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Lantun P Dewanti
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

M Rudyansyah Ismail
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Achmad Rizal
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Alexander Khan
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Sri Fitriah Rahmaningrum
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Izza M Apriliani
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Corresponding Author:
Lantun P. Dewanti
Faculty of Fisheries and Marine Ssciences Universities Padjadjaran, Bandung-Sumedang Street KM 21 Sumedang, West Java, Indonesia

Stock assessment of hairtail fish (*Trichiurus* spp) Landed in pangandaran, West Java

Lantun P Dewanti, M Rudyansyah Ismail, Achmad Rizal, Alexander Khan, Sri Fitriah Rahmaningrum and Izza M Apriliani

Abstract
This reaserch analyzed of hairtail fish (*Trichiurus* spp) resoure exploitation of fisheries management of gordon shaefer model. The data was was analyzing by using quantitative desriptive analysis and surplus production Gordon Schaefer analysis. This reaserh used seondary data secondary data was obtained from time series data period 2001-2014 about prodution data capture fisheries and fishing effort in Pangandaran waters. The result showed effort of Maximum Sustainable Yeild (MSY) is 4657 trip/years and produtions aproximately 670,71 tonnes/years the number of catches allowed at 536.57 tonnes/years

Keywords: Hairtail fish (*Trichiurus* spp.), sustainable potential, pangandaran

Introduction
Potential fish resources in Pangandaran Regency consist of crustaceans, demersal fish, large pelagic fish, and small pelagic fish. There are five main commodities that have high economic value, namely shrimp, lobsters, white pomfret, black pomfret, and hairtail. As many as 54% of demersal fish production is hairtail fish [1].
Hairtail fish is one of the important demersal fish species [2]. Hairtail fish are widely distributed in the Indo-Pacific and Atlantic waters [3]. According to Muhammad, *et al*. (2017) hairtail fish over a period of 10 years has slowly become the dominant marine commodity.
Information about fish resources can help policymakers to consider objectively management options in allocating fish resources efficiently [4]. Analysis of sustainable potential can make policymakers easier to determine policies for the management of hairtail fish resources. Quantitative fisheries information is very much needed for fisheries development planners either now or in the future. Thus the hairtail fish resources can be optimally used and also maintained its sustainability.
The purpose of this study is to analyze the sustainable potential of hairtail fish (*Trichiurus* spp.) In Pangandaran.

Materials and Methods
The research was conducted for three months, starting from August-October 2018, located in Pangandaran Regency, West Java.
This study used a survey method, the survey method is a direct investigation that aims to get the facts of the symptoms that exist and look for factual information [5]. The data used in this study are secondary data. The secondary data obtained from the Fisheries and Maritime Affairs Office of Pangandaran Regency, which covers production data and Time-series capture efforts (2010-2014). The used data is secondary data in the form of time series data of hairtail fish production from Analysis of the sustainable potential of hairtail fish (*Trichiurus* spp.) which processed using Microsoft Excel.

Data Analysis
Fishing Gear Standardization
There are various types of fishing gear, one of the fishing gear can be used as standard and the other fishing gear can be standardized by that standard fishing gear. In choosing a standard fishing gear.

In choosing a standard fishing gear it can be seen from the highest production values. Fishing gear standardization uses the formula of Sparre and Venema (1999), as follows:

$$U_i = \frac{Ci}{fi} \qquad U_s = \frac{Cs}{fs}$$

With a standard fishing power index (FPI_i) equal to 1 then:

$$FPI_i = \frac{Ui}{Us}$$

Information
Ui = CPUE i-fishing gear unit
Us = CPUE standard fishing gear unit
Ci = Value of i-fishing gear production
Cs = Production value of standard fishing gear
fi = Effort fishing gear i
fs = Effort standard fishing gear
FPIi = Fishing Power Index i-fishing gear
FPIs = Fishing power index of standard fishing gear

Maximum Sustainable Yield (MSY)
Analysis of maximum sustainable production is carried out by estimating the maximum sustainable yield (MSY) using the data from catch production and fish catching efforts by using the Schaefer model. In analyzing using the Schaefer model, the values of slope (β) and intercept (α) are required. Slope (β) and intercept (α) values are obtained from the linear relationship between CPUE and Effort (f). In the equilibrium state, to determine the optimum estimate effort is using the equation as follow:

$$E_{opt} = {}^{1}/_{2}\ (\alpha/\beta)$$

Estimate the maximum sustainable production (MSY) in equilibrium conditions as an indicator of the potential of sustainable capture fisheries resources using the equation as follow:

$$MSY = {}^{1}/_{4}\ (\alpha/\beta)$$

Information
Eopt = Effort optimum
α = slope
β = intersep

Utilization Status
Calculating the status of utilization is using the following formula:

$$\text{Utilization rate} = \frac{Ci}{MSY} \times 100\%$$

Information
Ci = Current number of catches
MSY = Maximum Sustainable Yield

3. Results

The production surplus model is a method that makes it easier to estimate fish stocks. The use of the Schaefer model is to determine the value of the optimum effort that can be used without disturbing and affecting stock productivity in the short term or long term or can be called the maximum sustainable yield (MSY).
Fishing Gear Standardization
Hairtail fish in Pangandaran were caught using a variety of fishing gear. The Table shows the results of the standardization of fishing gear that caught hairtail fish.

Table 1: Fishing Gear Standardization Results

Fishing Gear	C	E	CPUE	FPI
Fixed Longline	4136,52	749303,00	0,00552049	0,012861568
Bottom Trawl	1314,43	262645,00	0,005004588	0,011659625
Beach Seine	764,96	58177,00	0,013148839	0,030633997
Purse Seine	752,00	1752,00	0,429223744	1
Clit Net	690,41	11513,00	0,059967862	0,13971236
Fixed Gill Nets	14260,97	1024423,00	0,013920978	0,032432917
Tremmel Nets	1966,68	389302,00	0,005051811	0,011769644
Lift net	278,13	41826,00	0,006649692	0,015492367

Accordance with Table 1, ring trawl is a fishing gear that is determined as standard fishing gear. This is because ring trawl has a fishing power index or fishing power index (FPI) equal to one.

Catch Per Unit Effort (CPUE)
Following the standardization of fishing gear, the following graph is the relationship between hairtail fish production and laying fish-catching efforts from 2001-2014 presented in Figure 1.

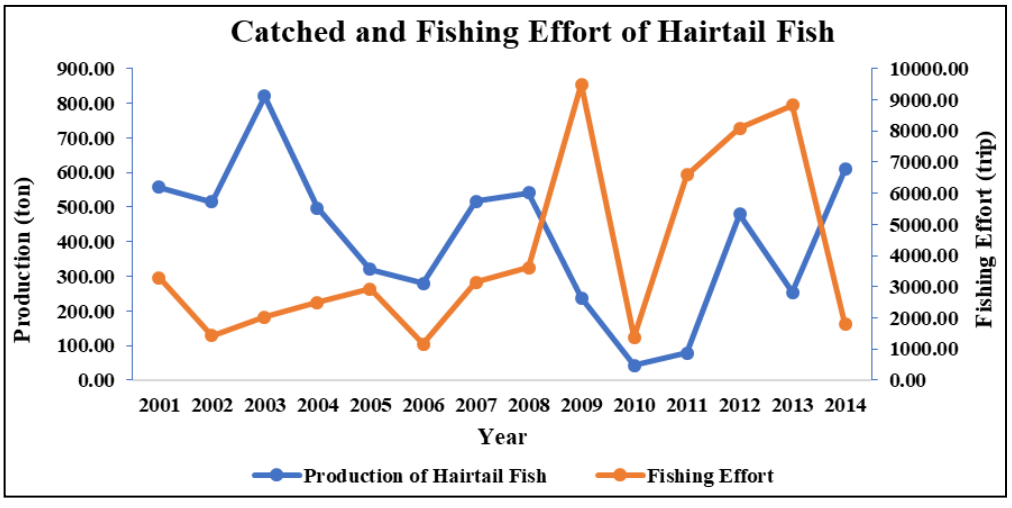

Fig 1: Catching Results and Efforts to Catch Hairtail Fish in Pangandaran

Based on figure 1 shows that the catch and fishing effort of hairtail fish in Pangandaran have fluctuated. The highest catch occurred in 2003, amounting to 820.20 tons while the lowest catch was in 2010 with a catch of 42.50 tons. The highest catching efforts that occurred in 2009 with 9505.07 trips while as the lowest trips were in 2006 with 1161 trips.

The data of hairtail fishing efforts can be analyzed by calculating the value of catch per unit effort (CPUE) of hairtail fish. CPUE calculation is used to determine the level of productivity of the fishing gear. Catches every fishing effort of hairtail fish presented in Figure 2 as follows.

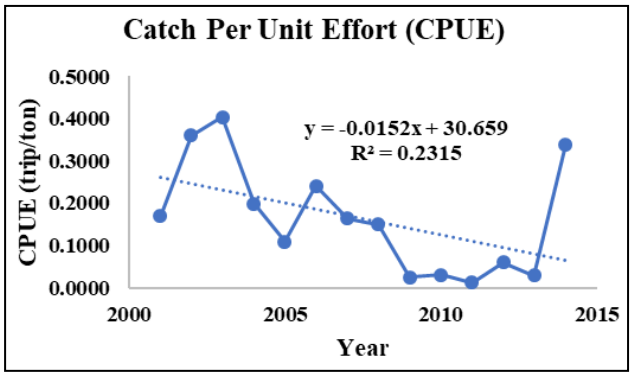

Fig 2: The Curve of Catch Per Unit Effort (CPUE)

Figure 2 shows that the catch per attempt was highest in 2003 and the lowest in 2011.

Relationship between Catch Per Unit Effort and Effort

In assuming the maximum sustainable yield (MSY), carried out by analyzing the relationship between the capture effort and the catch per attempt (CPUE).

CPUE value describes the stock of hairtail fish that in nature, while effort is an effort to capture the resources of hairtail fish. Based on the CPUE and effort relationship curve shows a linear relationship with a coefficient of determination of 47%.

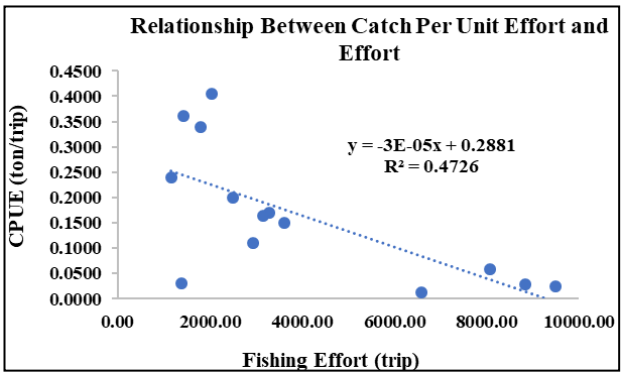

Fig 3: The curve of relation between CPUE and cathing effort

Based on Figure 3, the equation obtained from the relationship between CPUE and the effort of hairtail fish resources is y = -3E-0.5x + 0.2881. Based on the equation, the value of the intercept (a) is 0.2881 and the slope (b) is -0.0000031.

Sustainable Potential

Based on the Schaefer regression model, it's known that sustainable catches or maximum sustainable yield (MSY) and optimal capture effort (Fmsy). Information regarding the analysis of the production surplus model is presented in the following table (Table 2).

Table 2: The Result of Analysis Production Surplus Models.

Parameter	Unit	Schaefer
a	-	0,2881
b	-	-0,0000031
R^2	%	47,26
F_{msy}	Trip	4657
MSY	Ton/year	670,71
JTB	Ton/year	536,57

Table 2 is the result of an analysis of the surplus model known for the number of allowed fish catches (JTB) of 536.57 tons/year and maximum sustainable potential (MSY) of 670.71 tons/year with optimum results of 4657 trips. Information on the production surplus model is presented in Figure 4.

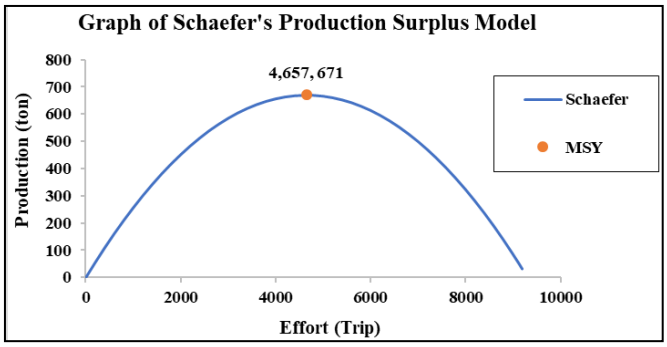

Fig 4: Production Surplus Model with Schaefer's Model

Utilization Fish Stock

The level of utilization of hairtail fish can be known after getting Cmsy value. The utilization level is calculated by the number of catches in a certain year (in percentage) against its maximum sustainable yield (MSY). The level of utilization hairtail fish in Pangandaran shown in Table 3 as follows:

Table 3: The level of utilization fish resources

Year	Production (Ton)	MSY (Ton/year)	Level of Utilization (%)
2001	557,10	670,71	83,06
2002	515,00	670,71	76,78
2003	820,20	670,71	122,29
2004	497,80	670,71	74,22
2005	320,80	670,71	47,83
2006	279,27	670,71	41,64
2007	517,12	670,71	77,10
2008	540,69	670,71	80,61
2009	238,23	670,71	35,52
2010	42,50	670,71	6,34
2011	78,59	670,71	11,72
2012	479,81	670,71	71,54
2013	253,25	670,71	37,76
2014	609,97	670,71	90,94

Accordance with Table 3, shows that the level of utilization in 2003 was excessive. The values that exceed 100% indicate that the utilization of hairtail fish resources in Pangandaran has exceeded the limits of its conservation potential. In 2014 the use of hairtail fish resources was around 90.94%.

Discussion

Fishing Gear Standardization

Fishing capacity is often estimated in terms of a number of ships, tonnage, engine power, and a number of days at sea.

Measuring fishing capacity is not an easy task, because the result depends on the number of ships, the size of ships, technical efficiency, and the time spend in fishing [6]. That's why standardization of fishing gear is needed. Based on Table 1 it's known that ring trawl is a fishing gear that determined as standard fishing gear. This is because ring trawl has a fishing power index (FPI) equal to one.

Catch Per Unit Effort (CPUE)

The effort to catch hairtail fish carried out by Pangandaran fishermen from 2001 to 2009 generally experienced an increase but in 2010 the effort to catch hairtail fish decreased to 1384 trips. However, an effort to catch hairtail fish has been reappointed to 8832 trips in 2013. In 2014 efforts to catch hairtail fish have decreased dramatically to reach 7034 trips from the previous year.

In figure 1 can be seen that the catch of hairtail fish has fluctuated. The fluctuation of hairtail fish catches is affected by several factors such as the number of fishing units operated, a fishing season of hairtail, the fishing techniques used and the availability of hairtail fish in nature.

The effort to catch each year is different because of the fishing season, in the peak season, fishermen found fish easier compared to other seasons. Fishermen will catch a lot of fish [7]. CPUE has fluctuations that tend to decrease. The decrease in CPUE of hairtail fish resources occurs due to increased fishing activities (effort).

Subsistence, commercial and tourism capture fisheries activities have an impact on population dynamics growth, carrying capacity, availability and sustainability of aquatic fish stocks regardless of environmental conditions and other external factors [8].

Relationship Between cacth per unit effort dan effort

The relation of this equation can be interpreted that if there is a fishing effort of x units per year, it will reduce the CPUE value by 0.0000031. The negative correlation between CPUE and fishing effort indicates that the productivity of fishing gear that catches hairtail fish will decrease with an increase in fishing effort. This can occur if the increased effort to catch hairtail fish is not comparable with the increasing of catch result.

Sustainable Potential

The purpose of using the production surplus model is to determine the optimum level of effort, which is an effort that can produce an optimal catch that is sustainable without affecting the productivity of fish resource stocks in the long term. The model commonly used in predicting sustainable catches and optimum catching efforts is the Schaefer model. The Schaefer model is the most commonly used model because of its simplicity [9].

MSY condition is a maximum condition of hairtail fish resources that can be caught without disturbing its sustainability to grow back. If the actual catch of hairtail fish is greater than the MSY condition, it will cause the catch of hairtail fish to become unsustainable.

Accordance with the result of the research, known value (MSY) of hairtail fish from 2001-2014 amounted to 670.71 tons/year. According to Gulland (1983) MSY is the most balanced catch that can be maintained all the time at a certain fishing intensity which causes the biomass of fish stocks at the end of a certain period to be the same as the biomass stocks at the beginning of that period. Based on this statement, the amount of biomass of hairtail fish in Pangandaran that can be utilized annually is 670.71 tons.

JTB number shows that the amount of fish that can be utilized hairtail equal to 80% of the potential for sustainability, with attention to the preservation of the species through recruitment (Setyohadi 2009). JTB value of hairtail fish in Pangandaran is 536.57 tons/year. The JTB value is calculated based on the assumption of maximum utilization of 80% of the MSY value. With a JTB value of 536.57 tons/year, 20% or 134.14 tons/year of MSY hairtail fish can regenerate in Pangandaran.

Utilization status

This shows that hairtail fish resources has already reached fully exploited conditions, Hairtail fish in the fisheries management area of the Republic of Indonesia based on KepMen No.45 of 2011 the condition is still in Moderate condition but in 2014 its utilization status has experienced fully exploited, if catching hairtail fish in Pangandaran are not treated carefully it can lead to overfishing condition.

Conclusions

Potential of hairtail fish resources based on the Schaefer production surplus model obtained has MSY value of 670.71 tons/year and the optimum fishing effort of 4657 trips/year with utilization rates of 90.94%.

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