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CPUE, BIOLOGICAL AND CONDITION FACTOR OF KAWAKAWA (*EUTHYNNUS AFFINIS*) CAUGHT BY PURSE SEINE IN WEST SUMATRA

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ABSTRACT

Kawakawa (*Euthynnus affinis*) is one of the important catch of small-scale fisheries in Indonesia. This species is included in the neritic tuna group that mostly utilized by using purse seine and gillnet. This research aims to investigate the Nominal CPUE, Length distribution, and condition factor of kawakawa. Data collection was conducted for 11 months from February to December 2019 in Aceh, Sibolga, and Bengkulu (FMA 572). A total of 1,622 specimens was collected, measured (cm FL) and weighted (kg). CPUE analysis shows the fluctuations in each month, with the highest CPUE value in August and the lowest in May. The measurements showed that the length ranged from 20 – 55 cm FL and weight ranged from 0,13 – 3,06 kg. Analysis of length-weight relationships was $W=0{,}00001FL^{3{,}1079}$ with a determination coefficient (R^2) 0.967. The growth pattern of positive allometric. The highest relative condition factor (Kn) occurred at the upper limit of length class 21 cm FL with a value of 1.25 and the lowest at 57 cm FL with 1.06. The monthly relative condition factor tends to stabilise, with the highest value in December at 1.265 and the lowest in April at 1.081 and tended to fluctuated for the small-sized group. At the same time, adult fish tends to decrease along with the length increase.

Keywords: Condition Factor; CPUE; Kawakawa; Length Distribution

INTRODUCTION

Kawakawa (*Euthynnus affinis*) is one of the commodities representing as much as 10% neritic tuna in the world trade in marine fisheries (Ahmed *et al*., 2015). Kawakawa is a type of pelagic fish and fast swimmers that live in groups where the distribution area is in coastal and oceanic waters (Blackburn, 1965 in Nurhayati, 2001). Indian Ocean Tuna Commission/IOTC (2006) reported that kawakawa inhabits coastal water and has a preference to stay in relatively warm water 18°- 29°C. This species forms school that appears down to 400 m depth.

Suwarso (2009) reported that the common gear used to catch kawakawa in the Indian Ocean region is purse seine (67%) and gillnet (33%). The nominal catch per unit of fishing effort (CPUE) can be used to determine the abundance of fish in waters and the level of utilization calculated based on the distribution of the total catch with effort. In fisheries biology, length distribution is one of the important parameters to describe the pattern of fish growth condition factor or often called index of plumpness that used to compare conditions or the relative health condition of fish populations (Everhart & Youngs, 1981).

Indian Ocean Tuna Commission (2016) reported that the condition of the kawakawa stock in the Indian Ocean does not overfished and does not a subject to overfishing with F2013 / F MSY2013 (0.98 or 98%). To ensure sustainable catch, good management of kawakawa needs to be strengthened. One of the information needed for fisheries management is the CPUE, length distribution, and condition factor.

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Figure 1. Kawakawa (*Euthynnus affinis*).

MATERIALS AND METHODS

A total of 1.622 samples were collected from three provinces around Indonesian waters from February to December 2019. The samples were collected from Aceh, Sibolga, and Bengkulu in the west part of Sumatera Island (Fig. 2). The sampling was carried out daily by enumerators on each landing site. The weight to the nearest 0.1 kg, fork length (FL) to the nearest 0.1 cm were measured for each fish collected. The other parameters were taken including, the fishing gear, number of days at sea, and production of kawakawa.

Length-Weight Relationship: Fish fork length (cm FL) was measured using the measuring board, while weight was measured using a weighing balance (Kg). The Length-weight relationship (LWR) (Lagler, 1970) was estimated by using the equation:

$$W = aL^b \quad \text{...} \quad (1)$$

Where;
W = The weight of fish in kilograms
L = The Total length of fish in centimetres
a and b = Constants of the regression equation

The log transformed data gave a regression equation:

$$\text{Log } w = \log a + b \log L \quad \text{....................................} \quad (2)$$

Condition Factor: The condition factor (K) is calculated for each range length every month. The method used for relative condition factor calculations using the formula of King (2007) with the equation:

$$K_n = \frac{W_m}{W_p} \quad \text{...} (3)$$

Where;
Kn = Relative condition factor
Wm = Monthly of mean weight
Wp = General predicted weight of fish from the same mean length

Catch per-unit of Effort (CPUE): Calculated using the formula of Sparre & Venema (1999) with the equation:

$$CPUE = C/E \quad \text{...} \quad (4)$$

Where;
C = catch in ton
E = effort in a number of days at sea (days at sea)

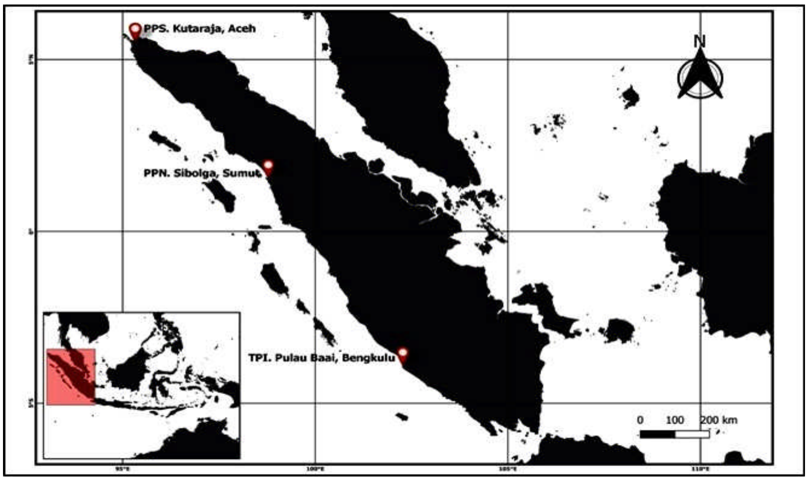

Figure 2. Aceh, Sibolga, and Bengkulu landing sites.

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RESULTS AND DISCUSSION
Results

CPUE analysis shows fluctuating results every month. The highest production yield was in October, and the lowest was in March (Tab. 1). While the highest CPUE was in August, and the lowest was in May (Fig. 3).

Kawakawa data is regularly collected from a port-based monitoring program in the Indian Ocean (FMA 572) from February to December 2019. A total length of 1622 kawakawa specimens measured and 1609 kawakawa's weighed (Tab. 2). Length measurements were carried out on 1,622 kawakawa with lengths between 20 - 55 cm FL dominated by sizes of 24 - 30 cm FL (Fig. 4).

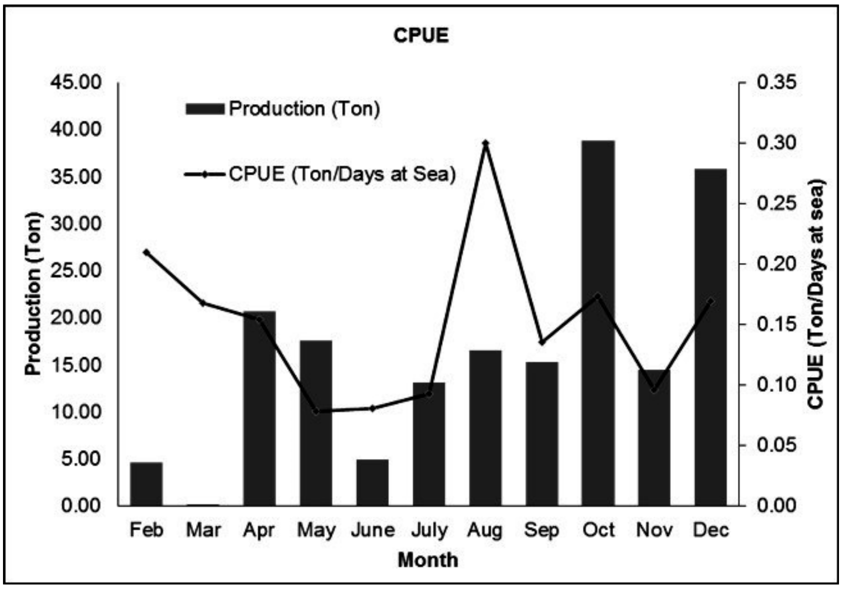

Figure 3. Monthly CPUE Analysis CPUE.

Table 2. Parameter and growth pattern of kawakawa

Month	n	Length (cm FL)			Weight (Kg)			Parameter			Growth Patterns
		Min	Max	Average	Min	Max	Average	a	b	R Square	
February	21	24	40	35.11	0.23	1.2	0.87	0.000003	3.4987	0.9737	Alometric Positive
March	39	20	30	27.3	0.13	0.5	0.37	0.00001	3.1308	0.9557	Isometric
April	209	22	49	26	0.19	2.27	0.35	0.00003	2.8053	0.9083	Alometric Negative
May	168	25	50	32.53	0.27	2.3	0.68	0.00001	3.1235	0.9738	Alometric Positive
June	44	21	39	31	0.15	1.01	0.55	0.00001	3.0843	0.9614	Isometric
July	182	23	53	34	0.2	2.95	0.72	0.00002	3.024	0.9587	Isometric
August	99	24	53	40	0.21	3.05	1.23	0.00002	3.0331	0.9442	Isometric
September	111	21.5	52	36.1	0.16	2.72	0.93	0.000006	3.3128	0.9793	Alometric Positive
October	220	21	50	29	0.15	2.48	0.53	0.00002	3.0091	0.977	Isometric
November	238	21	54	33	0.16	2.68	0.75	0.00001	3.0608	0.986	Alometric Positive
December	278	23	55	37	0.22	3	1.11	0.000007	3.2701	0.9192	Alometric Positive

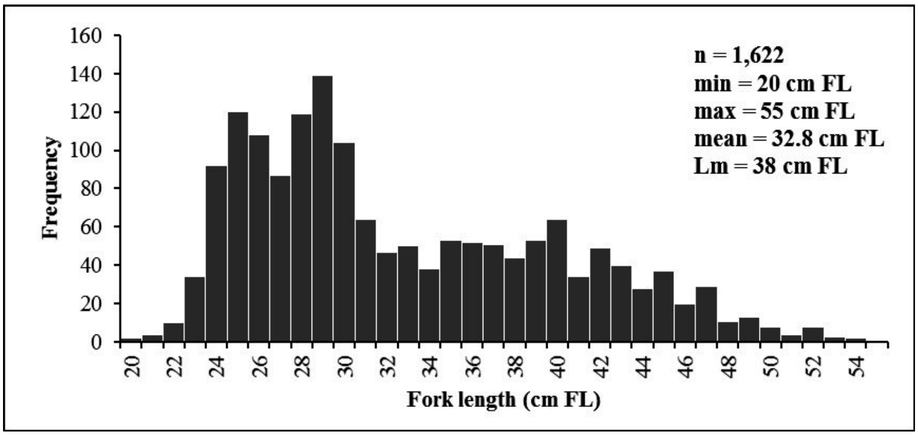

Figure 4. Length measurements of kawakawa.

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There were 1,609 individuals fish of kawakawa recorded which were weighed (kg) from a total of 1,622 samples. The measurement results show that kawakawa weighs 0.13-3.06 kg. Analysis of the relationship of weight-length obtained W = 0.00001 $FL^{3.1079}$ with a coefficient of determination (R^2) 0.967, indicating that the fork length can estimate the weight of kawakawa with an accuracy 96.7% (Fig. 5). The results of the t-test showed that the growth pattern of kawakawa by positive allometric.

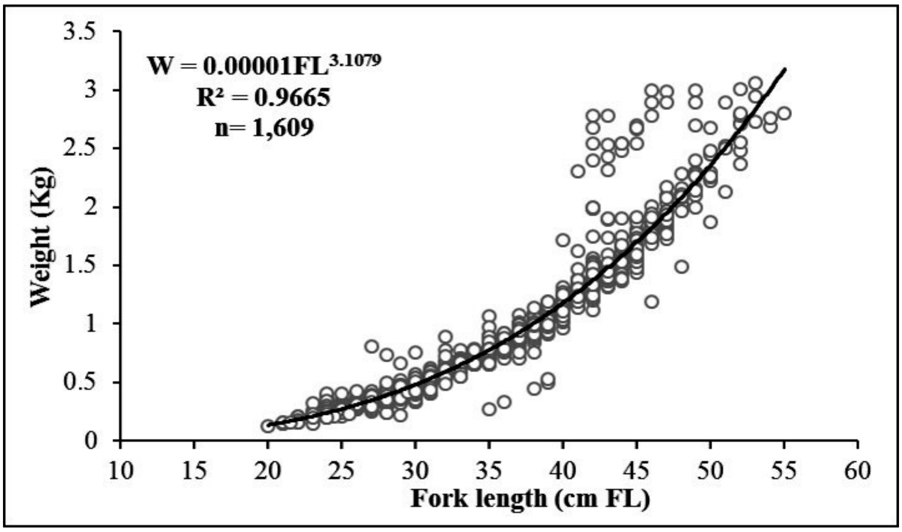

Figure 5. Length-weight relationship of kawakawa.

Condition factor of kawa-kawa was observed by enumerator in three fishing ports, Sibolga, Bengkulu, and Lampulo. The relative condition factor (Kn) of kawakawa is 1,178 and tends to stable in small-sized fish (21-27 cm FL) then fluctuates in size fish 27-39 cm FL, whereas, in mature fish, it shows a declining trend with increasing length. The highest relative condition factor appears at the upper limit of the 21 cm long class at 1.25, and the lowest occurs at the upper limit of the 57 cm long class at 1.06 (Fig. 6). In general, the result shows that kawakawa has a good growth with condition factor (Kn) > 1.

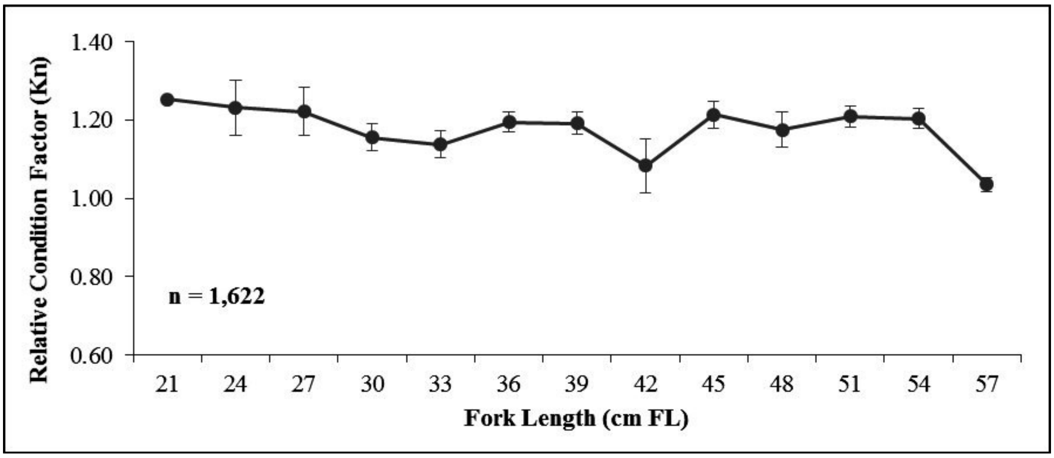

Figure 6. Relative condition factor based on length frequency of kawakawa.

Whereas the relative monthly condition factor tends to be stable during the observation process. Generally, the monthly value shows from 1.08 to 1.27 (Fig. 7). The lowest condition factor occurred in April and the highest happened in December. This phenomenon might cause by environmental factor for example transition period.

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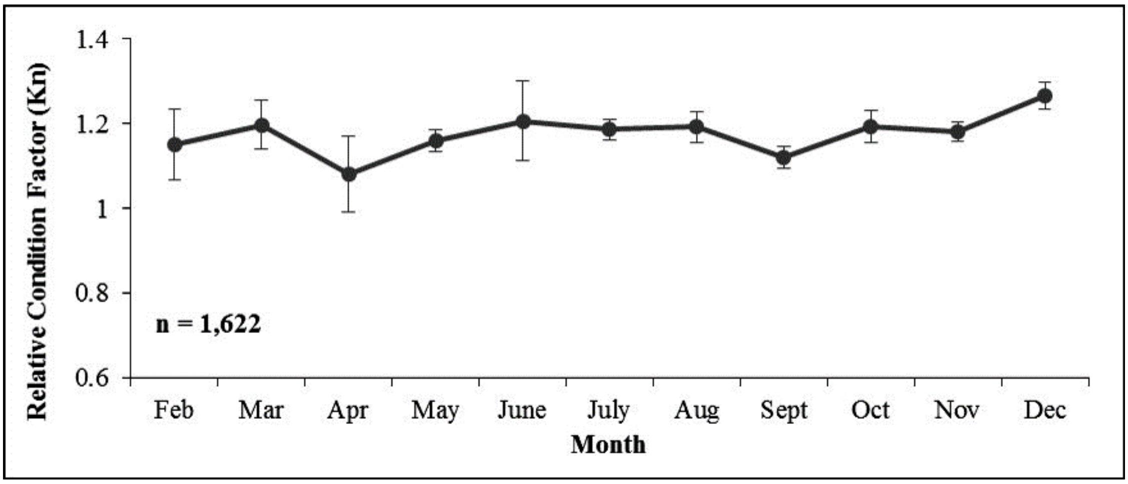

Figure 7. Relative condition factor based on month of kawakawa.

Discussion

Kawakawa production chart in the Indian Ocean (FMA 572) shows that the highest production was in October, and the lowest was in March. At the same time, Catch Per Unit Effort (CPUE) analysis of kawakawa used to know the abundance of the species in waters and its utilization rate, which is calculated based on sharing of total catch by catch effort. CPUE analysis shows results that tend to fluctuate every month. The average CPUE tends to decrease in March to July, then the CPUE value increased in August and decreased again in September to December. So the highest CPUE result was in August, and the lowest was in May. The monthly CPUE value of 8 - 30 kg/ day sea which is greater than previous research in the Indian Ocean south of Java in 2017, which was 16.4-92.6 kg/day in Labuhan Lombok and 12.4 - 50.6 kg/day in Prigi (Tampubolon *et al*., 2018). This CPUE difference is caused by the use of different fishing gear. Fishermen in West Sumatra mostly use purse siene while fishers in south of Java use handlines.

The decrease in the catch is related to the decrease in fishing effort, as indicated by the decrease in the number of days at sea and the number of vessels carrying out fishing activities from February to July. This is related to weather conditions and natural factors, wherein the February period, there is a western season that hinders fishing activities. Kawakawa has a higher abundance in the east monsoon to transitional season 2, from June to its peak in November (Wudji & Suwarso, 2014). According to Sulistyaningsih *et al*. (2011), the value of CPUE may decrease due to several factors, such as the influence of tuna fishing season, decreased fishing effort (trip), the presence of waves and large winds. Nugroho *et al*. (2018) mentioned that the fishing season in western Sumatra usually occurs in March, April, May and October. Whereas January, February, June, July, August, November, and December are not the fishing season. CPUE value itself is influenced by fishing techniques and water conditions (Sadiyah *et al*., 2012).

The length measurement of kawakawa is critical because it can determine the maturity and size of the fish. The length of fish to be caught at first maturity (Lm) (Jamal *et al*., 2011). Indian Ocean Tuna Commission (2014) stated that the length at first maturity (Lm) of kawa-kawa ranges from 38 – 50 cm FL. Most of kawakawa caught in the Indian Ocean (FMA 572) dominated by immature fish. The length measurement was landed in the Indian Ocean (FMA 572) between 20 - 55 cm FL, dominated by sizes of 24 - 30 cm FL. This length measurement is not too different from Jatmiko *et al*. (2014) that in the waters of West Sumatra, the length distribution of kawakawa ranges from 30-60 cm. This length measurement is slightly different from kawakawa caught in the Java Sea. Chodrijah *et al*. (2013) stated the length of kawakawa fish in the Java Sea ranged from 11.7 to 55.4 cm with an average of 34.1 cm, and Kaymaran & Darvishi (2012), the length of Kawakawa fish in Iranian waters ranges from 28-88 cm, with an average of 66 cm. The difference in the length measurement of kawakawa caught can be caused by differences in fishing gear and aquatic environment. Different fishing gear can affect the length of the fish caught (Noegroho & Chodrijah, 2015). Differences in length measurements can be caused by differences in aquatic environmental conditions (Jonsson & Jonsson 2014).

The growth pattern can be determined by the value of *b* obtained from the equation of the Length-weight relationship (Asrial *et al*., 2017). Analysis of the relationship of weight length obtained W = 0.00001 $FL^{3.1079}$ with a coefficient of determination (R^2) 0.967

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with the growth pattern of kawakawa by allometric properties. The growth pattern shows similarities to kawakawa that was caught on Tanjung Luar (Agustina *et al*., 2018). Meanwhile, the different growth patterns shown by kawakawa in the Java Sea (Masuswo & Widodo, 2016) have an isometric pattern. Differences in growth patterns can be caused by several things, namely the physiological conditions of fish, water conditions, and food availability. According to Dwirastina & Makri (2014), differences in growth patterns in fish can be caused by three factors, namely age, type of fish and environmental conditions.

Meanwhile, according to Suruwaky & Gunaisah (2013), the length of the weight of the fish caught can be influenced by overexploitation of fish. The more caught the smaller the size of the fish. Differences in the growth parameter could be caused by differences in the maximum length of the samples collected and differences in the location of the waters (Widodo & Suadi, 2006). The length-weight relationship is used to determine possible differences between the same species in different stocks (King, 2007). The length-weight relationship can also be used to estimate condition factors, which are important derivatives of growth, to compare the relative health condition of fish populations (Everhart & Youngs, 1981).

Based on observations, the relative condition of kawakawa tends to stable in small-sized fish (21-27 cm FL) then fluctuates in size fish 27-39 cm FL. This is presumably because the number of samples in small fish is minimal, which is indicated by a standard error (standard error) that is quite high. Whereas adult fish shows a declining trend with increasing length. The relative condition factor of kawakawa shows that high values occur in the range of 21-27 cm FL in length. Faizah & Aisyah (2011) said that the difference in condition factors between small and large fish is caused by differences in the growth and level of gonad maturity of each fish. The relative monthly condition factor tends to be stable throughout the year. Kawakawa condition factors in Indian ocean waters (FMA 572) indicate that they are in good condition and can be consumed with a value of 1.081 - 1.265 every month. This pointed out that kawakawa in the Indian Ocean waters (FMA 572) were in a relatively similar waters and food source environment. Condition factors can indicate the state of good or not long fish weight expressed in numbers and viewed in terms of physical capacity for survival and reproduction (Effendie, 1997). The main determinants of the value of the kawakawa condition factor in water are the body size of the fish and the aquatic environment. This can estimate that these waters are sufficient to provide the necessary food for kawakawa growth. According to Wujdi *et al*. (2012), more than one condition factor value also indicates that the observed fish samples are in good environmental conditions and can be used for consumption.

CONCLUSIONS

CPUE analysis of kawakawa in the Indian ocean (FMA 572) shows fluctuations each month, with the highest CPUE value in August and the lowest in May. This CPUE result is higher than the previous year in South Java. The length measurements showed ranged from 20 – 55 cm FL. Analysis of length-weight relationships was $W = 0,00001FL^{3,1079}$ with determination coefficient (R^2) 0.967 and growth pattern of positive allometric. The highest relative condition factor (Kn) occurred at the upper limit of length class 21 cm FL with 1.25 and the lowest at 57 cm FL with 1.06. The monthly relative condition factor stabilises, with the highest value in December at 1.265 and the lowest in April at 1.081.

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