CPUE analysis of crab resources in Karangantu, Serang Banten, Indonesia. Pickassa,

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Abstract. Karangantu Archipelago Fisheries Port is one of the crab fishing centers in Banten Province. In 2017 Karangantu AFP was able to produce Crabs reaching 56,965 kg. This study aims to analyze the catch per catch effort and the Maximum Sustainable Yield (MSY) of crab resources in the Karangantu Archipelago fishing port. The data analysis method used to determine the catch effort per catch is CPUE analysis and standardization of fishing gear. The results showed catch value per effort or resources of the crabs CPUE (Catch Per Unit Effort) that landed in the Brondong island fishing port in 2008-2017 fluctuating with an average CPUE value of 5,074 kg/trip, based on the value of the optimal fishing effort (fopt) 15,598 trips/year and the value of MSY 85,596 kg. The average utilization rate reaches 91% of the total MSY obtained.

Key Words: *Portunus pelagicus*, MSY, AFP, fishing, sustainable.

Introduction. Indonesian fisheries have the potential of large marine fish resources. One of the potential of marine fisheries is crabs (*Portunus pelagicus*). Crabs are a type of Crustacean that is popular within its community and they are spread in almost all Indonesian waters (Ningrum et al 2015). Besides that, crab is a fishery commodity with a high selling value, both as a local commodity and an export commodity (Prasetyo et al 2014). In Indonesia, crab is a fishery commodity that is exported mainly to the United States of America, which reaches 60% of the total catch of crabs (Setiyowati 2016). Problems that commonly occur in fisheries resource management are biological problems, which can cause a decrease in fish resource stocks and a decrease in fishermen's income (Yusfiandayani & Sobari 2017).

Karangantu Fisheries Port (AFP) located on the North Coast of Banten, is a type B fishing port in Banten Province. Landed catch production is the largest compared to the surrounding fishing ports, namely 93% (2,797 tons) in Serang City and Serang Regency in 2013 (Hamzah et al 2016). The amount of catch production is said to be very influential on the existing fishing industry. AFP Karangantu fisheries production in 2017 reached 2,293 tons (Karangantu AFP 2017). From the production there are 56.9 tons of crab commodities landed by fishermen using various fishing gear such as, Gill Net, Danish seine, Lift Net, Trammel Net, and Trap.

P. pelagicus is a high-economic fishery commodity that has been long sought home and abroad; capitalized at a relatively high price (2.10-3.50 USD/kg of meat) (Kurniasih et al 2016). *P. pelagicus* crabs are a type of fishermen's catch at Karangantu AFP which has a high economic value compared to other fish species and is also one of the export commodities. So that with the existing conditions, it will attract high attention from fishermen to use or capture more crabs. However, the continuous arrests due to ignorance of the phases of the biological development of the crab, resulted in decreased recruitment rates (Santoso et al 2016; Kembaren et al 2018), so that the crabs, just as any fish species, need to be carefully managed because they are renewable biological resources. But can experience depletion or extinction. Resources have limited abundance, in accordance with the carrying capacity of their habitat (Tangke 2010).

Excessive use of fish resources is feared to affect the ecosystem as well as the availability of fish stocks, especially crab commodities. One way to manage the *P. pelagicus* fishery resources stock sustainability can be performed within various options, including through the protection of essential habitats in the form of nurseries (Kurnia et al 2014). Then there is a need to conduct a study to find out the number of crab stocks in the sea, so later the results of the study can be used as a reference for determining the optimal number or effort in using crab resources.

The purpose of this study was to analyze the catch per effort of capture (CPUE) of *P. pelagicus* resources that were landed at Karangantu AFP, optimum fishing efforts and MSY.

Material and Method. The present research was conducted at the Karangantu AFP, Serang, Banten Province. Data collection started in 2008 and lasted until 2017 from the Archipelago Fisheries Port (AFP) for crabs (*P. pelagicus*) which includes the number of crab catches (*P. pelagicus*) and efforts made (trips). While the research methods used were survey and descriptive method.

The data needed in the present study were primary and secondary data. Primary data was obtained through interviews and direct observations covering the specifications of the fishing gear unit, fishing methods, catches of several trips, fishing grounds. Secondary data was obtained from fisheries production data at Karangantu AFP, Banten.

Data analysis. Data's obtained were in the form of data amount of effort, annual production data (catch) according to the type of fishing gear production data according to the type of fish per fishing gear per year (for provinces), annual production data (catch) for fish per district. Sustainable production data obtained was used as information material to analyze MSY and F-Opt (Effort / Maximum Effort) for *P. pelagicus* crab commodities, where data analysis was done through several stages, namely:

<u>Analysis of fishing power index</u>. Unit effort of number of fishing fleets with fishing gear and certain times were converted into "boat-days" (Tangke 2010). The standardization of fishing gear into a standard unit of standard fishing gear can be done as follows: the standard capture tool used has the largest CPUE and has a value of capture power factor (fishing power index, FP1) equal to 1. FPI values can be obtained through the following equations (Gulland 1983):

$$CPUE_i = \frac{C_i}{f_i} \quad r = 1, 2, 3, \dots P$$

$$CPUE_s = \frac{C_s}{f_s} \quad s = 1, 2, 3, \dots Q$$

$$FPI_i = \frac{CPUE_i}{CPUE_s} \quad i = 1, 2, 3, \dots K$$

Where:

P = Standardized fishing gear

Q = Standard fishing gear

K = Type of fishing gear

$CPUE_r$ = Total catch (catch) per catch effort (effort) from r fishing gear that will be standardized (tons/trip)

$CPUE_s$ = Total catch (catch) per catch effort (effort) from fishing gear s which is used as a standard (ton/trip)

FPIi = Fishing power index of i capture devices (standardized and standard capture devices)

<u>Analysis of standard effort</u>. FPIi value is used to calculate the total standard effort with the equation:

$$E = \sum_{i=1}^{n} FPI_i E_i$$

Where:
E = Total effort or number of capture efforts from standardized fishing gear and standard fishing gear (trip)
E_i = Effort from standardized fishing gear and standard fishing gear (trip)

MSY and F opt analysis. Estimates of the potential of capture fisheries resources are based on the number of fish catches landed in an area and variations in fishing gear per trip. The estimation procedure was carried out by the Schaefer (1954) model. Calculation of CPUE (catch per unit effort) aims to determine the value of the catch rate of fishing efforts based on the distribution of catches to effort, (Rahmawati et al 2013) with the equation:

$$CPUE_n = \frac{Catch_n}{E_n}, n = 1, 2, 3, \ldots M$$

Where:
$CPUE_n$ = Total catch per effort that has been standardized in year n (tons/trip)
Catch = Total catch in year n (tons)
E_n = Total effort or the number of catch attempts from standardized fishing gear with standard fishing gear in year n (trip)

Schaefer model. The Maximum Sustainable Yield (MSY) can be estimated from the following input data:

f (i) = year effort i, i = 1, 2, ..., n
Y / f = catch (in weight) per unit effort in year i.

The simplest way to express catch per unit of effort (Y / f) as a function rather than effort (f) is the linear model suggested by Schaefer (1954). MSY and F-Opt for Schaefer's model (1954) are:

$$MSY = \frac{a^2}{4b}$$

$$F(Opt) = \frac{-a}{2b}$$

Where:
a = Intercept
b = Slope

Values a and b are obtained by analyzing the effort-standard as a free variable (X) and the CPUEi value = Yi / Fi as a non-free variable (Y) so that the obtained equation is:

$$Y = a + bx, or \frac{Y_i}{F_i} = a + b^* f(i), if\ f(i) \leq -\left(\frac{a}{b}\right)$$

Determining the utilization rate of the catch was calculated using the following formula (Simanungkalit 2007 in Cahyani et al 2013):

$$Utilization\ Level = \frac{Catch}{MSY}\ x\ 100\%$$

Results and Discussion. Judging from the existing data the most dominant fishing gear in the number of crab production is Gil net, followed by Trap and Danish seine. Data on *P. pelagicus* crabs production at Karangantu AFP can be seen in Table 1.

Table 1

Production of *Portunus pelagicus* crabs in Karangantu AFP

No	*Fishing gear*	*Portunus pelagicus production (kg/year)*										*Total*
		2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	
1	Gill net	20.309	21.426	29.754	29.483	34.166	27.953	22.634	61.052	89.019	40.769	411.741
2	Danish seine (Dogol)	7.450	21.588	800	1.217	614	2.161	6.073	5.381	1.174	19	51.419
3	Lift net	7.138	1.906	63	404	7.776	574	156	6.289	1.134	784	35.862
4	Danish seine (Payang)	921	537	-	-	15	8	-	-	-	16	2.099
5	Guiding barriers (Sero)	8.072	3.288	2.259	4	4	46	92	18	19	-	13.802
6	Bottom gill net	39.200	426	382	387	218	275	-	216	-	-	41.104
7	Traps	-	30.032	37.740	32.059	36.508	43.578	28.591	26.556	26.469	15.377	276.910
	Total	83.090	79.203	70.998	63.554	79.301	74.595	57.546	99.512	117.815	56.965	832.937

Catch per unit effort. CPUE was obtained from periodic data (time series) from production and fishing efforts to estimate biological parameters and technological parameters of the bioeconomic model. After standardization of fishing gears, the standard fishing gear is Danish seine. The standard CPUE value can be seen in Table 2.

Table 2

CPUE value

Year	*Production (kg)*	*Standard effort (Trip)*	*Standard CPUE (kg/Trip)*
2008	83.090	9.994	8,314
2009	79.203	12.809	6,183
2010	70.998	24.239	2,929
2011	63.554	21.133	3,007
2012	79.301	22.426	3,536
2013	74.595	19.056	3,915
2014	57.546	15.135	3,802
2015	99.512	14.206	7,005
2016	117.815	14.796	7,963
2017	56.965	13.947	4,084
Total	782.579	167.741	50,739
Average	78.258	16.774	5,074

Source: Karangantu AFP fisheries production data 2017.

The highest CPUE occurred in 2008 amounting 8.3 kg/trip, this happened because in 2008 the catch obtained was 83,090 kg with fishing effort of 9,994 trips, while the lowest CPUE occurred in 2010 amounting to 2.9 kg/unit, this happened because in 2010 the catch was 70,998 kg with a fishing effort of 24,239 units. The CPUE of *P. pelagicus* crab resources landed in the Karangantu Archipelago Fisheries Port within 10 years (2008-2017) experienced fluctuations in increase and decrease as shown in Figure 1 and Figure 2.

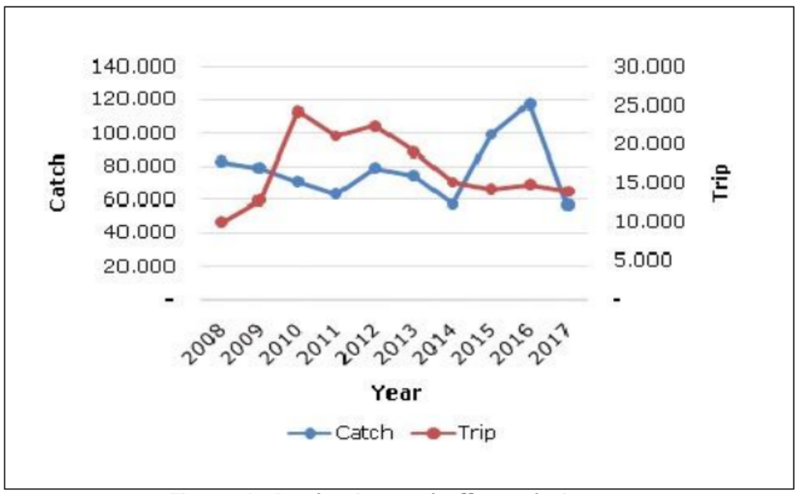

Figure 1. Production and effort relations.

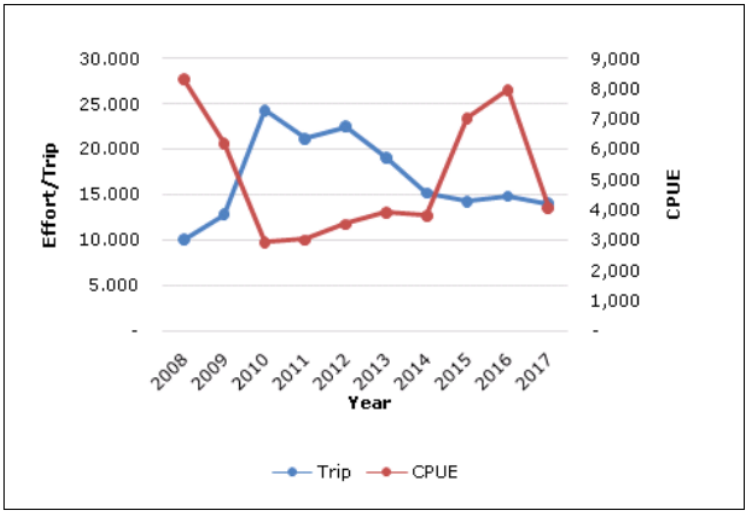

Figure 2. CPUE and effort relations.

Based on the regression analysis between effort and CPUE the intercept value (a) = 10.9749 and the slope value (b) = -0.0004 was obtained. From these results the optimum effort value (fopt) and maximum potential (MSY) can be obtained.

Maximum fishing effort (fopt) is the amount of fishing effort carried out by the arresting unit, in order to obtain maximum catch without damaging the sustainability of fisheries resources in the waters. After calculation, the optimum capture effort (fopt) value is 15,598 trips/year (Figure 3).

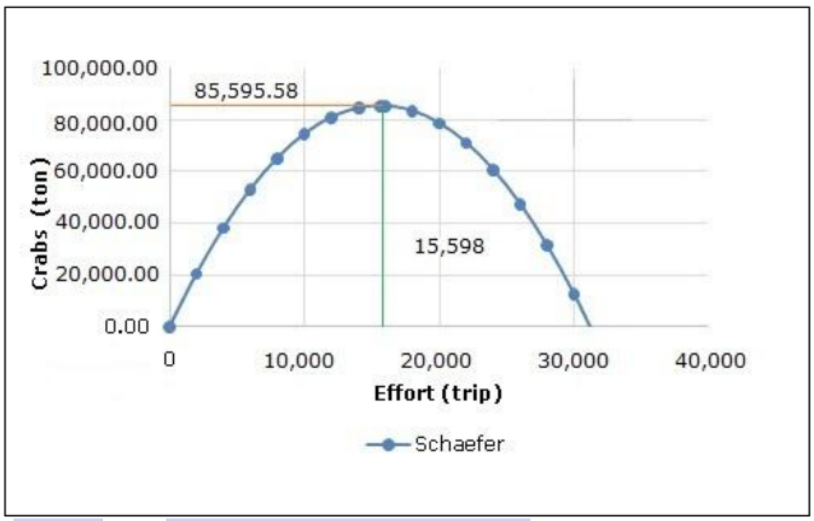

Figure 3. The maximum sustainable yield (MSY) for *Portunus pelagicus*.

The maximum sustainable yield (MSY) is the amount of fish that can be captured continuously from a resource without affecting the sustainability of the fish stock. MSY is used to find out the fish resources used, to determine the level of resource utilization by estimating the fluctuations in the abundance of a type of fish and describing fish biomass in waters. The MSY value obtained was 85,596 kg (Figure 3). This value is a limit where fish resources can still be utilized without disturbing its sustainability. By knowing the optimum fishing effort value and MSY value, the average utilization rate from 2008 to

2017 is 91%. This means that fishing efforts have exceeded the sustainable potential that should be allowed to be captured, which according to Bafagih (2014), the use of fisheries resources above 80% does not support the sustainability of these resources.

Based on the production data and the number of trips in the Karangantu AFP, the data shows that there are years where the value of production and the number of trips have exceeded the MSY limit and the optimal effort (Fopt). For example, from 2010 to 2013 the level of utilization or effort (trip) in utilizing crab resources exceeds optimal effort so that the yield on the production is less than in the years before and after, where the level of utilization or effort carried out is still below optimal line of effort (Fopt) (Figure 4).

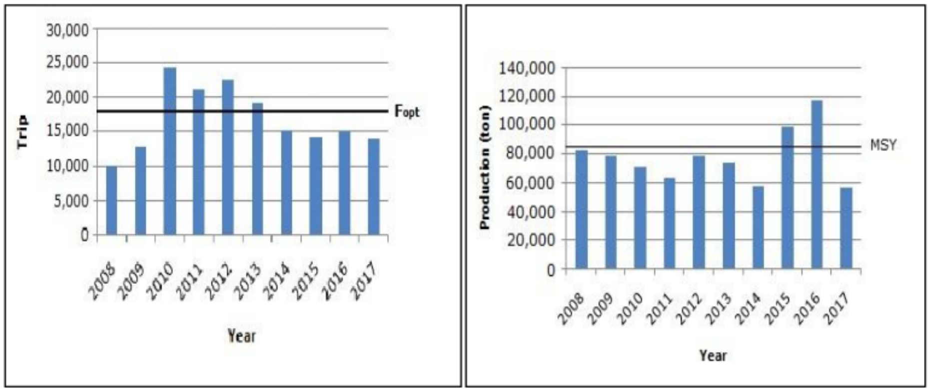

Figure 4. Production and crab catch effort in the period of 2008-2017.

Conclusions. The MSY of *P. pelagicus* crab resources according to the Schaefer's analysis was 85,596 kg/year with optimal efforts of 15,598 trips. When compared with the available data, the *P. pelagicus* crab resources looks like has been overfished since 2010. This is evidenced by the high amount of effort but does not produce a high amount of production or yield. Therefore the *Portunus pelagicus* utilization management need to be regulated and closely monitored, so that these resources can be utilized sustainably.

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