

Growth Performance of Layang (Scad) Fish (*Decapterus russelli*, Ruppell 1830) Caught from Tomini Bay, Indonesia

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Abstract

Regarding exploitation and optimizing fisheries resources management in Tomini Bay, the Layang scad fish (*Decapterus russelli*, Ruppell 1830) is one of the small pelagic fishes inhabiting the bay that still lacks biological information. The species becomes the main target commodity for local fishers as it is commonly consumed as a protein source for coastal communities. This study aimed to determine the length-weight relationships and the growth pattern of Layang fish caught by fishers from Tomini Bay. The samples were collected once per month at Gorontalo City Fish Landing Spot from April to June 2020. Tomini Bay was confirmed as the fishing ground of all the landed fish. Layang is caught by Mini purse seines with a minimum mesh size of $\frac{3}{4}$ inch. A total of 896 samples of Layang fish were collected randomly from the fishers' catch during their unloading activity at the landing site. Abdomen dissection was performed on all samples for determining the fish's sex. The fish samples' total length and body weight were measured using a ruler (nearest = 1 mm) and a scale (nearest = 0.01 gram). The result revealed that the length-weight equation of male Layang was $W = 0.000004 L^{3.1972}$ ($R^2 = 97.57\%$), and that of female was $W = 0.0000007 L^{3.0613}$ ($R^2 = 98.99\%$). This result implied a positive allometric growth pattern, excluding the females in April 2020.

Keywords: Gorontalo; scad; length-weight relationship

Introduction

Tomini Bay forms a semi-enclosed water area (Miller *et al.*, 2016) that is fertile (Kadim *et al.*, 2019) with high marine biodiversity supported by the availability of phytoplankton (Kadim *et al.*, 2018) as a primary food source. Diverse species of marine mammals also inhabit the bay (Mustika *et al.*, 2021), various pelagic fishes (Mardijah and Patria, 2016; Pasingi *et al.*, 2020a; 2020b; 2021a; 2021b), small amphidromous fishes (Olii *et al.*, 2017; Pasingi and Abdullah, 2018; Olii *et al.*, 2019; Pasingi *et al.*, 2021c; 2020b; 2020c), as well as macrozoobenthos (Kadim *et al.*, 2022). Moreover, local wisdom supports the sustainable management of coastal and marine resources in Tomini Bay (Obie, 2018).

Scientific data of Tomini Bay pelagic fish population dynamics are still minimal, making the level and utilization of the fish resources uncontrollable. Therefore, efforts to optimize fish resources to maximize the community's welfare around the bay area are still not optimal. Layang fish (*Decapterus russelli*, Ruppell 1830) that has the common name Scad (Sunaryo *et al.*, 2019; Suwarso and Zamroni, 2015) or Indian Scad (Poojary *et al.*, 2010; Chiesa *et al.*, 2019) is one of the pelagic species of the Carangids group which is widely

distributed including Tomini Bay as a part of the Indo-Pacific region (Panda *et al.*, 2012), western Indian Ocean, and northern Arabian Sea (Kalhoru *et al.*, 2017). Apart from having a substantial economic value (Khasanah *et al.*, 2020) and being in demand by the broader community due to its taste, the fish also contains protein (Cahyono and Mardani, 2020; Fatma *et al.*, 2020) to be consumed as a source of food nutrition. Diversification of Layang fish's products and processing (Tondais *et al.*, 2020; Kurniawan *et al.*, 2020a; 2020b; Henra *et al.*, 2020; Paparang, 2013) were also being developed in order to meet market demand for the commodity.

The lack of scientific data on Layang fish resources in Tomini Bay is a challenge in determining and formulating the proper management direction by considering Layang fish *D. russelli* as the target fish caught by fishers in Indonesia as in Tomini Bay (Lawadjo *et al.*, 2021), Malacca Strait (Alnanda *et al.*, 2020), Makassar Strait (Cahyono and Mardani, 2020) and Ternate (Tangke, 2020). *D. russelli* is also one of four species commonly caught by fishers from Ambon Island waters (Pattikawa *et al.*, 2018). In Tomini Bay, such information has not been reported. Therefore, comprehensive and up-to-date data on Layang fish's condition in nature is needed to monitor their availability and sustainability. This study aimed

to determine length-weight relationships and the growth pattern of Layang fish *D. russelli* in Tomini Bay.

Materials and Methods

The sampling was conducted once a month at Gorontalo City Fish Landing from April to June 2020. It was confirmed that the fishing ground was in Tomini Bay. Mini purse seines with a minimum mesh size of 3/4 inch were used to catch the Layang fish in Tomini Bay. 896 Layang fish samples were collected randomly from the fisher’s catch at the landing site (Figure 1.). The total length and weight of the samples were measured using a ruler (minimum accuracy = 1 mm) and a scale (minimum accuracy = 0.01 g). The abdomen dissection was performed to determine sample sex.

Data analysis

The relationship between total length and body weight of the samples was calculated and determined through the following equations (De Robertis and Williams, 2008):

$$W = a L^b$$

where: W = body weight (gram); L = total length (mm); a = constant value; b = growth parameter

A natural logarithmic transformation was applied to make a relationship linear as follow:

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

The a and b length-weight relationship parameters and the coefficient of determination (R²) were obtained through the least-squares regression. The slope b value was performed the growth dimension of width, length, and body depth. The fish growth pattern was figured out by testing the value b from the equation through the t-test at the 95% confidence level (Steel et al., 1993). If b= 3, growth has an isometric pattern; b< 3, it has a negative allometric pattern; b> 3, it has a positive allometric pattern (De Guzman and Rosario, 2020).

Result and Discussion

The length ranges of samples found in this study were 77-290 mm and 87-286 mm for male and female fish, respectively. For comparison, the length range of *D. russelli* in Trincomalee District, Sri Lanka, from October 2019 to January 2020 ranged from 110 to 225 mm (Anushika et al., 2020), while the Indian scad's length caught by mini purse seine in the waters around Tasikagung Fishing Port of Rembang ranged from 102 to 185 mm (Khasanah et al., 2020). The total number and distribution frequency of the total length and body weight of *D. russelli* found during the three months of sampling varied (Figure 2.). Among the three-time samplings, the total length range of 77 - 98 mm for males and 121 - 142 mm for females were commonly found.

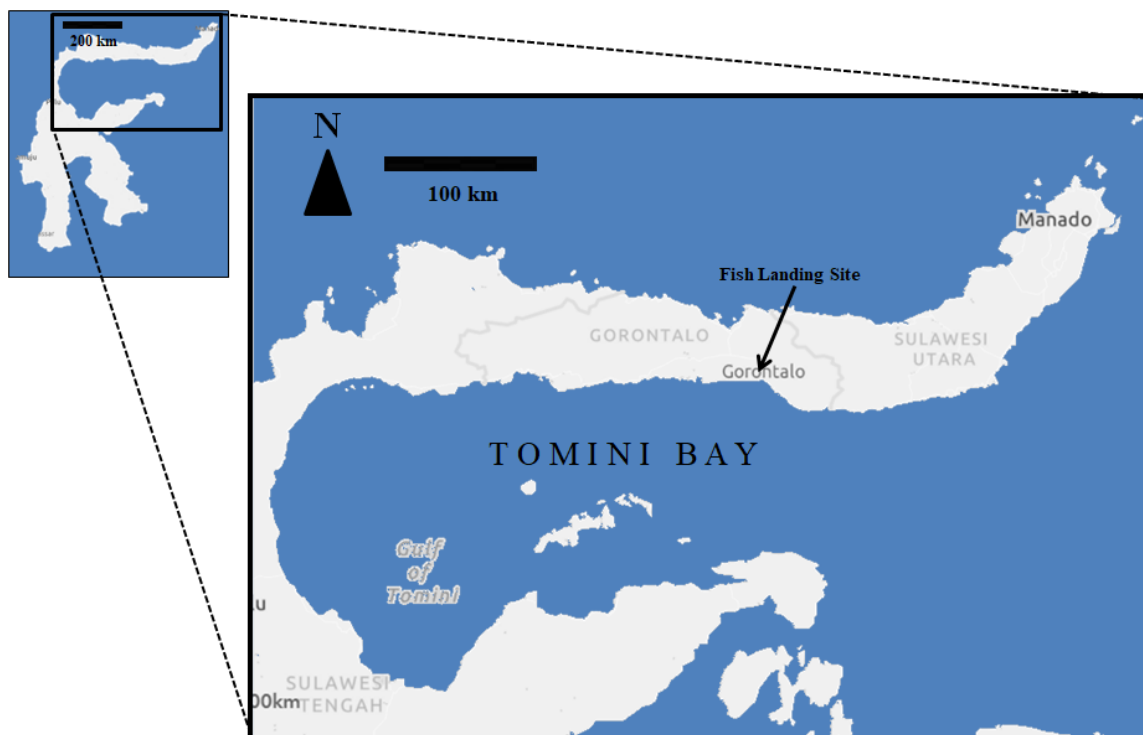


Figure 1. Fishing Area and Gorontalo Fish Landing Site of Layang Fish *Decapterus russelli*

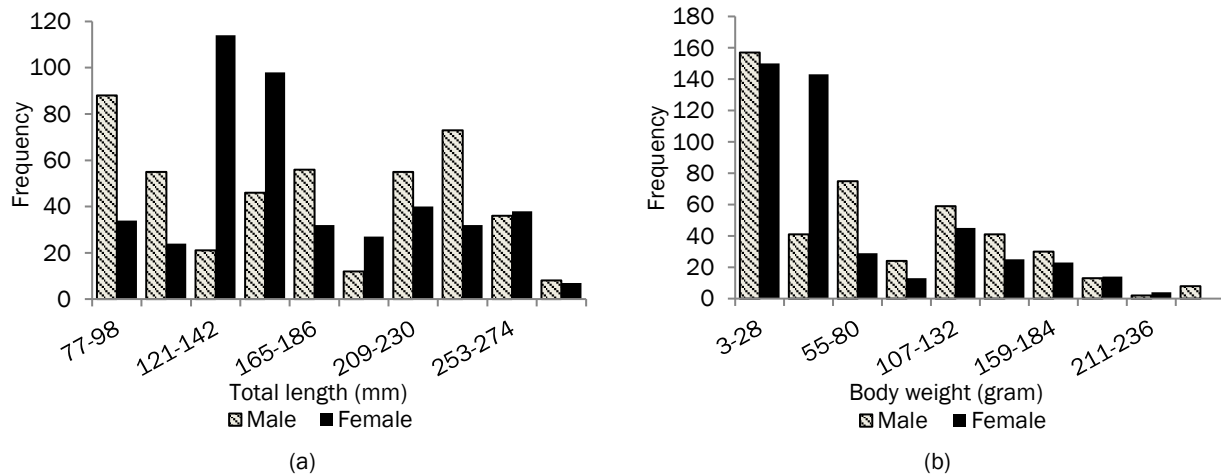


Figure 2. Frequency distribution of *Decapterus russelli* in Tomini Bay based on (a) total length and (b) body weight

The fish length-weight analysis is essential to monitor their stocks and biological conditions to ease the implementation of fish sustainability and biodiversity management (Agista *et al.*, 2019). The relationship of total length and weight of male and female *D. russelli* based on monthly and combined data are shown in Figure 3. Khasanah *et al.* (2020) found that the length-weight relationship of the Layang fish in Tasikagung Fishing Port of Rembang from January to April 2019 was $W = 0.0000546 TL^{2.73}$, while in Probolinggo Regency, Indonesia during January to May 2017 it was $W = 0.0049 L^{3.2882}$ (Bintoro *et al.*, 2019). In Mayangan Probolinggo, Indonesia, from December 2017 to April 2018, $W = 0.014 L^{2.8513}$ (Bintoro *et al.*, 2019).

The determination coefficient (R^2) that describes how well the model fits the data (Nakagawa *et al.*, 2017) on the polynomial equation in this study is relatively high, above 95%. The R^2 value in this study is quite diverse when compared to several previous studies. In comparison, the *D. russelli* caught by purse seine from March to August 2014 in the waters around Pemangkat Fisheries Port, West Kalimantan was $W = 0.0093 L^{3.1309}$ with $R^2 = 87.19\%$ for males and $W = 0.0094 L^{3.1359}$ with $R^2 = 85.76\%$ for females (Faizah and Sadiyah, 2020). In addition, the Layang fish in Malaka Strait taken from April to September 2016 had $W = 0.0057 L^{3.2984}$ ($R^2 = 97.45\%$) for males and $W = 0.0079 L^{3.183}$ ($R^2 = 98.25\%$) for females (Faizah and Sadiyah, 2020). From the fisheries biology perspective, the length and weight relationship of the fish are important information that need to provide for fisheries resources management (Bernas, 2016).

Many studies use length and body weight relationship data to predict the growth patterns of fish. Fish might attain either isometric, negative allometric, or positive allometric growths. An

isometric pattern is associated with no alteration of body shape as individual growth. Furthermore, a negative allometric indicates the fish becomes more slender as it increases in weight, while positive allometric growth denotes relatively deeper or stouter bodies since it increases in length (Riedel *et al.*, 2007). All growth patterns of Layang fish in this study perform positive allometric, unless for females in April 2020 (Table 1.). The fish growth pattern is related to environmental conditions, linked to specific species morphological characteristics, and with no plausible explanation unless it might be related to stomach fullness (Jisr *et al.*, 2018). In the present study, it is predicted that the gonadal development of *D. russelli* is in the spawning season. The spawning season of *D. russelli* in this study is the same as in the Malacca Strait waters in which happen from April to October with a peak in October (Hariati *et al.*, 2017). In that case, it is assumed that the female Layang fish in Tomini Bay in April 2020 are still at the beginning of gonadic growth. Therefore, the body in April is relatively less plump than in the following months. The fish spawning season is influenced by environmental conditions (temperature, salinity, and climate) that benefit for fish spawning (Bintoro *et al.*, 2019).

The growth pattern of Indian scad for males and females in the south of China Sea (Faizah and Sadiyah, 2020), in Paiton, Probolinggo Regency from January 2017 to May 2017 (Bintoro *et al.*, 2019) and in Inengo, Gorontalo from February 2021 to March 2021 (Pasingi *et al.*, 2021d) also revealed positive allometric. However, a negative allometric growth pattern was shown by *D. russelli* in Trincomalee District, Sri Lanka during October 2019 to January 2020 (Anushika *et al.*, 2020) and from December 2017 to April 2018 in Mayangan Probolinggo, Indonesia (Bintoro *et al.*, 2019). The Layang fish in Latuhalat waters, Ambon in June- August 2016 showed positive allometric growths except for males

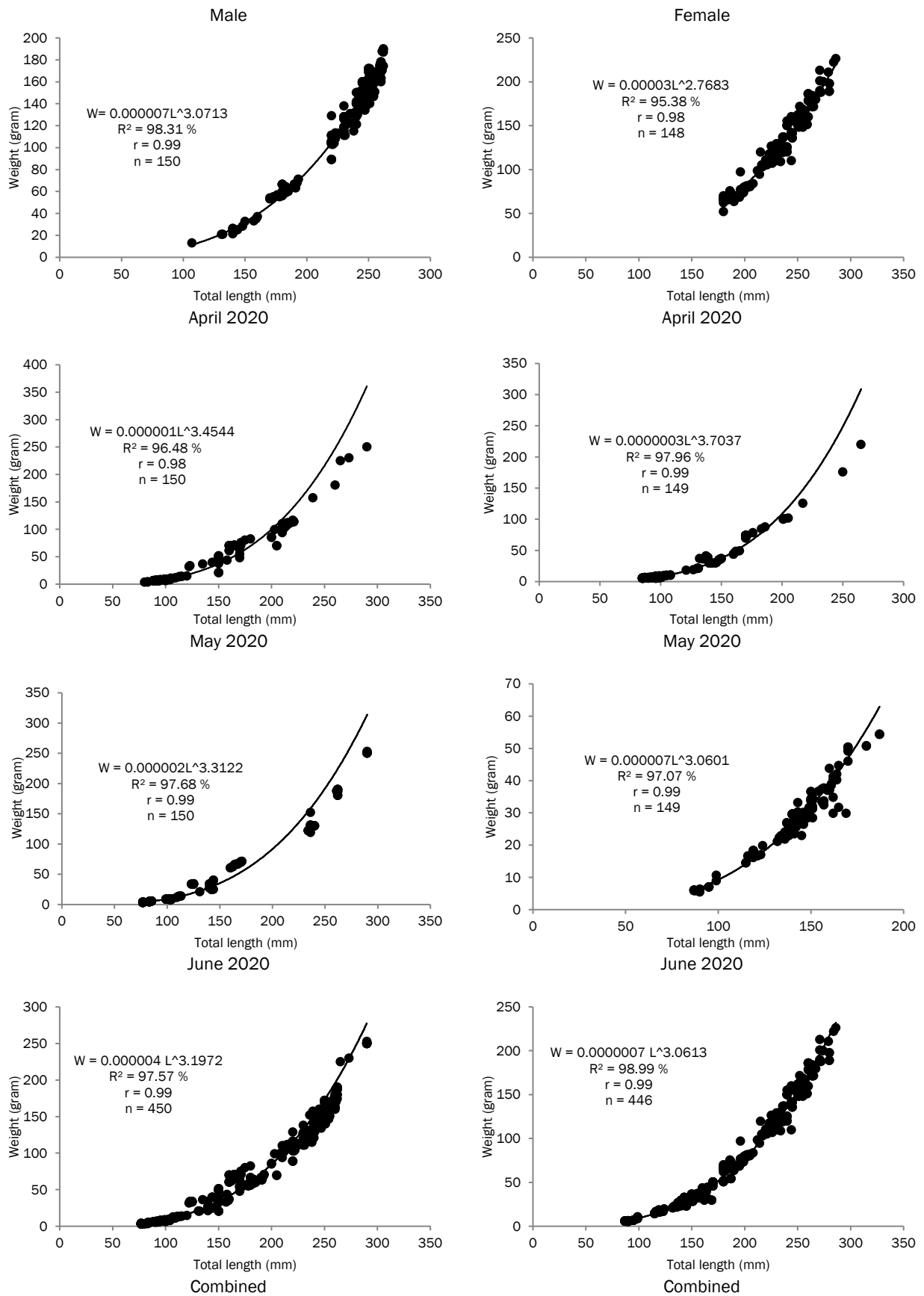


Figure 3. Length-Weight Relations of *Decapterus russelli* in Tomini Bay

Table 1. Linear relation of length-weight data and growth patterns of *D. russelli* in Tomini Bay

Sampling periods	Male		Female	
	Length-Weight linear relationships	Growth pattern	Length-Weight linear relationships	Growth pattern
April 2020	In W = -11.9189 + 3.0713 ln L	positive allometric	In W = -10.264 + 2.7683 ln L	negative allometric
May 2020	In W = -13.6983 + 3.4544 ln L	positive allometric	In W = -14.9327 + 3.7037 ln L	positive allometric
June 2020	In W = -13.0305 + 3.3122 ln L	positive allometric	In W = -11.8668 - 3.0602 ln L	positive allometric
Total	In W = -12.5017 + 3.1972 ln L	positive allometric	In W = -11.8687 + 3.0613 ln L	positive allometric

(p value < 0.05)

of August 2016, which showed an isometric growth pattern (Ongkers et al., 2016).

The variation in growth patterns might be caused by differences in species, gonad maturity, spawning factors, food, sex, and age (Randongkir et al., 2018). Availability of supportive food and aquatic habitat characteristics might influence the variation of fish growth patterns (Nugroho et al., 2018) as the food taken will affect the growth, maturity of each individual and the successful life of the fish (Effendie, 2002).

Conclusion

The polynomial equation for the length and weight of Layang scad fish *Decapterus russelli* is $0.000004 L^{3.1972}$ ($R^2 = 97.57\%$) for male and $0.0000007 L^{3.0613}$ ($R^2 = 98.99\%$) for female. The growth of male and female Scad fish in Tomini Bay has a positive allometric pattern, except the female pattern in April 2020. These values exhibited the biological and environmental factors experienced by the species. Although it needs more qualified time series data, these results generally reflected that species are in good biological and optimal environmental conditions. It needs to be maintained or even improved to optimize the utilization of *D. russelli* in Tomini Bay.

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