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Sustainable catching analysis of cakalang (*Katsuwonus pelamis*) in Pantar strait waters, Alor Regency East Nusa Tenggara Province

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Abstract
Decreased catches and changes in the composition of natural resources have pushed the ministry to make efficiency efforts in the form of increasing shipbuilding, capture technology, and fishing assistance tools which are in common aimed at increasing fishing capacity. The purpose of this study was to determine the maximum catch of skipjack (*Katsuwonus pelamis),* to find out the optimum efforts in the utilization of skipjack (*Katsuwonus pelamis)* and formulate the relationship between maximum catch and optimum utilization of skipjack *(Katsuwonus pelamis)* in the Pantar strait waters and surrounding data. The procedure for collecting data in this study is in the form of capture data for 9 (nine) years, namely from 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013 and 2014. Analysis of the data used is the calculation of surplus production in the form of catch of business unit or CPUE (*catch per unit effor),* analysis of the alleged sustainable potential of MSY (*Maximum Sustainable Yield),* namely to find out the potential for sustainable potential, analysis of catches allowed for *Total Allowableatch* (TAC) or (JTB) and calculation for utilization opportunities and development opportunities. The results showed that the catch per unit effort (CPUE) was at position 219.3, namely in 2011 with a total production of 73.1 tons / kg and the lowest catch at the position of 49.59 i.e. in 2006 with a total production of 7, 08 ton / kg. The maximum sustainable catch (MSY) based on the Schaefer model obtained a value of 33.33 tons, the average utilization rate from 2006 to 2014 obtained a value of 3.89%. The total catch allowed by *Total Allowable Catch* (TAC) is 19.19%.

Keywords: cakalang fish, sustainable catching

Introduction

The potential of marine resources in Indonesia has been utilized in various economic activities of the community where one of them is capture fisheries, capture fisheries are the most common activities compared to other marine resource economic activities. Fish resources are marine potential that are renewable common property, this enables everyone to have the right to exploit and exploit these resources because people's views assume that fishing is not a major factor in declining fish populations, this means that the amount of fish stocks available in the waters, Desniarti *et al.,* [1]. Pantar strait waters are one of the regions that are distinctive and have great marine and fishery potential, but exploration of resources is still inadequate and requires professional and integrated management to be able to ensure the sustainability of fisheries development in the Pantar strait waters well, so that sustainable use will occur and still maintain the sustainability of existing resources. According to Tuli M *et al*., [2] broadly the fisheries sector is the main livelihood for coastal communities, but there is still a lack of utilization of technological systems so that most of the potential of existing fisheries has not been utilized properly, it has an impact on the potential that is not in accordance with the production achieved so far. In general, the activity of catching skipjack (*Katsuwonus pelamis*) in the Pantar strait waters uses *Handline* in fishing for skipjack (*Katsuwonus pelamis*), one of the obstacles in catching skipjack (*Katsuwonus pelamis*) is the weak information of *fishing ground* both spatially and temporal.

The changing global climate conditions make it increasingly difficult to determine the *fishing ground* of skipjack (*Katsuwonus pelamis*), so that catching skipjack (*Katsuwonus pelamis*) becomes less effective and efficient (time and fuel). According to Sala, R. 1999 in D, Rosalina *et al.*, [3] fishing activities will be more efficient and effective if *fishing ground* fish can be predicted beforehand, before the fleet departs from the *fishing base*.

The activities of catching skipjack (*Katsuwonus pelamis*) have developed in Indonesian waters, especially the waters of Eastern Indonesia since the early 1970s. According to Dahuri [4] the decline in catches and changes in fish resource composition, has encouraged fishermen to make efficiency efforts in the form of increasing ship power, fishing technology, and fishing aids all of which aim to increase fishing capacity. Parente J, [5] said that the importance of information about the CPUE relationship to be able to estimate the catch capacity and fishing effort of the fishing fleet was used. The purpose of this study was to determine the maximum catch of skipjack (*Katsuwonus pelamis*), to determine the optimum utilization skipjack (*Katsuwonus pelamis*) and formulate the relationship between the maximum catch and the optimum effort to use skipjack (*Katsuwonus pelamis*) in the Pantar strait waters and its surroundings.

Materials and Methods

1. Tools and Materials

The tools used in this study were stationery, digital cameras for documentation. While the material used in this study was catch fisherman questionnaire data, and data from relevant agencies.

2. Methods

Collection Methods collection methods used in this study consisted of primary data and secondary data:

a. Primary Data

Data is obtained by following direct capture operations. To get the primary data, several activities were carried out, namely: Preparation of this activity in the form of a preliminary study in the form of literature studies, field observations, consultation with several fishermen and preparing all equipment supporting research activities.

b. Secondary Data

Data obtained through the source of the annual statistics of the Alor Regency Fisheries and Marine Services include data from the last few years of the Alor Regency Marine and Fisheries Service.

3. Data analysis

1. Method of surplus production is a method of catching businessor CPUE (Unitscatch per unit effort) that is as an index of relative abundance and can be obtained by the amount of bio mass transfer and estimated potential of a species or species using linear regression formula by Gulland 1983 in Helmi *et al.,* [6] namely:

$$Y = a + bx$$

Where:
y = catch (Ton / year)
a and b = catch perunit effort with total effort.
X = Number of fishing gear per unit.

2. An analysis of the alleged sustainable potential of MSY (Maximum Sustainable Yield) is to determine the alleged sustainable potential. MSY (Maximum Sustainable Yield) or sustainable maximum catch is the highest number of fish stocks that can be captured continuously from an existing potential without affecting the preservation of fish stocks, namely using formulas according to Schaefer 1957 in Helmi *et al.*, [6]:

$$MSY = \frac{a2}{4b}$$

Where:
a and b are perunit catches of effort with total effort.

3. The catch allowed is *Total Allowableatch* (TAC) or (JTB). Amount of Catch allowed. *Total Allowable Catch* (TAC), which is the maximum amount or weight of fish in a stock that can be taken by catching without disturbing the sustainability of the stock in a certain area. This means that the number of fishing in an area needs to be known first and then it will be possible to determine the *Total Allowable Catch* (TAC) of a particular type of fish, namely using the formula from FAO 1995 in Sharif A *et al*., 2009 [7]:

TAC = Potential X 60 - 80%

4. Opportunities for utilization and development opportunities. Utilization of fisheries resources, especially marine fisheries, is still dominated by small-scale fisheries, which generally have small scale business characteristics, using simple technology, limited fishing coverage around the coast and relatively low productivity. Calculation of utilization rates using the formula from FAO 1995 in Sharif A *et al.,* 2009 [7]:

$$\frac{Ptt}{NJTB}\ X\ 100\%$$

Where:
Ptt = Last year's production.
Njtb = Value of catch allowed.
Development opportunities with the formula:
100 - Level of utilization

Results and Discussion

Production surplus (CPUE)

The results of calculation of data of skipjack fishing (*Katsuwonus pelamis*) obtained CPUE results as in table 1.

Table 1: Maximum catch, optimum effort and CPUE

No	Tahun	Total Produksi (Ton)	Total Effort (f)	CPUE
1	2006	7,08	49,59	14,28
2	2007	7,14	49,99	14,28
3	2008	2,14	96,70	2,22
4	2009	15,25	106,79	14,28
5	2010	15,97	111,80	14,28
6	2011	73,1	219,3	33,33
7	2012	28,21	112,86	25
8	2013	14,10	112,86	12,5
9	2014	1,29	112,85	1,14

The development of actual fishing business is inseparable from the various economic forces that influence, fishing costs and fish prices are two factors that determine the development of Setyawan's capture fisheries industry [8]. The existence of a profit which is a surplus from the acquisition of a fishing business encourages fishermen to develop their fishing fleet. Furthermore, according to Purwanto, 2003 in Nurhayati A, [9] it is said that currently fishing efforts are still relatively low, an increase in fishing efforts must be followed by an increase in maximum catch . According to Parente J [5] the value of CPUE illustrates the level of productivity of the *effort*, the higher CPUE value indicates that the productivity level of the fishing gear used is also higher, the contribution of fishing efforts in terms of fishing trips and fishing fleets used is expected to achieve value CPUE is appropriate. Based on the results table, it can be seen that productivity is not stable when compared to catching effort, it will reduce the catch. This shows that not always adding a fishing gear will increase production as the following mention here figure 1 and figure 2.

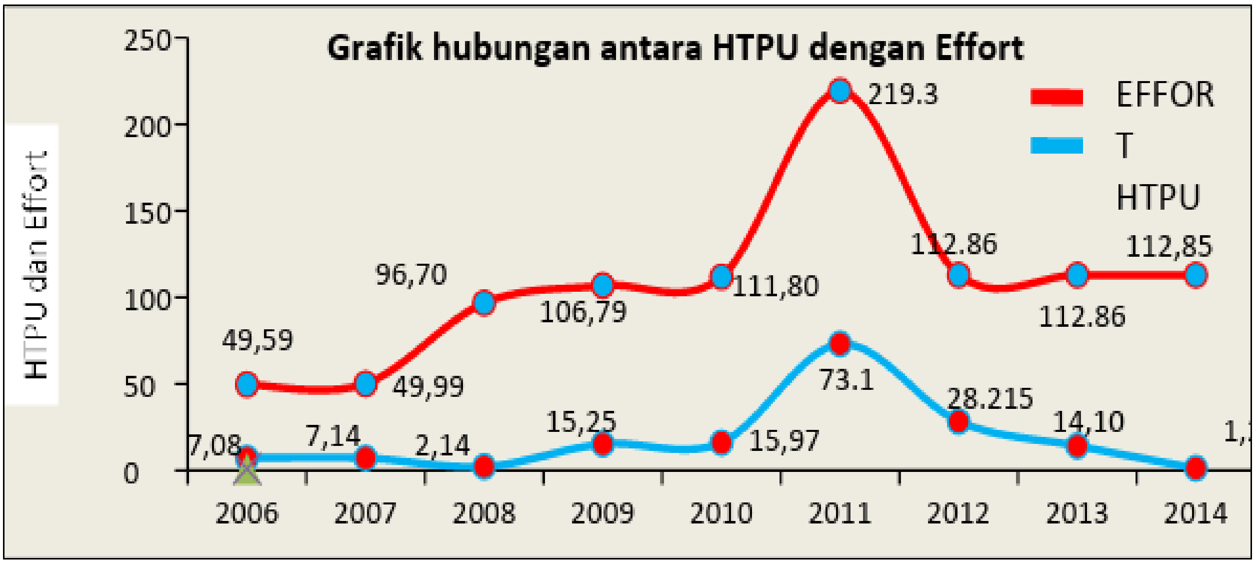

Fig 1: Graph of the relationship between catch (*Catch*) and effort (*Effort*) per year

Based on the graph of the relationship between catch (*Catch*) and catching (*Effort effort*) can be seen that the increase in catch occurs to a certain point, namely when the fishing effort is at position 219.3, which is in 2011 with total production or catch of 73.1 (Ton / Kg) and the lowest catch at position 49.59, namely in 2006, with total production or catch of 7.08. If the *effort (total effort) is* increased the catch will still not increase or even decrease. The catch decreases even though fishing efforts are raised, presumably due to a combination of a number of stock indicators such as decreasing CPUE, decreasing total catch, decreasing average fish weight and ecosystem indicators, resulting in changes in age structure / size structure even changes in species composition in the pollution. The results of the Siahainenia study [10] state that fishing operations can be carried out throughout the year, namely in the western season (February –Mei) and in the east monsoon.

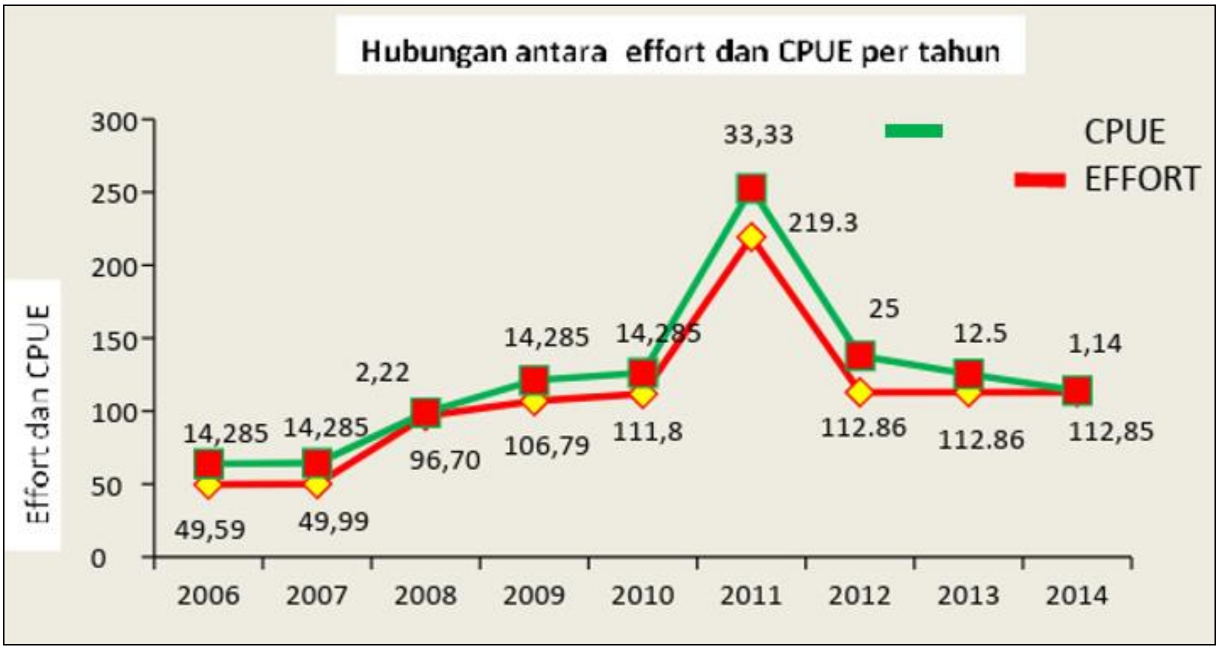

Fig 2: Graph of the relationship between *effort* and CPUE

Graph above can be explained that the increasing effort of catching, the catch per unit effort will be higher, it can be seen that the *effort* has increased from 2006 to 2011 and after it declined in the following year, namely in 2012 until 2014. Unlike the *effort*, the catch per unit effort (f) experienced the same thing, so it can be concluded that the increasing effort of catching or decreasing fishing effort, the catch per unit effort is the same as CPUE value.

According to the rising CPUE trend is a picture that the level of exploitation of fish resources can be said to be still at the developing stage. It is necessary to know the relationship between the value of CPUE and *effort*. The regression calculation results, the correlation between CPUE and *effort* shows a positive relationship, namely the higher the *effort*, the CPUE value is also high and vice versa, it needs to know the relationship between CPUE and *effort,* from the regression calculation, the correlation between CPUE and *effort* shows a positive relationship. That is, the higher the *effort,* the higher the CPUE value. A positive correlation between CPUE and *effort* indicates that the productivity of skipjack fishing gear with kite fishing rods will increase if the *effort* increases. The similarity between the effort to catch and CPUE is obtained: CPUE = 182.95 + 0.357 from the equation, it is known that each additional *effort* of one unit of kite fishing line will increase CPUE by 182.95 kg.

Analysis of sustainable potential predictions (MSY)

Based on the equation c = 182.95 + 0.357 the optimum effort value can be obtained, i.e the optimum level of effort to catch skipjack fish is 73.1 units per year as presented in table 1. The MSY value is 33, 33 tons which is a boundary where the tuna fish resources can still be utilized without disturbing their sustainability to breed and maintain their offspring or in other words have not reached overfishing (Overfishing). This is based on Widodo and Suadi's opinion [11] which states that overfishing will occur when the level of fishing effort in a particular fishery exceeds the level needed to produce MSY, so that it requires an increase in fishing efforts to obtain optimum catch. But fishing efforts must be managed carefully so that the available resources can be balanced and there is no overfishing. According to Sobari *et al*., [12] depletion of stock due to the excessive amount of effort will threaten the aquatic resources of the fishing area and can result in a decrease in the welfare of the fishermen themselves. In addition, Desniarti *et al.,* [1] and Dahuri, R. [13] also stated that fish resources are renewable resources, but that does not mean that they are not infinite so that if not managed carefully, it will have a negative impact on the availability of fish resources and the environment. According to Kawimbang E, *et al*., [14], the principle of MSY is that if the production level experiences a surplus, it will not interfere with the sustainability of the stock of existing fish resources, this means that the Cakalang fishing effort will remain sustainable if the catch does not exceed MSY.

Optimumor optimum *effort effort* is an fishing effort that can be carried out by a fishing gear unit to obtain optimal catch without damaging the sustainability of the fish resources. MSY or maximum sustainable catch is the highest number of fish stocks that can be captured continuously from a potential that exists without affecting the sustainability of the fish stock. By knowing the value of MSY, the level of utilization of a fish resource is expected not to exceed its MSY value so that the sustainability of the resource can be maintained, in other words the optimal number of catches needs to be known so that each fishing effort does not harm the sustainability of the resource. The benefit of estimating the optimum level of fishing effort is that loss of time, energy and fishing operation costs can be minimized and the fishing effort undertaken is expected to always achieve optimal results. In order for the fishing effort to be optimum, it is necessary to allocate the number of fishing units according to the fishing area and the fishing season. Supadiningsih and Rosana [15] said that the spread of skipjack (*Katsuwonus pelamis*) of ten follows the spread or circulation of convergence line currents between cold currents and hot currents which are rich in organisms and are thought to be excellent ground fishing for skipjack fisheries (*Katsuwonus pelamis*).

Permissible catch results (TAC)

According to Dahuri, R. [4], the TAC is 80% of the maximum sustainable potential (MSY), the results of the study indicate that total arrests allowed indicate TAC = 33.33 X 60 - 80% = 19, 19% of this shows that the capture of Cakalang Fish in the waters of the Pantar Strait is still for 9 years to be exploited again. The aim of the TAC shows that it is not only an effort to control the catch but also indirectly controls the level of fisheries exploitation. According to Hilborn and Walters [16] the management strategy is the determination of the number of catches that can be taken from the amount of fish stock each year by considering the economic and social conditions of fishermen.

The utilization opportunities and development opportunities

Optimum value of fishing effort and MSY value can be identified. The average utilization rate from 2006 to 2014 obtained a value of 3.89%. This means that the fishing effort can be increased by sustainable potential which should be allowed to be captured using fisheries resources below 80% to support the sustainability of these resources. The opportunity to use Cakalalng fishing is 96.10%, which means that the opportunity to develop Cakalang fishing needs to be improved.

Conclusion

Conclusion of this study is the catch per unit effort (CPUE), which is the capture effort at position 219.3, which is in 2011 with total production or catch of 73,1 (Ton / Kg) and the lowest catch at position 49, 59 which was in 2006 with total production or catch of 7.08 Ton / kg. The maximum sustainable catch (MSY) based on the Schaefer model was a value of 33.33 tons which is a boundary where the tuna fish resources can still be utilized without disturbing its sustainability to breed and look after their offspring. The average utilization rate from 2006 to 2014 obtained a value of 3.89%. This means that efforts to catch skipjack (Katsuwonus pelamis) can be increased in the Pantar strait waters and sustainable potential that should be allowed to be captured, because the utilization of fisheries resources is below 80% supporting the sustainability of these resources, thus fishing efforts still need to be increased as long as they do not exceed MSY value is available. Allowed *Total Allowable Catch* (TAC) is 19.19% so it can be concluded if the number of catches allowed is smaller than the MSY value, the number of catches of tuna that is allowed is still in the low category so that the catch can still increased, but does not exceed the limit of sustainable optimum catch.

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