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Study of biological and management of fisheries of squid *(Loligo sp.)* that was land at PPP Tasik Agung Rembang

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Abstract. Squid is a family of Loliginidae which consists of 8 genera, of which 3 genera of which have important economic value, namely Loligo, Sepioteuthis and Uroteuthis. One of the catches in Rembang waters which is quite high is the squid fishery which landed at PPP Tasik Agung. The most common types of squid landed at PPP Tasik Agung are Loligo chinensis, Loligo duvaucelli, and Loligo edulis. The purpose of this research is to know the biological condition of squid, the condition of capture fisheries, and to know the management that can be done. The study was conducted from June to July 2022. Random sampling method is the method used in sampling. Analysis of the data used is the relationship between length and weight, sex ratio, gonad maturity level, size at first caught and mature (Lc and Lm), and EAFM domain of fish resources. The results showed that the capture of squid is still not well controlled. The results of the t-test measuring the length-weight relationship of the three species that have been found indicate that the growth is allometric negative. As many as 49.6% of the three types of squid that have been caught are indicated to be immature gonads because they have been dominated by TKG I and II. The ratio of male and female sex of all samples is 1: 0.54. The overall composite indicator assessment result on the fish resource domain indicator is 0.48 (48%). One of the strategies in the management of squid fisheries that can be done is to make regulations for limiting fishing efforts and the minimum size of fish that can be caught.

Keywords: Squid, Fisheries Biology, SDI domain EAFM, Rembang Regency

Introduction

Capture fisheries is one sector that has an important role for the Indonesian economy because it is able to absorb labor, provide animal protein and alternative sources of livelihood for communities in coastal areas, especially fishermen (Yuzrizal et al., 2016). One of the water areas in Indonesia that has the potential of fishery resources is in the waters of Rembang. The potential for fishing in Rembang Waters has increased quite high and fluctuated, where in 2018 the production produced was 9640252.2 tons and in 2020 production increased to 11172104.1 tons (Department of Marine and Fisheries of Rembang Regency, 2020). One of the high catches

is the squid fishery which landed at PPP Tasik Agung. In 2018 it produced a catch of 42,263 tons which is an opportunity for capture fisheries in Indonesia to be put to good use (Department of Marine and Fisheries Rembang, 2021). The fishing area is located in the fisheries management area (WPP) 712 which is located in the northern region of Java Island which consists of 8 provinces and 164 fishing ports (Tegar, 2018). The level of exploitation of squid resources in FMA 712 based on ecological and economic aspects is in the moderate category based on research results (Atmaja et al., 2016). In order to maintain the potential, it is necessary to make a selective fishing effort (Sobari et al., 2003). One of the efforts that will be carried out is the assessment of fish resources. The purpose of this research is to know the biological condition of squid, the condition of capture fisheries, and to know the management that can be done. The results of the study can be a policy input for managing squid resources, both in terms of the optimal number of catches and the number of optimal fishing efforts (Wulandari, 2018).

Research methods

Research Time and Location

The research was conducted on June 1 - 20, which is located at PPP (Coastal Fishery Port) Tasik Agung, Rembang Regency, Central Java Province. The following picture below is the location of the study and the sampling point.

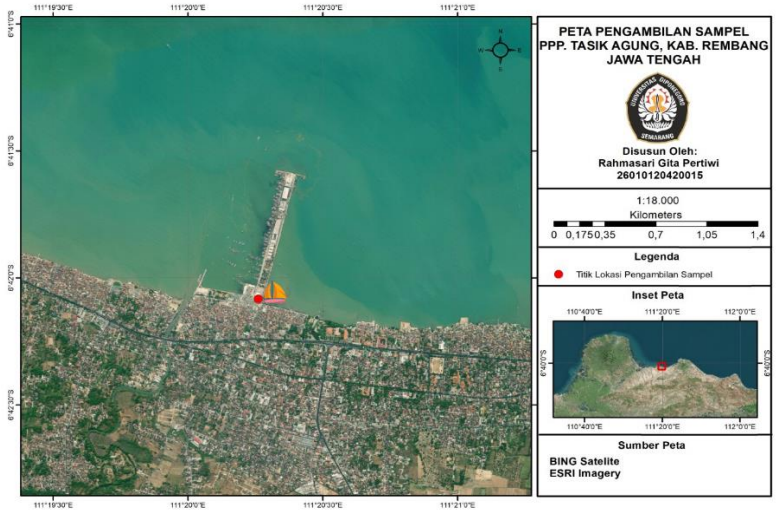

Figure 1. Research Location Map

Sampling method

Determination of respondents was carried out using the accidental sampling method, namely the determination of fishermen who carried out squid fishing activities that would be used as respondents according to their good communication skills in filling out the questionnaire. The method used in sampling squid is random sampling. Sampling was done with a period of 2 times a week for one month. So the total sampling to be carried out is 15 times.

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Data analysis

Morphology

Analysis of squid morphology based on visual observations using the book Status of Cephalopod Resources in Indonesia (Tarigan *et al.*, 2019).

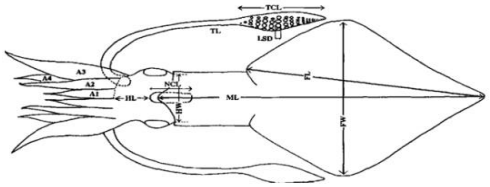

Figure 2. Measurement of Squid's Coat Length (Djajasasmita *et al.*, 1993)

Relationship Length Weight

Analysis of squid length and weight data based on mantle length and squid body weight measurements using the formula (Anusha & Fleming, 2014):

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

Information :
W : Weight of squid (grams)
L : Length of squid (cm)
a : Constant or intercept
b : Exponential or tangential angle

Furthermore, a T-test analysis (partial test) is used to determine whether the b value obtained is significant with 3 or not, using the following formula;

$$t = \frac{3 - b}{Sb}$$

To find out the closeness of the length and weight values in the length and weight equation, it is necessary to know the correlation coefficient value by using the equation:

$$r^2 = \frac{(\sum Xi\,Yi)^2}{(\sum Xi^2)\ (\sum Yi^2)}$$

$$r = \sqrt{r^2}$$

Information :

r : correlation coefficient, is an abstract measure of the degree of relationship between x and y variables (-1 r 1)

r : 1, it means that there is a close and positive relationship

r : -1, it means that there is a close and negative relationship

r : 0, means that there is no close relationship

Frequency Distribution

Length frequencies were analyzed using length data from each total fish length (Walpole, 2002). The analysis of the length frequency data by determining the number of class intervals, determining the width of the class, determining the frequency of the length of each length class

and making a graph of the distribution of the length frequency and seeing the shift in the distribution of the long class distribution (Pratiwi, 2013). The frequency distribution of fish length can use the following formula (Sudjana, 2002).

$$K = 1 + 3{,}3\log(n) \ldots\ldots\ldots(1)$$

$$C = W/K \ldots\ldots\ldots\ldots\ldots(2)$$

Information:
K = Number of classes.
n = Number of data
C = Class interval.
W= Length of interval (Pmax – Pminimum)

Sex Ratio

The sex comparison of squid was carried out through visual observation of a number of male and female individuals obtained as samples at the study site. The sex ratio is known by using the formula:

$$X = X / (X + Y) \times 100\ \%$$
$$Y = Y / (X + Y) \times 100\ \%$$

Information :
X : Number of males
Y : Number of Females
Gonad Maturity Level (TKG)

Gonadal maturity level was determined by visual observation of gonadal morphology. Furthermore, the observed characteristics are adjusted to the characteristics of the level of maturity. The following table below is the maturity level of squid gonads based on gonad morphological characteristics developed by Cassie and modified by Effendi (1979):

Table 1. Classification of Squid TKG (Oktariza *et al.*, 2016)

TKG	Betina	Jantan
I (Young)	Sexual organs are very difficult to find without an aid (microscope or magnifying glass). The oviduct and NG(Nidamental Glands) look like lines that can be penetrated by light. Ovaries translucent, webbed.	Sexual organs are very difficult to find without an aid (microscope or magnifying glass). Spermatophores look complex (if present) as a clear or translucent stain. The testes are translucent and membrane-like.
II (Immature)	The sexual organs are clear or whitish. The oviduct and NG are clearly translucent or like a whitish line. Oviduct looks tortuous. The NG is small, all the contents of the stomach behind it can be seen easily. Ovaries clearly visible without tools	The sexual organs are clear or whitish; separate parts of complex Spermatophores are clearly visible; small testicles; structure is not visible.

III (Preparation)	The sexual organs are opaque. The indentation of the oviduct is long. The NG enlarges, covers several internal organs such as the kidneys and the distal part and the outer tissue of the oviduct fattens and expands. The outer shape of the ovary is clearly visible	The sexual organs are not see through. The vas deferens is whitish or white; Spermatophoric Organs with white coating; testicular structure is unclear.
IV (Medium Rising)	Many eggs in the oviduct. The oviduct curve begins to harden. Eggs are not clear (95% coarse) and solid at least in the proximal oviduct. There may be differences in the maturation stage of the egg in the distant part of the oviduct.	White spermatophorous ducts; twists and turns; enlarge; The spermatophore sac is elongated with whitish particles in it, but without the spermatophores; narrow testicles; have no liquid; The surface of the testes is covered by tissue.
V (ripe)	As above, but the eggs are translucent/clear (more than 60%) at least proximal to the oviduct. When scratched, NG releases a thick yellowish substance.	White spermatophorous ducts; tortuous; enlarge; The spermatophore sac is elongated with particles in it whitish, the spermatophores are present in the spermatophore sac; narrow testicles; dry; The surface of the testes is covered by tissue.

Size First Caught and Mature (Lc and Lm)

Estimation of the first caught squid is done by measuring the length of the mantle which has been grouped by total length class (x axis). Calculation to obtain the value of Lc (length at first capture) is with a percentage of L50% which means the length where 50% of the squid is retained (Tallo, 2006):

$$\mathbf{SL} = \frac{\mathbf{1}}{\mathbf{a} + \mathbf{exp}(\mathbf{a} - \mathbf{bL})}$$

$$\mathbf{Lc} = \frac{-\mathbf{a}}{\mathbf{b}}$$

The Lm50% value was obtained by plotting the percentage of the cumulative proportion of gonadal fish with each standard length of fish (King, 2013). The estimation of the length at first maturity of the gonads Lm (length at first maturity) is carried out according to the calculation procedure using the formula (Widjayana *et al.*, 2015):

$$m{:}\, xk\left(\frac{x}{2}\right) - (X\sum pi$$

Information:
M : Logarithm of the long class at first maturity
d : The difference of the logarithm of the increase in the mean length
k : Number of long classes

xk : Logarithm of the mean length of the gonadly mature fish (Pi:1) taking the equation above, then the size of the first ripe gonad (Lm) is obtained

Catch per unit of Effort (CPUE)

Catch rate value or (CPUE) of catch data and fishing effort is carried out by comparing the number of squid caught with the number of catching efforts (trips) of each squid fishing gear. CPUE calculation results using the CPUE equation according to (Tresnati *et al.*, 2012):

$$CPUE_{t:\frac{Y_t}{E_t}}$$

Information:

CPUEt : CPUE at time t (kg/trip)

Yt : Catch at time t (kg)

Et : Fishing effort at time t (trip)

Ecosystem Approach to Fisheries Management (EAFM)

EAFM analysis is done through an indicator approach. The indicator used in this study only uses one domain, namely the Fish Resources (SDI) domain. The assessment of the management status of the squid landed at PPP Tasik Agung uses a composite analysis of indicators from the fish resource domain which is then visualized with the flag modeling technique (Adrianto et al., 2014).

Table 2. Criteria and Weights for Fish Resource Domains in EAFM

No	Indicator	Monitoring/Collection	Calculation Criteria	Weight (%)
1	CPUE	CPUE secondary data	1 = CPUE drops sharply (>25%) 2 = CPUE decreased slightly (<25%) 3 = CPUE stable or increasing	40
2	Fish Size Trends	Fisherman interview	1 = size is getting smaller 2 = fixed relative size 3 = size is getting bigger	20
3	The composition of the caught juvenile fish	Random sampling - survey at TPI - interview of fishermen	1 = a lot (>60%) 2 = a lot (30-60%) 3 = little (<30%)	15
4	Composition of target and non-target species	Observation, sampling and secondary data - Survey and interview	1 = Less proportion of target fish (<15% of total volume) 2 = proportion of target fish equal to non-target (16-30% of total volume) 3 = Larger proportion of non-target fish (>30% of total volume)	10
5	Range collapse	Surveys and interviews - Surveys and monitoring,	1 = Fishing ground is very far 2 = Fishing ground Far 3 = relatively Fixed fishing ground	10
6	Captured ETP population	logbook - data poor fisheries: interview	1 = there are ETP individuals caught but not released; 2 = caught but released 3 = no ETP individuals caught	5

The value of each fish resource domain indicator will then be analyzed using a simple composite analysis based on the arithmetic mean which is then displayed in the form of a flag model as shown in table 3 below.

Table 3. Classification of Composite Index Values and Visualization of Flag Models

Composite Value Range	Flag Model	Description
1		Bad
2		Moderate
3		Good

Research result

Research sites

Rembang Regency has an area of about 1,014 km2 and a coastline of 63 km. As much as 35% of the total area of Rembang Regency is a coastal area of 355.95 km2, the Marine and Fisheries Service of Rembang Regency, 2021). The geographical position of Rembang Regency is between 111o00'-111o30' east longitude and 06o30' - 07o00 south latitude with 14 sub-districts namely Kaliori, Rembang, Lasem, Sluke, Kragan, Sarang, Sedan, Gunem, Pamotan, Sulang, Sumber, Bulu and Pancur.

Coastal Fishing Port (PPP) Tasik Agung Rembang is one of the fishing ports located in Tasik Agung Village, Rembang District, Rembang Regency, Central Java Province. Nearly 60% of fishery products in Rembang Regency come from Rembang District.

Biological Aspect

The results of research conducted at the Tasik Agung Beach Fishing Port, Rembang, found three types of squid, namely Loligo chinensis, Loligo duvaucelii, and Loligo edulis. The total squid samples obtained during the study were 655 tails. The three squid species were obtained from large and small vessels with a size range of 10-80 GT with the main fishing gear being marsupial nets (JTK), purse seines, and mini purseines. The squid samples obtained were dominated by Loligo chinensis squid with a total of 383 tails with 252 males and 131 females. The lowest or least samples of squid were obtained from the Loligo edulis species which amounted to 63 tails with 38 males and 25 females.

Frequency Distribution

The number of squid samples were grouped into 9 long groups with an interval of 3.5 cm. The results of observations on the distribution of mantle length of squid caught from June to July at PPP Tasik Agung can be seen in the graphic image below.

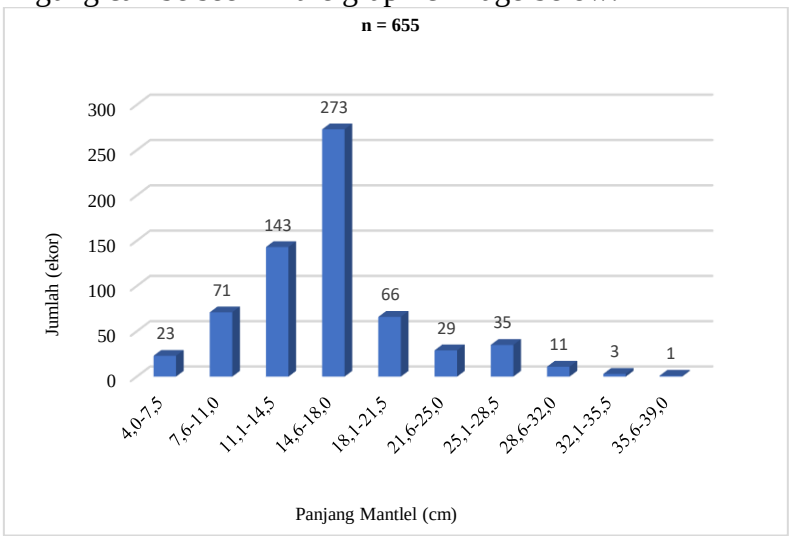

Figure 3. Frequency Distribution of Total Length of Squid Samples

The results of observations during the study showed that the mantle length of the total sample of squid was dominated in the length range of 14.6 - 18.0 cm, totaling 273 tails or (41.68%) with an average mantle length of 14.47 cm. . The largest mantle length measurement was in the range of 32.1-35.5 cm of mantle length, which only amounted to 3 tails, while the least caught squid samples and at the same time the smallest size caught were in the range of 4.0-7 mantle length. ,5 cm totaling 23 tails.

The difference in the distribution of the length of the squid's mantle is influenced by several factors, including; related to ring trawl fishing operations where the size of the mesh and variations in the length of the day of operation will affect the wider fishing area. This can cause the size of the fish caught to be more varied. The second factor: environmental conditions, abundance and availability of food, temperature, and light in different waters (Zamroni et al., 2019).

Relationship Length Weight

The total number of squid samples obtained during the study were 655 individuals with a coat length range of 4-37cm and body weight ranging from 6-478 grams, with an average coat length of 14 cm and an average weight of 99.75 grams. The following graphic image below is the relationship between length and weight of the whole sample of squid.

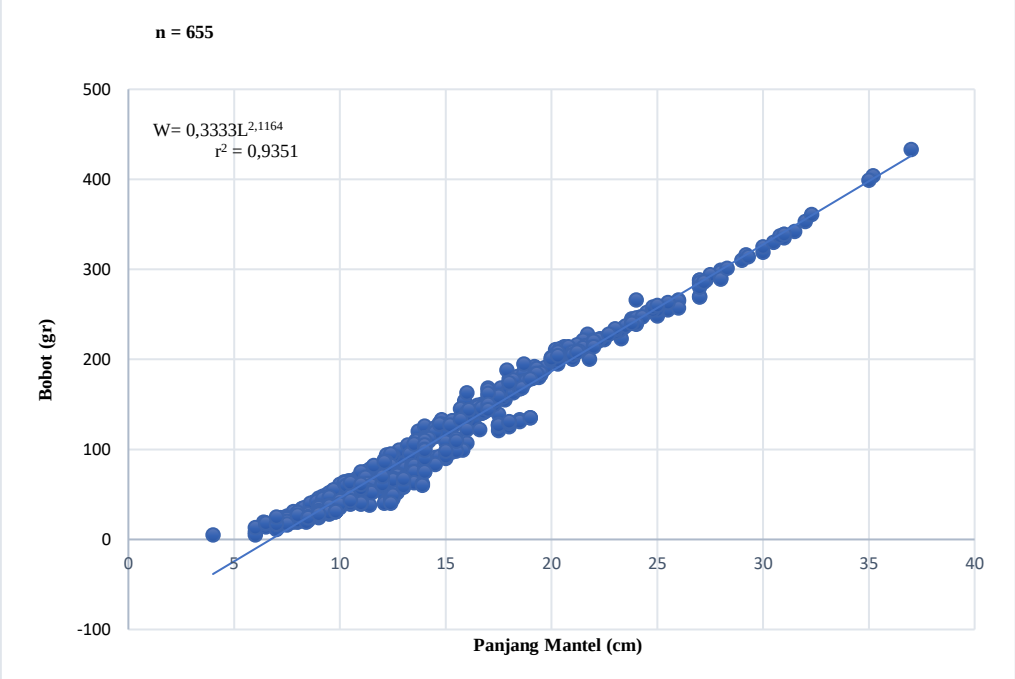

Figure 4. The Relationship of Length and Total Weight of Squid Samples

Based on the results of the analysis of the entire squid sample above, it shows that the slope (b) value obtained is less than a value of 3, from this value it can be concluded that the growth pattern of the squid's mantle length is negative allometric which means that the increase in the length of the squid's mantle is faster than its weight growth (Amin *et al.*, 2013). The magnitude of the closeness of the relationship is determined by the coefficient of determination (r2), which is 0.9351. This shows that the length of the mantle can estimate the weight of the squid with an accuracy rate of 93.51%.

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In this study, it was found that the value of b is relatively small and the results of current measurements show that the water conditions are relatively calm so that it is contrary to the research of Shukor et al., (2008) which states that fish that live in fast-flowing waters generally have a lower b value and vice versa. In general, the value of b depends on physiological and environmental conditions such as temperature, pH, salinity, geographic location, and sampling technique (Jenning et al., 2001) as well as biological conditions such as gonadal development. and food availability (Froese, 2006).

Sex Ratio

The composition of squid catches in this study showed that the dominant sex of squid caught was male. A total of 655 squids were dissected to observe sex, consisting of 425 males and 230 females.

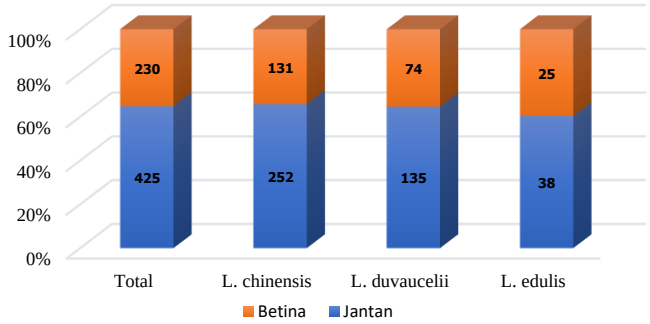

Figure 5. Total Sex Ratio of Squid Samples

The results of the comparison of the total sample of squid, and the three species of squid that have been found that the sex ratio between male and female squid is not 1:1 or it can be said that it is still in an unbalanced ratio so that it will inhibit regeneration. The difference in the number of male and female fish is strongly influenced by various factors such as squid behavior according to gender, aquatic environmental conditions, growth rates and susceptibility to fishing pressure (Aprilia F, 2017).

Gonad Maturity Level (TKG)

The results of observations of the gonad maturity level of 655 squid from the three types of squid showed that the gonad maturity level varied from TKG I to TKG III. The following percentage of gonad maturity level can be seen in the table below.

Table 4. Percentage of gonadal maturity level in total squid samples

Sample	Number of Sample	Gonad Maturity Level (%)					
		I		II		III	
		n	%	N	%	n	%
Total	655	325	49,6%	257	39,2%	73	11,1%
Male	425	215	50,6%	161	37,9%	49	11,5%
Female	230	110	47,8%	96	41,7%	24	10,4,5%

The total sample of squid was dominated by the maturity level of young gonads or TKG 1 as many as 325 tails or 49.6%, followed by TKG II which was 257 or 39.2% and TKG III 73 tails or 11.1%. Male squid TKG I by 51% (215 individuals), TKG II 38% (161 individuals), and TKG III 11% (49 individuals). The female squid are still the same as the male species

where only three stages of gonad maturity are found and dominated by TKG I with a total of 110 individuals (48%), TKG II 42% (96 individuals), TKG III 10% (24 individuals) which means that male and female Loligo sp were found to be immature gonads.

Size First Caught and Mature (Lc and Lm)

The length of the first caught and mature length was calculated using frequency data and length class intervals. Analysis of the length of the first time caught was obtained based on samples of squid caught on mini purse seine and JTK fishing gear.

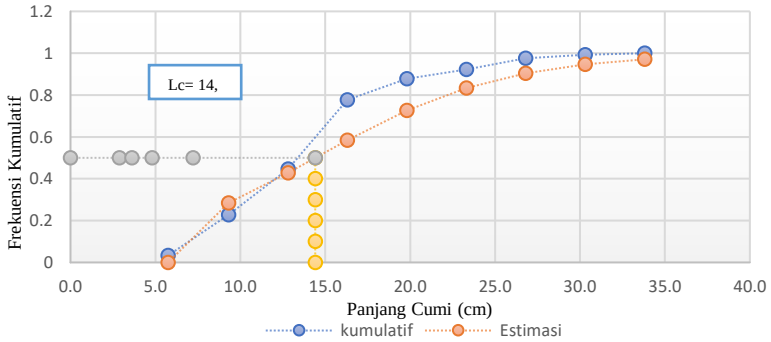

Figure 6. The size of the first time caught the total sample of squid

The total number of squid samples landed at TPI Tasik Agung obtained an Lc50% value of 14.4. The size of the first caught Lc is influenced by the fishing gear used. The greater the value of Lc indicates the more selective a fishing gear is. To determine the condition of the first fish caught, whether the gonads have matured or not, it is necessary to compare the length of the first caught (Lc) with the length of the first gonad maturity, Lm. The following table below is the result of the analysis of Lm and Lc.

Table 16. Results of Lc and Lm . analysis

Sample	ni	fi	ri	pi = (ri/ni)	X = Xi2-Xi1	qi = 1-pi	(pi*qi)/(ni-1)	Lm	Lc
Total	655	592	63	4,00	0,39	6,00	0,02	26,47	14,41
Loligo chinensis	383	329	54	3,80	0,24	5,20	0,03	28,52	13,75
Loligo duvauceli	87	63	27	2,23	0,07	3,77	0,01	21,31	16,50
Loligo edulis	63	55	8	1,46	0,67	5,54	0,04	16,50	12,53

***Catch Per Unit of Effort* (CPUE)**

The conditions described in the linear equation that produce R2 = 0.8235 indicate that the magnitude of the effect of effort and yield in influencing the increase or decrease in CPUE is 82%, while the remaining 18% is influenced by other variables outside of the two variables. Thus the value of R2 is considered statistically strong enough to represent the influence of the variables used in this model, because the closer the R2 value is to 100%, the stronger the influence of the variables (Listiyani et al., 2017).

The trend of squid CPUE in 2015-2017 has increased which shows that resource utilization is still within safe limits, after that in 2018 to 2021 it tends to decrease which is an indirect indication of excessive utilization.

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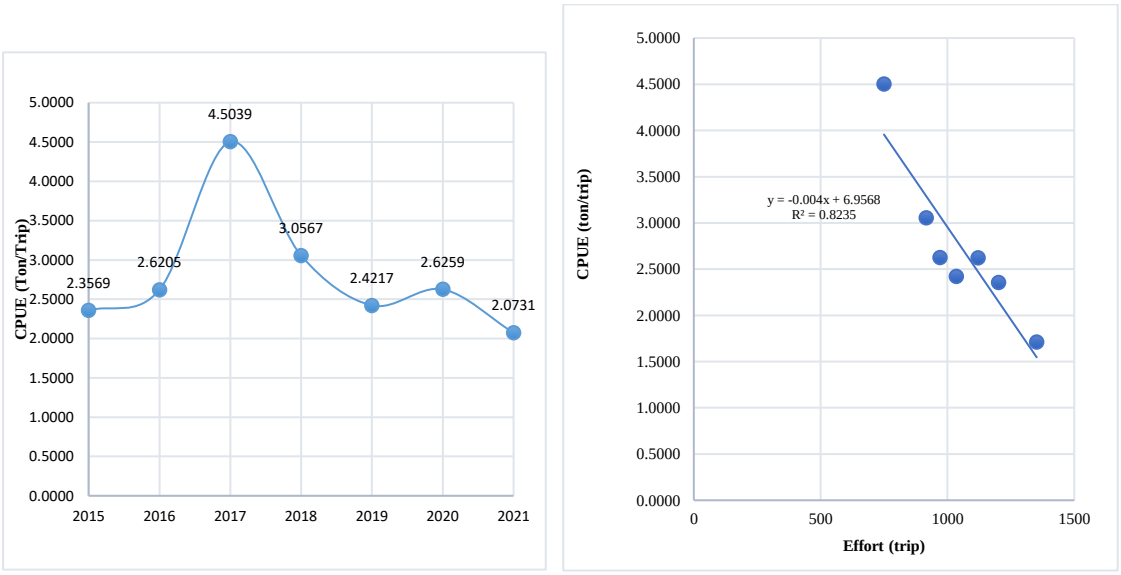

(a) (b)

Figure 7. (a) Squid CPUE Fluctuations at PPP Tasik Agung and (b) CPUE and Effort Relationship in Linear Equations

The trend of squid CPUE in 2015-2017 has increased which shows that resource utilization is still within safe limits, after that in 2018 to 2021 it tends to decrease which is an indirect indication of excessive utilization. The decline in the standard CPUE value of squid resources at the Tasik Agung PPP for the period 20215-2021 tends to decrease, in the last seven years there has been a decrease of up to 14.29%. The rising CPUE trend is an illustration that the level of exploitation of fish resources can be said to be still in the developing stage. The flat trend of CPUE is an illustration that the level of exploitation of fish resources is approaching the saturation of efforts, while the trend of declining CPUE is an indication that the level of exploitation of fish resources will lead to a situation called 'over-fishing' (Badrudin & Karyana et al. , 2014).

Ecosystem Approach to Fisheries Management (EAFM)

Fish Resource Domain (SDI)

The results of the EAFM assessment with indicators can be visualized with the modeling flag. Based on the results of the assessment on each EAFM indicator in the Fish Resource Domain, then in the form of a modeling flag there are three (3) colors from the results of the assessment of the fish resource domain, namely yellow, orange, and red. it was found that overall for each indicator in the fish resource domain, it was in the poor or moderate category in implementing EAFM.

Table 5. Results of Fish Resource Domain Flag Modeling

Indikator	Model Bendera	Deskripsi
1. Raw CPU		Currently implementing EAFM
2. Fish size trends		Bad at implementing EAFM
3. Proportion of juvenile fish caught		Bad at implementing EAFM

4. Composition of caught species		Bad at implementing EAFM
5. Range Collapse of fish resources		Lack of implementing EAFM
6. ETP species		Bad at implementing EAFM

Factors from the results of the flag model assessment in table 5 are caused by the relatively small catchability of the fishing gear used by fishermen in PPP Tasik Agung. The low probability of catching the squid illustrates the high effort in catching squid issued by fishermen in each setting. Then the indicator of the proportion of juvenile fish in the low category will be closely related to the pressure on aquatic ecosystems due to the use of fishing gear that is not selective and not environmentally friendly. This will have an impact on reducing juvenile fish stocks which will later develop into productive fish in the future.

Conclusion

There were three types of squid found in PPP Tasik Agung, namely: Loligo chinensis and Loligo duvauceli, and Loligo edulis. The three types of squid were found to have negative allometric growth properties. The results of the value of Lc < Lm indicate an indication of excessive exploitation. The declining trend of CPUE is an indication that the level of exploitation of fish resources if left unchecked will lead to a situation called 'over-fishing'. The results show that squid fishing in Tasik Agung PPP is in poor condition based on the EAFM assessment using the domain of fish resource indicators. Efforts to manage fishery resources that need to be done are making regulations on limiting fishing efforts and the minimum size of fish that can be caught, socializing and educating on sustainable fisheries management, enforcing the law and providing strict sanctions.

References

[1] Aprilia, F. (2017). Perbandingan Panjang Dan Berat Cumi-Cumi Di Pantai Rebo Dan Pantai Bedukang Kabupaten Bangka *(Studi Kasus: Hasil Tangkapan Bulan April 2016 Sampai Juli 2016)*.

[2] Atmaja, S. B. (2016). Perkembangan Perikanan Cumi–Cumi Di Sentra Pendaratan Ikan Utara Pulau Jawa. *Jurnal Penelitian Perikanan Indonesia*, *19*(1), 31–38.

[3] King, M. (2013). *Fisheries Biology, Assessment And Management*. John Wiley & Sons.

[4] Listiyani, A., Wiajayanto, D., & Jayanto, B. B. (2017). Analisis Cpue (Catch Per Unit Effort) Dan Tingkat Pemanfaatan Sumberdaya Perikanan Lemuru (Sardinella Lemuru) Di Perairan Selat Bali. *Jurnal Perikanan Tangkap: Indonesian Journal Of Capture Fisheries*, *1*(01).

[5] Oktariza, W., Wiryawan, B., Baskoro, M. S., Kurnia, R., & Wisudo, S. H. (2016). Model Bio-Ekonomi Perikanan Cumi-Cumi Di Perairan Kabupaten Bangka, Provinsi Kepulauan Bangka Belitung (Bio-Economic Model Of Squid Fisheries In The Waters Of Bangka Regency, Bangka Belitung Islands Province). *Marine Fisheries: Journal of Marine Fisheries Technology and Management*, *7*(1), 97–107.

[6] Sobari, M. P., Kinseng, R. A., & Priyatna, F. N. (2003). Membangun Model Pengelolaan Sumberdaya Perikanan Berkelanjutan Berdasarkan Karakteristik Sosial Ekonomi Masyarakat Nelayan Tinjauan Sosiologi Antropologi. *Buletin Ekonomi Perikanan*, *5*(1).

[7] Tallo, I. (2006). Perbedaan jenis dan kedalaman pemasangan atraktor terhadap penempelan telur cumi-cumi.

[8] Tresnati, J., Mallawa, A., & Rapi, N. L. (2012). Size structure, age groups and growth of squid Loligo Pealeii In The Waters Of Barru Regency, *South Sulawesi*. *2*.

[9] Vecchione, M., Shea, E., Bussarawit, S., Anderson, F., Alexeyev, D., Lu, C., Okutani, T., Roeleveld, M., Chotiyaputta, C., & Roper, C. (2005). Systematics Of Indo-West Pacific Loliginids. *Phuket Mar. Biol. Cent. Res. Bull*, *66*, 23–26.

[10] Wulandari, D. A. (2018). Morfologi, Klasifikasi, Dan Sebaran Cumi-Cumi Famili Lolinginidae. *Oseana*, *43*(2), 48–65.

[11] Yusrizal, Y., Nugraha, E., Syamsuddin, S., Krisnafi, Y., & Fadly, Z. R. (2019). Analisis Komoditas Unggulan Perikanan Laut Di Ppn Brondong Kabupaten Lamongan Provinsi Jawa Timur. *Buletin Jalanidhitah Sarva Jivitam*, *1*(1), 25–36.