Saintek Perikanan: Indonesian Journal of Fisheries Science and Technology
Available at http://ejournal.undip.ac.id/index.php/saintek
Vol. 16 No. 3 : 199-207, October 2020

BIOLOGICAL ASPECTS, CATCHING ASPECTS AND FISHING GROUND OF EASTERN LITTLE TUNA OR KAWAKAWA(*Euthynnusaffinis* (Cantor, 1849)) BASED ON THE FISHING GEAR AT WPP 572

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Received : 14 September 2020, Accepted : 28 October 2020

ABSTRACT

Eastern little tuna (*Euthynnus affinis*) is the main catch in WPP572. The caught *E. affinis* are still in their infancy. This research aims is to know the biological aspects, the fishing aspects and the distribution of the fishing gear per fishing gear, as a consideration for sustainable fisheries management. The research was carried out during the years 2019-2020. Taking samples for gonad observation was carried out by direct survey to the location in February, May, July and October 2019. The measurement of fish length was carried out in stratified random. Catching data were retrieved by requesting secondary data and interviews with related parties. The distribution of fishing grounds is mapped using the QGIS 3.4, the spatial distribution of catches is mapped. This study showed the size structure of *E. affinis* on purse seine, troll line and encircling gill netfishing gear from 16-55 cm FL, while on the boat/raft lift net it was 21-50 cmFL. These fish growth's is positive allometric on purse seine and encircling gillnet fishing gear, negative allometric on boat/raft lift net fishing gear, and isomeric on troll line. The sex ratio is in the ratio 1: 1.15 and balanced. Based on the maturity level, the gonads were mature in July and October and immature in February and May. Gonads ripened for the first time at a size of 42.032 cmFL. The distribution of the purse seine catchment areas at 3°-6°N and 93°-96°E, and 3°-6°S and 94°-95°E. Boat/raft lift net at 0°-3°S and 95° -101°E. Troll line 4°-6°N and 94°-95 E. Encircling gillnet 0°-2°S and 99°-101°E.

Keywords: Biology; fishing gear; fishing ground; Eastern little tuna

INTRODUCTION

The potential of fish resources in Indonesian waters is 9.931 million tonnes per year with potential in WPP 572 (Indian Ocean west of Sumatra and the Sunda Strait) of 1.228 million / year (12%) (Suman, Irianto, Satria, &Amri, 2016). The Indian Ocean is a fishery area in Indonesia that produces tuna's main catch, including large pelagic fish groups (Arnenda&Rochman, 2019). Utilization of the potential in the area is dominated by fishing gear in the form of purse seines to cath pelagic fish, especially tuna. The types of tuna caught were Eastern little tuna or kawakawa (*Euthynnusaffinis*), krai tuna (*Auxisthazard*) and tuna tuna (*Auxisrochei*). (Salmarika, Tauruman, &Wisudo, 2019).

E. affinis is economically important pelagic fish (Hidayat, Noegroho, & Chodrijah, 2018). *E. affinis* in WPP 572 has an exploitation rate (E) = 0.55 indicating that the level of utilization is at a moderate level (Jatmiko, Kartika, &Nugroho, 2014). *E. affinis* live at the age of 1–2 years to a size of 34–50 cm. This fish spawning takes place twice a year in July-August and November-January (Ahmed et al., 2015).

Catched *E. affinis* are the main catch from purse seines, drift gill nets, trolling line, hand line and chartan. In 2011, around 55.5% of *E. affinis*caught in the purse seine based in Sibolga were adult fish. (Widodo, Satria, &Sadiyah, 2014). *E. affinis*production is estimated to have increased every year by an average of 17%. within the next 5 years (Kurnia, Mustaruddin, &Lubis, 2019). Many cobs are caught during the growth period with the rate of exploitation of males and females already exceeding the optimum exploitation rate (Kusumawardani, Fachrudin, & Boer, 2013).

E. affinis fish resources in WPP572 are one of the assets towards prosperity for the nation, so research is needed on biological aspects, namely growth aspects consisting of length, weight and length structure (Liestiana, Ghofar, &Rudiyanti, 2015). It is important to do this as the basic knowledge needed in resource management (Restiangsih&Amri, 2018). In the aspect of capturing the relationship between the length of the net and the catch, it is known that with the addition of the length of fishing gear, the catch will also increase (Anwar &Rahmah, 2017). The use of purse seines is not environmentally friendly because it can interfere with the sustainability of the population of tuna and protected biota. (Purbani et al., 2016). So it is necessary to map the distribution of the fishing ground so that it can be used as a reference in managing fisheries to take place in a sustainable manner..

RESEARCH METHODS

The research was conducted through direct survey activities and enumerators in 5 locations, namely Kutaraja (Aceh), Sibolga (North Sumatra), Gaung Market (West Sumatra), Bengkulu and Lampung (South Sumatra). Primary data is obtained directly from related fisheries actors and direct measurements in the field. The enumerator carried out biological data collection from January to October 2020 for the locations of Kutaraja, Sibolga, and PasarGaung. Meanwhile, Bengkulu and Lampung were carried out in 2019. Gonad sampling was carried out through direct surveys to the location in 2019. Secondary data in the form of fleet characteristics, fishing operations, fishing grounds, catches and production data were obtained from port or fisheries supervisor statistics. The measured length is the fork length and individual weight. The measurement of fish length was carried out randomly (stratified random).

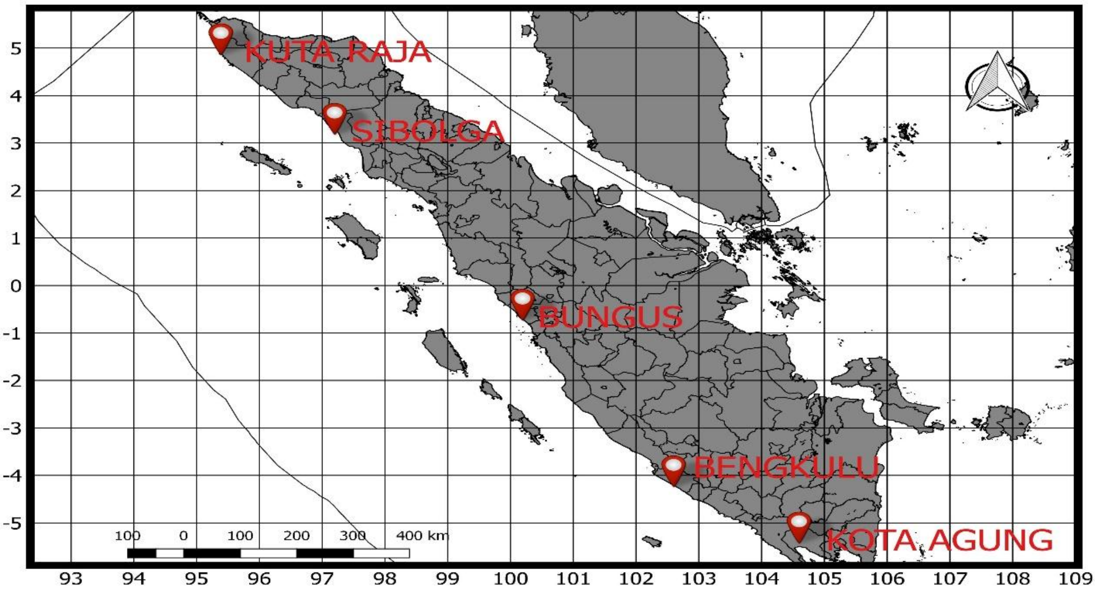


Figure 1. Research Sites in Sumatra

Growth analysis using parameters of length and weight, with a linear regression approach, the relationship between the two parameters can be seen with the formula. The parameter correlation of the length and weight relationship can be seen from the constant value b. Fish length-weight relationships were analyzed separately between fish (male and female) (Liestiana et al, 2015). The length weight equation can also be calculated using the exponential equation, The formula:

$$W = a L^{b} \qquad (1)$$

Information: W: Weight (g); L : Fork length (cm); a: Intercept (the intersection of the weight-length relation curve to the y-axis) ; b : Slope (angle of slope of the regression line).

The sex ratio is used to see the ratio of male and female fish. To find the sex ratio, you can use the following equation (Effendie, 2002):

$$P = \frac{n}{N} \times 100\ \% \qquad (2)$$

Information: P : Proportion of fish (male or female) ; n : Number of male or female ; N : Total number of fish (male and female)

Male and female ganads are separated, after which the gonads are observed morphologically. To find out whether there is a significant difference between the ratio of male and female individuals (Mote &Pangaribuan, 2015), this is done through the 'x2' (chi square) test with the following formula

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \qquad (3)$$

Information: x2 : chi square; Oi : The frequency of the observed biota; Ei : The expected biota frequency

Table 1. Maturity level of male gonads based on Cassie's modification (Effendie, 1979 in (Nane, 2019))

GML	Male
I	Testicles such as thread, shorter (limited) and visible ends in the body cavity. Clear color
II	Larger testicular size. The color is white like milk. Eggs are clearer than the 1st grade.
III	The surface of the testis is ridged. The white color, the bigger the testicles.
IV	In a preserved state it breaks easily. As in level III it seems clearer. Testicles getting thicker.
V	The back of the testicle is deflated and the part near the discharge is still filled.

Table 2. Maturity Levels of Female Gonads based on Cassie modification (Effendie, 1979 in (Nane, 2019))

GML	Female
I	Ovaries are like long threads to the front of the body cavity. Clear color smooth surface
II	Larger ovary size. The color is darker yellowish. Eggs are not clearly visible to the eyes of
III	Ovary yellow. Morphologically, the eggs begin to appear with the eye.
IV	Ovar is getting bigger, egg is yellow, easy to separate. Oil granules do not appear to fill 1/2-2 / 3 of the abdominal cavity, the intestine is under pressure.
V	he ovaries are wrinkled, the walls are thick, the remaining eggs are close to the release.

Estimating the size of the first time gonad ripens is done by looking at the fish that have matured for the first time from all long class intervals. Another method to estimate the size of the first maturity of gonads is done with a mathematical approach based on the Spearman-Karber method (Udupe, 1986)

$$m = \left[xk + \left(\frac{x}{2}\right)\right] - \left(x \sum p_i\right) \qquad (4)$$

$$\textbf{antilog m} = m \pm 1{,}96\sqrt{x^2 \sum \left(\frac{(p_i \times q_i)}{(n_i - 1)} \right)}$$

Description: : m : log of fish length at the first maturity of the gonad; ***x***k : log of thevalue of the last long class of fish that has matured gonads; ***x*** : log of length increment at the mean; p_i : the proportion of cooked fish gonads in class long-i with the number of fishin the hose length to i ; n_i : the number of fish on the class of long-i; q_i : 1 – p_i; M : length of the fish first ripe gonads as big as antilog m

The distribution of fishing grounds was mapped using the QGIS 3.4 application, mapped the distribution of catches spatially, then fishing gear. Production data counters inside and outside the EEZ, are calculated manually after mapping.

RESULTS AND DISCUSSION

Size Structure

The size of *E. affinis*caught on the purse seine, troll line and encircling gill net fishing gear during the study period ranged from 16-55 cm FL, while in the boat/raft lift net itwas between 21-50cmFL. The sizing mode of the purse seine is 26-30 cmFL in size. theboat/raft lift net, troll line and encircling gill net modes on sizes 31-35 cmFL. The distribution of the length of the length for each fishing gear can be seen in Figure 2.

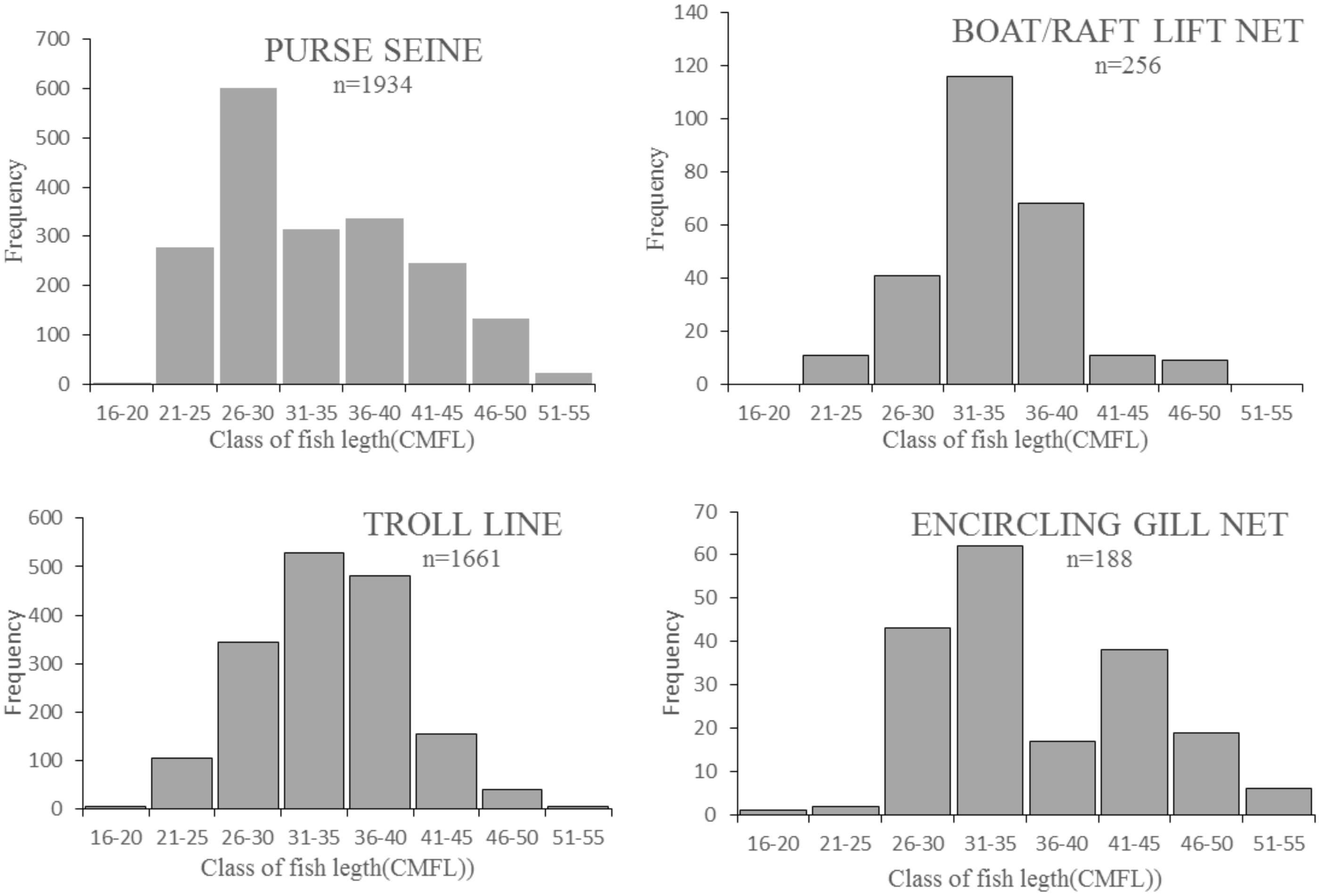


Figure 2. The Size Structure of The Komo Cob on Each Fishing Gear

The size structure of *E. affinis* caught in the West Indian Ocean Sumatra (WPP 572) captured in the Indonesian Exclusive Economic Zone (EEZ), Territorial Sea and High Seas. The size structure has decreased in the minimum size caught (Jatmiko et al., 2014). Research results in the Indian Ocean in PalabuhanRatu (Hargiyatno&Anggawangsa, 2013) south of Java (Lelono&Bintoro, 2019), south of Bali (Ekawaty&Jatmiko, 2018), southeast of Lombok (Agustina, Jatmiko, &Sulistyaningsih, 2018), strait Lombok and the Sumbawa Strait (Fathurriadi, Asrial, & Rizal, 2020). (Table 3). Judging from the modes that are 26-30 cm and 31-35 in size, most of the cobs caught are still juvenile and immature gonads (Hidayat et al., 2018). The difference in fishing gear results in differences in the size range of the fish caught (Noegroho&Chodrijah, 2015).

Table 3. Size Structure of *E. affinis*in Indian Ocean

Fishing Ground (Indian Ocean)	Type of Fishing Gear	Size Structure(cmFL)	Reference
West Sumatra	Purse seine, Encircling Gill Net, Boat/Raft Lift Net, Troll line	30-60	(Jatmiko et al., 2014)
Palabuhan Ratu	Drift Long Line	19-24	(Hargiyatno & Anggawangsa, 2013)
South Java	Purse seine	15.5-64.5	(Lelono & Bintoro, 2019),
South Bali	Drift Long Line	26-55	(Ekawaty & Jatmiko, 2018),
Southeast Lombok	Drift Gill Net	24-71	(Agustina et al., 2018),
LombokStrait	Drift Long Line, Drift Gill Net	18.2-50.1	(Fathurriadi et al., 2020).
South Sumbawa	Drift Long Line	26.82-33.50	(Fathurriadi et al., 2020).
West Sumatra	Purse Seine	16-55	This research
West Sumatra	Boat/Raft Lift Net	21-55	This research
West Sumatra	Troll line	16-55	This research
West Sumatra	Encircling Gill Net	16-55	This research

Legth-weight relationship

Recording of length and weight was carried out on 4 fishing gear, there were recorded as many 1934 on the purse seine fishing gear, 256 on the boat/raft lift net, 1661 on the troll line, and 188 on the encircling gill net. Analysis of the relationship between the length and weight of the purse seine, the results obtained W = 0.0126L3.102 with a coefficient of determination $R^2 = 0.964$, indicating that the fork length can estimate the weight of this fishing gear with an accuracy level of 96.4%. The relationship between the length and weight of the encircling gill net resulted in W = 0.0104L3.1486 with the coefficient of determination $R^2 = 0.9501$, indicating that the fork length can estimate the weight of this fishing gear with an accuracy level of 95.01%. The growth pattern of komo cobs on the purse seine and waring fishing gear shows a positive allometric (b> 3), which means that the weight gain of *E. affinis*on these two fishing gears is faster than the increase in length. The relationship between the length and weight of the boat/raft lift netresults in W = 0.0185L2.9858 with the coefficient of determination $R^2 = 0.8799$, indicating that the fork length can estimate the weight of this fishing gear with an accuracy of 87.99%. The growth pattern of *E. affinis*in fishing lats shows a negative allometric (b <3), indicating that the weight gain of *E. affinis* on this fishing gear is slower than the increase in length. While for the troll line, the results obtained were W = 0.0141L3.0554 with the coefficient of determination $R^2 = 0.8716$ indicating that the fork length can estimate the weight of this fishing gear with an accuracy level of 87.16%. The growth pattern of *E. affinis*on fishing lats shows isomeric (b = 3), indicating that the weight gain of *E. affinis* on this fishing gear is balanced with the increase in length. Consider Figure 3.

Length-weight analysis is very important to do to determine the biological condition of fish and fish stocks so that it is easy to manage the sustainability of fish biodiversity, so that in fisheries biology, the length-weight relationship of fish is one of the necessary complementary information. It is known in terms of fishery resource management, for example in determining the selectivity of fishing gear so that only the fish caught are of a suitable size (Nurhayati, Fauziyah, &Bernas, 2016). The b coefficient value is also influenced by fish behavior, for example active swimming fish (pelagic fish) shows a lower b value when compared to passive swimming fish (mostly demersal fish), this may be related to the allocation of energy expended for movement and growth. (Zuliani, Muchlisin, &Nurfadillah, 2016). The growth pattern of *E. affinis* on purse seine and gillnet fishing gear on the outer headland is allometric positive (Agustina et al., 2018). The hand line used in kedonganan Bali is positive allometric (Ekawaty&Ulinuha, 2015). The positive allometric growth characteristic with the size of the fish is still small (immature gonads) this means that the fat *E. affinis* is due to the availability of supportive feed in the waters, it should be that the komo tuna in the Indian Ocean and in the Java Sea has a higher maximum length than the Malacca Strait, because it has lower natural growth and mortality rates. Another factor that affects the maximum length that can be achieved is the intensity of the catch (Wagiyo, Pane, &Chodrijah, 2018). Based on the value of asymptotic length (L) and growth coefficient (k), the life span (life span or longevity) of *E. affinis*was able to reach the fork length and maximum lifespan of 80.75 cm and 4.29 years, respectively. As a result, the length of the fork of the komo tuna reached 47.6 cm, 66.4 cm, 75.8 cm, and 80.4 at the age of 1, 2, 3 and 4 years respectively (Wujdi, Hartaty, &Setyadji, 2020).

Sex Ratio

In general, the sex ratio of male and female *E. affinis* during the study period was 1: 1,15. The results of the X^2 test (chi-square) at a confidence interval of 95%, so it can be concluded that the ratio of male and female mackerel tuna is not significantly different or in a balanced state. The results of research in the Malacca Sleat the sex ratio of *E. affinis*varies between months and the balanced sex ratio occurs in January, April and September (Wagiyo et al., 2018). The sex ratio varies between areas (Nissar, Rashid, Phadke, & Desai, 2015). The sex ratio in immature *E. affinis*ranges from 1: 1, while male fish dominates in the adult stage (Ahmed et al., 2015)

Gonad Maturity Level (GML)

Observation of gonad morphology of female *E. affinis* at GML I has a small size with color reddish white. GML II has a reddish color and the female gonads in the form of eggs have not been seen. GML III has filled the abdominal cavity and has a yellowish red color and a large enough size accompanied by eggs. GML IV has a reddish yellow color with eggs that are very clear and solid. GML V Ovaries are wrinkled, thick walls, remaining eggs are near the release. The morphological observations of male *E. affinis* at GML I showed that the size of the gonads were still very small, pale white and had a thread-like shape. GML II shows a clear whitish color. GML III, the contents of the gonads have filled the abdominal cavity and have a milky white color. GML IV is solid white in color resembling a layer of fat. GML V Gonad is deflated with the remaining waste sperm.

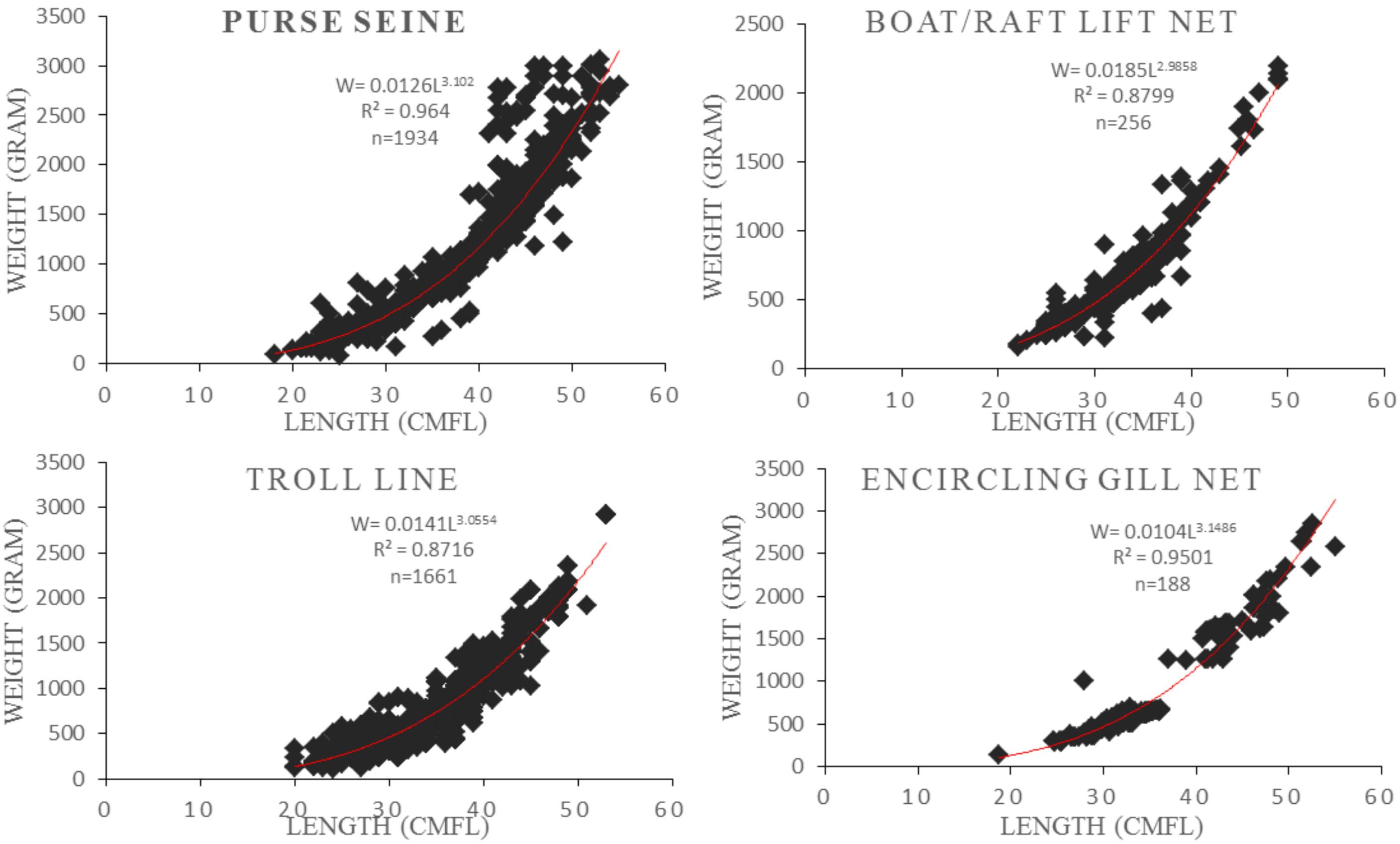


Figure 3. Legth-Weight Relationship of *E. affinis*

Gonad sampling was carried out in representative seasons, namely in February, May, July and October. The maturity level of female gonads in February and May is almost 100% at GML I and II or immature gonads. GML III, IV and V are found in July and October. Likewise with male gonads, it's just that male gonads in February and May were found GML I, II, and III. GML IV and V only appeared in July and October. This is in accordance with research in the Sunda Strait with the distribution of GML I and GML II *E. affinis*, both female, male and combined, is more dominant than fish with GML III and GML IV, this is due to the result of fishing pressure which causes the adult fish population that is mature gonads to become little (Ardelia, Vitner, & Boer, 2016). The spawning period for *E. affinis* occurs from June to August (Ekawaty&Jatmiko, 2018). The spawning season of *E. affinis* in the Indian Ocean can last from May to October (east season to transitional season II) (Hidayat et al., 2018). the peak of the *E. affinis* logging occurred during September - October when 40.7% of the catch landed, then a second small peak appeared again in December (Rohit et al., 2012). Spawning Potential Ratio (SPR) or the ratio of adult fish caught (fished) and those that are not caught or unfished is at a value level of 23% considered as a safe minimum egg production to maintain fish stocks (Wujdi et al., 2020). The percentage of Gonad maturity can be seen in Figure 4.

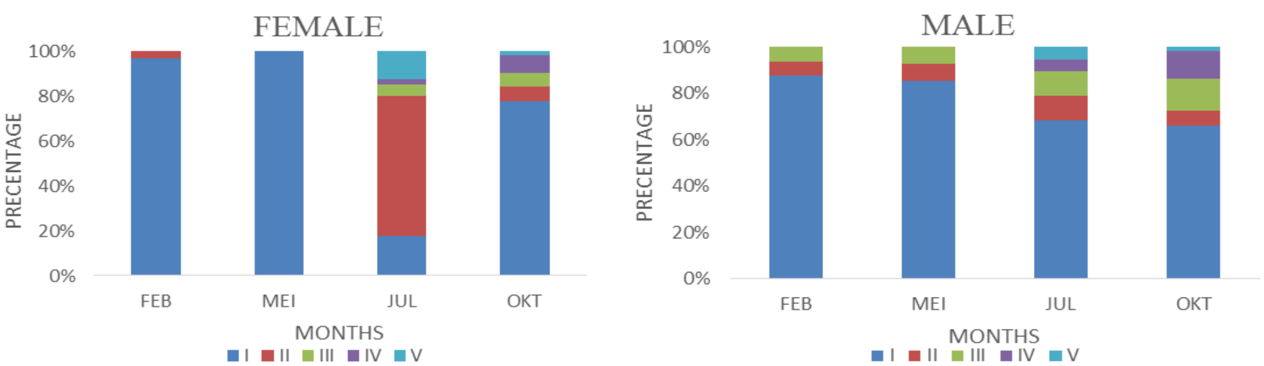
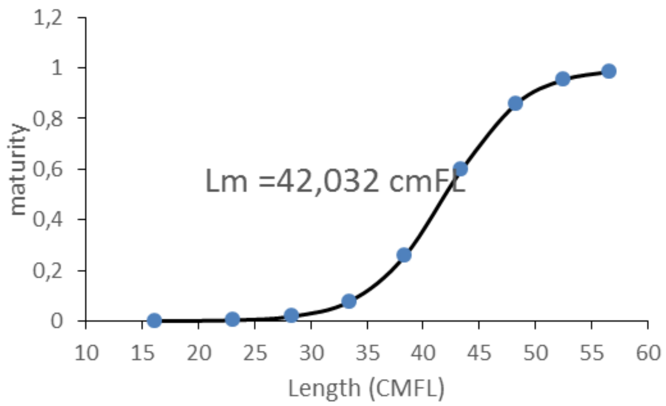


Figure 4. The Maturity Level of Male And Femaleof *E. affinis*

First Maturity

Analysis of the first maturity of gonads for *E. affinis* in this study obtained an Lm value of 42.032 cmFL. This Lm is greater than the length of the *E. affinis* in the Strait of Malacca with a value of Lm = 41 cmFL (Wagiyo et al., 2018), which is also greater than the size of *E. affinis* in the Sunda Strait Lm = 40.7 -40.8 cmFL (Ardelia et al., 2016). While the smallest size for the first time to ripen gonad (Lm) of *E. affinis* is in the Java Sea of 33.7 cm FL. Whereas for the k LM of *E. affinis* on the purse seine fishing gear is 50 cm (Bubun& Mahmud, 2016). According to Lagler et al. (1997), the factors that affect the first time the fish mature gonads are species, age, size, and adaptability to the environment. The average size of the first tuna caught on land is smaller than the size of the first time the gonads ripen, so if this happens continuously then biologically, the management of tuna in the waters of the Sunda Strait will be unsustainable (Ardelia et al., 2016). For the graph of Lm value can be seen in Figure 5



Gambar 5. Graph of First Maturity of *E. affinis*'sgonad (Lm)

Catching Aspects

There are 3 big ports in Sumatra, namely PPS Kutaraja, PPN Sibolga, and PPS Bungus. Fishing vessel based on the Kuta Raja PPS is dominated by purse seine and handline. Purse seine measuring 5 - 131 GT with a total drift long line of 231 and handline measuring 5 - 19 GT with a total drift long line of 32 vessels predominantly measuring 6 GT. Fishing vessels based on Sibolga PPN are quite diverse, including purse seines, boat /raft lift net, gill nets and handline. The number of unloading ships in 2018 was 5,247 trips and was dominated by 61-100 GT. However, the catching drift long line that land the catch of *E. affinis* are only purse seines and boat /raft lift net. The fishing gear used by fishermen based at PPS Bungus is dominated by tuna longline vessels (61 units), followed by vessels with spear fishing gear (35 units*E. affinis*komo are purse seines, boat /raft lift netand troll line. In general, neritic tuna is caught as a by-catch with high economic value or commonly termed as 'byproduct' in the encircling gill net (pelagic danish seine), purse seine, drifting gillnet, boat /raft lift net, huhate (pole and line), and hand lines.

Small scale fish landings are available at PPP PulaiBaai and PPP KutaAgung. The PPP PulauBaai has 5 types of ships that carry out fish landing or unloading activities at the Baai Island PPI, namely gill nets, boat /raft lift net, purse seines, hand lines and transport vessels (collecting vessel). The coastal fishing port (PPP) of Baai Island, Bengkulu, is dominated by small fishermen with a Gross tonnage (GT) capacity of <10 with a proportion of more than 82% in terms of the number of existing fleets. In 2018 the number of fleets operating at PPP PulauBaai is 105 units, with details of 71 small-scale units, 27 medium-scale units and 7 industrial-scale units. Kota Agung Beach Fishing Port, Tanggamus Regency, the number of fishing boats in Kota AgungSubdistrict in 2017 was dominated by encircling gill net boats (24 units), followed by motorboats (19 units) and purse seines (9 units).

Based on the results of research on *E. affinis*, it is known that the purse seine fishing fleet operating in the waters of the Indian Ocean is made of wood with a tonnage> 15 GT where the operation uses two types of systems, namely the one boat system and the two boats system. The purse seine nets are generally trapezoidal in shape with the codend at the end of the left side of the net. The fishing aid used is a FAD combined with a lamp as a fish lure and a scoop that functions to lift fish from the net to the hatch. The FADs installed are the catching areas for the purses seine fleet located in the waters of the Indian Ocean, west Sumatra, both inside and outside the Indonesian EEZ. The fishing area around the FADs or outside the FADs is used to catch hordes of tuna, tuna and skipjack tuna (Rahmat, 2016). FAD is a tool used as a fish collector. These FADs are planted based on the ownership of the FADs. Usually one FAD is owned by several community groups and one FAD is used by 6 fishing fleets. FADs can be used for 3-5 years depending on natural conditions and fishing activities in the sea (Agustina, Jatmiko, &Sulistyaningsih, 2020)

Apart from purse seines, troll line fishery also catch *E. affinis*. Troll line / fishing line operating in the waters of the Indian Ocean are generally made of wood with a tonnage of 6 GT and use more than one fishing gear when conducting fishing operations. Some even bring fishing gear other than fishing rods. Fishing area in Indian Ocean waters in Indonesia's EEZ waters. This fishing gear is used because *E. affinis*is classified as epipelagic, most of its life in waters near the coast with a temperature of 18° -29°C, at a young age it is found in bay waters even near ports. Forming schools (schooling) with other species with a number of 100 to 5,000 individuals (Widodo et al., 2014).

Distribution of fishing ground

The fishing production of *E. affinis* dominates the catch, and is the main catch in purse seines and boat /raft lift net. The results of the *E. affinis* were mostly caught in the EEZ and territorial areas, but some were caught in the open sea using purse seine fishing gear. The distribution of the purse seine catchment areas at 3 ° -6 ° N and 93 ° -96 ° E, and 3° -6° S and 94° -95° E. Boat/raft lift netat 0° -3° S and 95° -101° E. Troll line 4° -6° N and 94° -95° E. encircling gill net 0° -2°S and 99° -101° E. *E. affinis*mostly caught in the territorial sea. Production results are shown by the size of the circle on the map with each 1x1 scale on the map. To find out more clearly, it can be seen in Figure 6.The distribution pattern of the gill net fishing ground based at PPS Cilacap is relatively the same for 3 years (2008-2010), namely in the range of positions 10 ° -11 ° LS in April 2008 and 2009, however, in 2010, the fishing ground in April is relatively more towards the middle, namely the latitude range of 8 ° -10 ° S. In July and October, fishing grounds spread out at latitudes 7 ° - 9 ° S or more towards the nearshore (Widodo et al., 2014). The distribution of the catch of WPP RI 573 tuna in Labuhan Lombok has the smallest range of distribution compared to other TCTs. The distribution of *E. affinis*reaches 12 tons at latitudes 9º-10º S and 117º-118º E, and reaches 10 tons at latitudes 10º-11º S and 120º-121º E. The lowest distribution is at latitudes 10º-11º S and 116º-118º E (Arnenda&Rochman, 2019). This is because the sea surface temperature in the EEZ region tends to be warmer than the sea surface temperature in the high seas so skipjack tuna tend to be more abundant in the EEZ compared to the high seas (Nugroho&Jatmiko, 2019). The value of chlorophyll-a in nearshore areas is higher than with offshore waters inversely proportional to the sea surface temperature of chlorophyll-a getting to the open sea and the temperature value is getting colder, chlorophyll and SST are what affect the tuna catch (Fauziah, Triarso, &Fitri, 2020).

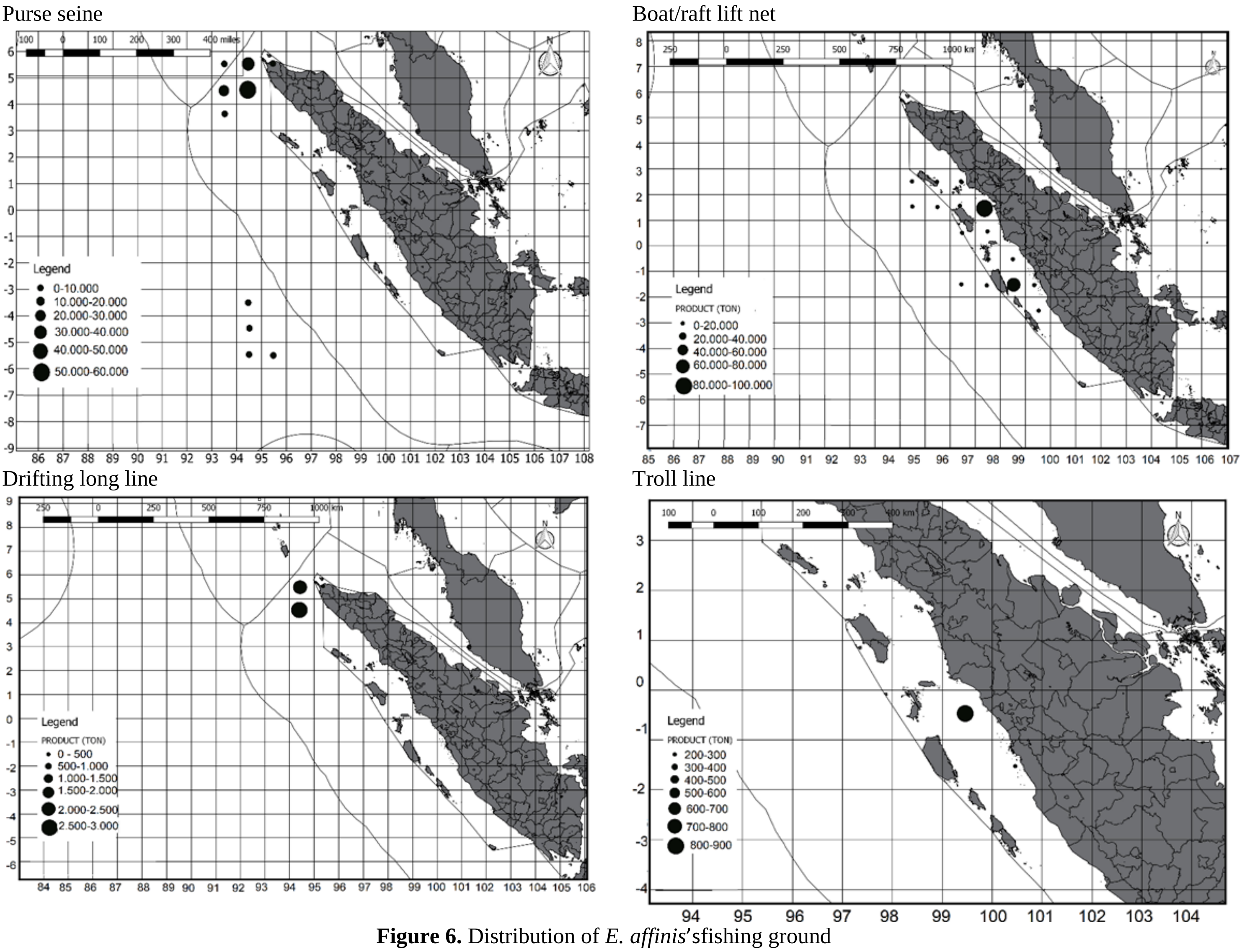


Figure 6. Distribution of *E. affinis*'sfishing ground

In this research, it is found that the largest yield of *E. affinis*is in the territorial sea as much as 226,222 tons. The purse seine produced 36.17% of the *E. affinis*, Boat/raft lift net 62.53%, the drifting longline was 0.97%, and the troll line was 0.31%. The production of *E. affinis* for each water area and its tanker is presented in Table 4. *E. affinis* is mostly caught using fishing gear as boat/raft lift net with a total of 230,584 tons. This is different from the drifting longline based in PPP Pondokdadap operating in territorial sea waters, exclusive economic zone (EEZ) and also outside the EEZ or in the high seas. PPP Pondokdadap hand line fishermen have a very wide fishing area, between 8º - 13º S and 107º - 116º E. In May, fishing activities are only carried out in the EEZ area and in June - August fishing activities are carried out in the territory, EEZ and in the high seas (Agustina et al., 2020). Fishermen based at PPS Cilacap are in the South Indian Ocean of Java (WPPNRI 573), the fishing area is located at a coordinate point between 6 ° LS - 15 ° S and 93 ° East - 114 ° East. The highest fishing activity is at coordinates between 8 ° -10 ° S and 107 ° - 110 ° East where the area is still within the EEZ area with fleets operating within the EEZ area are gill nets (50.4%) and tuna longline fleets (48.7%), while the fleets that catch TCT in the high seas (outside the EEZ) are dominated by tuna longline fleets (98.9%) (Nugroho&Jatmiko, 2019).

Table 4. Production *E. affinis*

Regional	Purse Seine	Boat/raft lift net	Drifting longline	Troll line	Total
Territorial Sea	1173	223554	345	1150	226222
Zee	126529	7030	3257		136816
Over seas	5665				5665
Total	133367	230584	3602	1150	368703

CONCLUSION

E. affinis on purse seine, troll line and encircling gill net fishing gear during the study period of ranged from 16-55 cm FL, while on the boat/raft lift net it was between 21-50 cmFL. The growth of these fish is positive allometric on purse seine and encircling gill net fishing gear, negative allometric on boat/raft lift net fishing gear, and isomeric on troll line. The sex ratio is in the ratio 1: 1.15 and balanced. Based on the maturity level, the gonads were found to be mature in July and October, and immature in February and May. Gonads ripened for the first time at a size of 42.032 cmFL. The distribution of the purse seine catchment areas at 3 ° -6 ° N and 93 ° -96 ° East, and 3° -6° S and 94° -95° E. Boat/raft lift netat 0° -3° S and 95° -101° E. Troll line 4° -6° N and 94° -95° E. encircling gill net 0° -2°S and 99° -101° E. Tongkolkomo mostly caught in the territorial sea.

ACKNOWLEDGEMENT

Thanks to Research Institute of Tuna Fisheries (RITF), this research is part of the RITF Workshop T.A. 2019 and TA.2020. Researchers at RITF. PPS Kuta Raja, PPN Sibolga, PPS Bungus, PPI Padang Baai, PP Kota Agung. All enumerator teams in all these research locations.All parties involved.

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