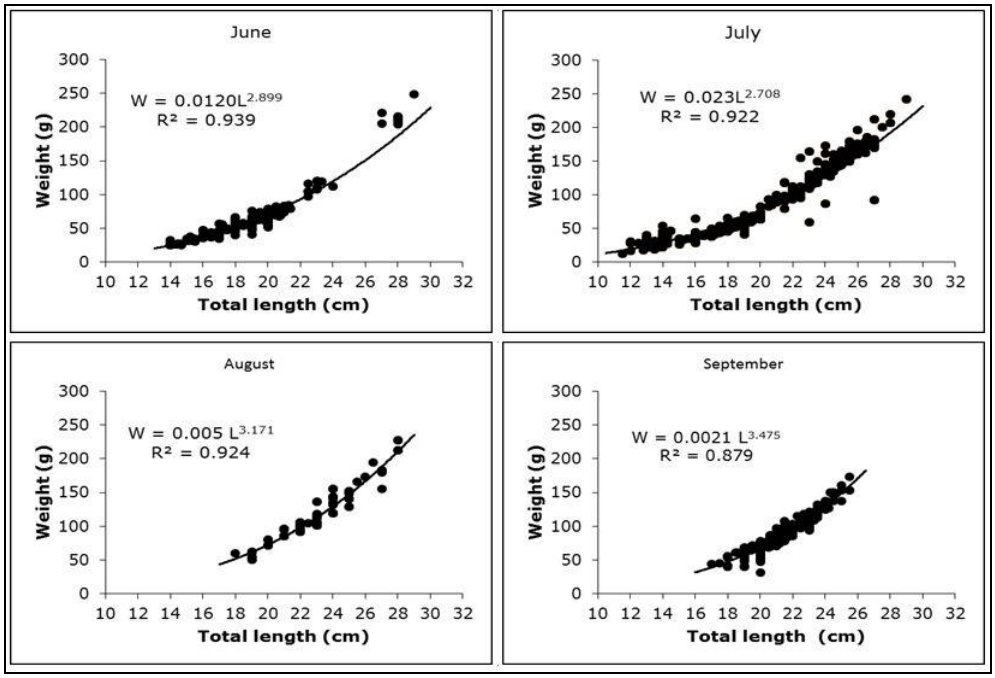

Figure 3. Length weight relationship of shortfin scad for the period of June to September.

Table 2

Results of regression analysis and t-Student test of shortfin scad

Period	*r*	*b*	*b at p=0.05*	*t calc.*	*t table*	*Growth pattern*
June	0.969	2.899	2.799 – 2.999	1.994*	1.971	Negative allometric
July	0.960	2.708	2.630 – 2.785	7.398*	1.966	Negative allometric
August	0.961	3.171	2.988 – 3.354	1.861^{ns}	1.984	Isometric
September	0.937	3.475	3.294 – 3.656	8.812*	1.972	Positive allometric

Notes: * = significantly different at p=0.05
^{ns} = not significantly different

Results of the analysis in Table 2 shows that coefficient of correlation (r) are ranging from 0.937 to 9.969 which indicated that there is close a relationship between length and weight, thus relationship between these two variables can be used for further analysis to determine growth pattern of shortfin scad (*D. macrosoma*) in Banda Island waters. Data in Table 2 shows that the values of slope (b), which are used to determine growth pattern, are ranging from 2.708 (July) to 3.475 (September). Results of t-Student shows that the calculated value of b in August (1.861) is smaller than t table value at p=0.05 (1.984), while those values in June, July and September are larger than t table value. Pauly (1984) stated that if the calculated value of b < t table (p=0.05) means that b = 3, while the calculated value of b > t table (p=0.05) means b ≠ 3. The interval values of b at 95% confidence interval are presented in Table 2. Sparre and Venema (1992) stated that if the value of 3.00 is included in these intervals means that b = 3 and vice versa if not included means b ≠ 3. Data in Table 2 shows that the value of 3.00 is only included for the period of August (2.988 – 3.354) while in other periods this value is not included.

According to Pauly (1984), the value of b = 3 indicates that growth pattern of fish is isometric which means that length increment is proportional to weight increment while for b ≠ 3 its growth pattern is allometric i.e. length increment is faster than weight increment (negative allometric) or weight increment is faster than length increment (positive allometric). Results presented in Table 2 show that shortfin scad (*D. macrosoma*) in Banda Island waters have negative allometric growth pattern in June and July, isometric growth pattern in August and positive allometric growth pattern in September. Isometric growth pattern of shortfin scad (*D. macrosoma*) had been reported by Widodo (1988) and Prihartini et al (2007) in Java Sea as well as by Ahmadi (2020) for the same species in Makassar Strait. Syahailatua (2004) found negative allometric growth pattern for this species in Ambon Bay, while Pattikawa et al (2017) reported isometric and positive allometric growth pattern for the same species in Eastern waters of Ambon Island. According to Froese (2006) variation of growth pattern is common in fish population and it is affected by season, food availability, maturity of the fish sampled and location of sampling.

Conclusion. For the 915 individuals of shortfin scad (*D. macrosoma*) in Banda Island waters collected from June to September 2022 the total length of fish ranged from 11.5 – 29.0 cm (mean 20.13 cm) and weight ranged from 13.0 – 249.0 g (mean 83.30 g). Length distribution of shortfin scad (*D. macrosoma*) in Banda Island waters was dominated by middle size class. Fish in this area have isometric growth pattern in August, negative allometric growth pattern in June and July and positive allometric growth pattern in September.

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Conflict of interest. The authors declare no conflict of interest.

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Authors:
Jesaja Ajub Pattikawa, Department of Aquatic Resource Management, Faculty of Fishery and Marine Science, Pattimura University, Ambon, Indonesia, e-mail: boypattikawa@yahoo.com
Friesland Tuapetel, Department of Utilization of Fishery Resources, Faculty of Fishery and Marine Science, Pattimura University, Ambon, Indonesia, e-mail: fristuapetel@gmail.com
Tjameria La Ima, Marine and Small Islands Resource Management Study Program, Postgraduate Program of Pattimura University, Ambon, Indonesia, e-mail: iftitahherman261@gmail.com

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