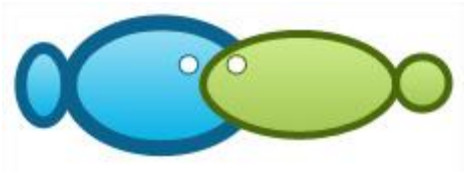

Sustainable potential of threadfin bream *Nemipterus japonicus* in Brondong, East Java, Indonesia

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Abstract. Threadfin bream *(Nemiperus japonicus)* is one of the leading commodities in Brondong Archipelagic Fishing Port (AFP). This study aims to determine the sustainable potential, optimum efforts and utilization rates of *N. japonicus* in Brondong AFP, East Java. The data used are secondary data obtained through the annual statistical report (2013-2017) Brondong AFP covering catch data and efforts to catch *N. japonicus*. Sustainable potential was analyzed using the Schaefer Model. The results of data analysis showed that the sustainable potential of *N. japonicus* in Brondong waters was 20,730,325.97 kg/unit with optimum efforts of 532 cantrang "Danish seine" units. Based on the total allowable catch (TAC) which is equal to 80% of the MSY value, it can be concluded that the catches of *N. japonicus* on Brondong waters are still below of the total allowable catch (TAC).
Key Words: stock assesment, maximum sustainable yield, utilization fisheries resources, danish seine

Introduction. Indonesia is an archipelagic country that has a fairly wide water area. Indonesia's marine waters and Exclusive Economic Zone (EEZ) have fish resources consisting of various species (multi-species) and are one of the natural resources that can be used for people's prosperity (Fatmawati et al 2015). One of the areas that is a center of fisheries or marine fisheries production area is Lamongan.

Lamongan is a district that contributes to the fisheries sector of 15-25% of the total fish production in East Java. Archipelagic Fishing Port (AFP) Brondong has a very strategic role in the business of developing capture fisheries, namely as the center of marine fisheries activities, especially in Lamongan Regency (Apriliani et al 2015).

Based on AFP Brondong data (2013-2017), one of the dominant commodities in AFP Brondong is the threadfin bream *(Nemipterus japonicus)*. *N. japonicus* is one of the economically important fish from the Nemipteridae tribe (Oktaviyani et al 2016). *N. japonicus* landed at AFP Brondong has a price of 2.55 USD/kg. *N. japonicus* landed at AFP Brondong is captured with cantrang "Danish seine". Cantrang is a type of fishing gear that is predominantly used by fishermen based in the Brondong Archipelago Fisheries Port (AFP) (Riyanto et al 2011).

An increase in the number of *N. japonicus* production in Brondong waters is feared to cause overfishing or a decrease in the number of catches in the following year. The occurrence of overfishing and extinction of stocks will certainly be an important problem in fisheries development. Therefore, there is a need for good management so that these resources can be utilized sustainably.

Utilization of fish resources correctly will be able to provide optimum support for fisheries development in Indonesia to run sustainably as part of National Development

(Purwanto & Wudianto 2017). One step that needs to be done is to conduct stock assessments to determine the sustainable potential, optimum efforts and utilization rates of *N. japonicus* so that these fish resources remain sustainable and available in the future without damaging the population (Widodo & Suadi 2006; Nugraha et al 2012).

The study of sustainable potential and the level of utilization of fish resources are very important to control and monitor the level of fishing exploitation carried out on resources in Brondong waters. This is taken as an action to prevent the occurrence of resource extinction due to the level of excessive exploitation and encourage the creation of fishing operations with high effectiveness without damaging the sustainability of these fish resources. Other than that with the continuous stock assessment, the novelty of data can be used as a basis in formulating accurate and accurate fisheries resource management policies to realize the welfare of fishermen in Indonesia (Suman et al 2017).

The purpose of this study was to determine the sustainable potential, optimum efforts, and the level of utilization of *N. japonicus* in Brondong waters.

Material and Method. The research method used was descriptive survey. Secondary data collection includes data on the production of catches of *N. japonicus* landed at AFP Brondong for five years (2013-2017), fishing efforts and the general state of the watershed area. The data was obtained from literature studies from the archives held by AFP Brondong.

Data analysis. The analyzed data was obtained from the AFP Brondong statistics for the past five years in the form of data on the production of *N. japonicus* and attempts at catching *N. japonicus* in the same period.

Catch per unit effort. Calculation of CPUE (catch per unit effort) aims to determine the value of catch rate of fishing efforts based on the division of catch (catch) against effort (effort), (Gunawan 2004).
The formula used is as follows:

$$CPUE_i = \frac{c_i}{f_i}$$

Where:
ci = i-catch (kg)
fi = effort to catch-i (unit)
CPUEi = total catch per unit effort (kg/unit)

MSY and F (Opt) analysis. According to Schaefer (1954) in Kurniawan (2001), effort and catch relationships produce a symmetrical parabolic curve. The formulas presented are:

Relationship between Catch per Unit Effort (CPUE) and effort (f):

$$CPUE = a - bf$$

Where:
CPUE : Catch per Unit Effort
a : Intercept
b : Slope
f : Effort

Relationship between catch (c) and fishing effort (f):

$$Catch\ (c) = af - bf^2$$

Effort Optimum obtained from the derivative of equation (2) = 0, namely:

$$c = af - bf^2$$
$$c' = a - 2bf = 0$$
$$a = 2b\ x\ f$$
$$f = \frac{a}{2b}$$

Maximum sustainable yield (MSY) is obtained by substituting the maximum Effort value into equation (2), namely:

$$c = af - bf^2$$
$$MSY = a\left(\frac{a}{2b}\right) - b\,(a^2 - 4b^2)$$

Then:

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

The step to calculate the CPUE formula using the Schaefer method formula were as follows:

1. Make a catch data table (c) and effort (f) and calculate CPUE
2. Plot the CPUE value against the corresponding (f) and calculate Intercept (a) and Gradient (b) using linear techniques
3. Count (f opt)
4. Count MSY

The magnitude of a and b can be searched using the equation:

$$b = \frac{n.\sum xy - \sum x.\sum y}{n.\sum x^2 - (\sum x)^2}$$

$$a = \bar{y} - b\bar{x}$$

Determining the utilization rate of the catch was calculated using the formula (Bafagih 2014), as follows:

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

Results and Discussion. Fluctuations in the catch of *N. japonicus* in the Brondong waters are not always caused by catching but can be caused by changes in environmental conditions.

The effect of changes in environmental conditions can be direct or indirect to a type of fish. This is in accordance with (Suhaeti 2002) that fish catch fluctuations are influenced by several factors, among others, the presence of fish, the number of fishing attempts, and the success rate of fishing operations.

Based on Table 1 the effort to catch *N. japonicus* in Brondong water tends to decrease. In 2013-2017 the highest fishing effort was in 2013 amounting to 1,224 units and the lowest in 2017 which was equal to 119 units, while in 2015 and 2016 the number of arrests did not multiply the change of 689 units.

Catch per unit of effort (CPUE) based on Table 1 shows that the CPUE value has increased in the last five years. The highest CPUE value occurred in 2017, which was equal to 80,647.06 kg/unit with the number of fishing efforts amounting to 119 units, while the lowest CPUE value occurred in 2013, amounting to 1,406.37 kg/unit with the number of arrests of 1,224 units. For more details, the graph of the effort to capture fishing with the number of catches and CPUE values can be seen in Figures 1 and 2.

Table 1

Production and catch per unit effort for *Nemipterus japonicus*

Years	*Production (Kg)*	*Effort (Unit)*	*CPUE (Kg/Unit)*
2013	1,721,400	1,224	1,406.37
2014	7,223,689	926	7,800.96
2015	12,125,158	689	17,598.20
2016	10,357,000	689	15,031.93
2017	9,597,000	119	80,647.06
Average	8,204,849.40	729.40	24,496.90

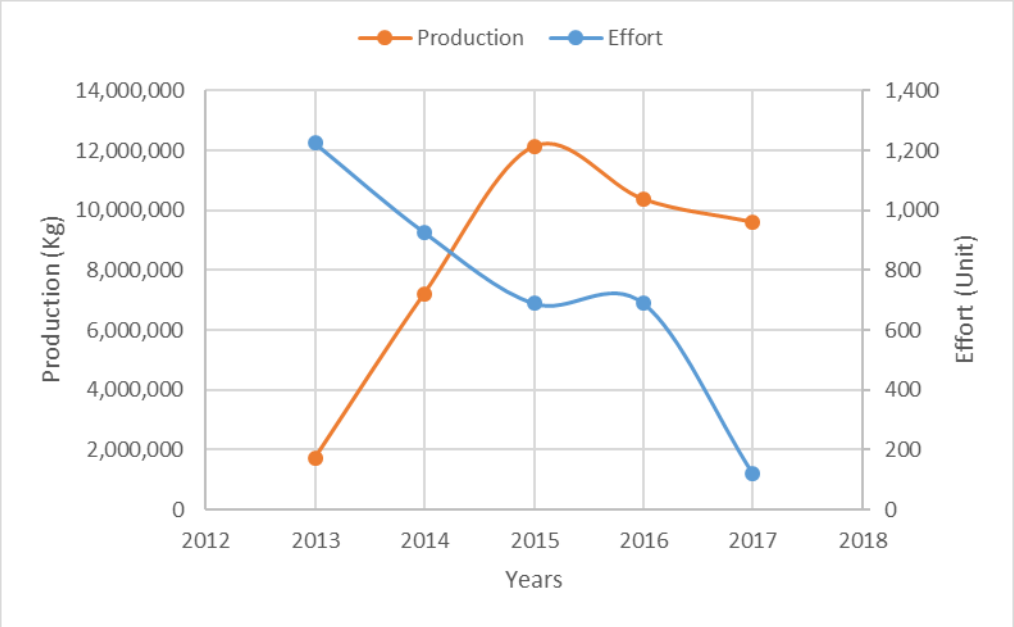

Figure 1. Production relations with effort concerning *Nemipterus japonicus* exploitation.

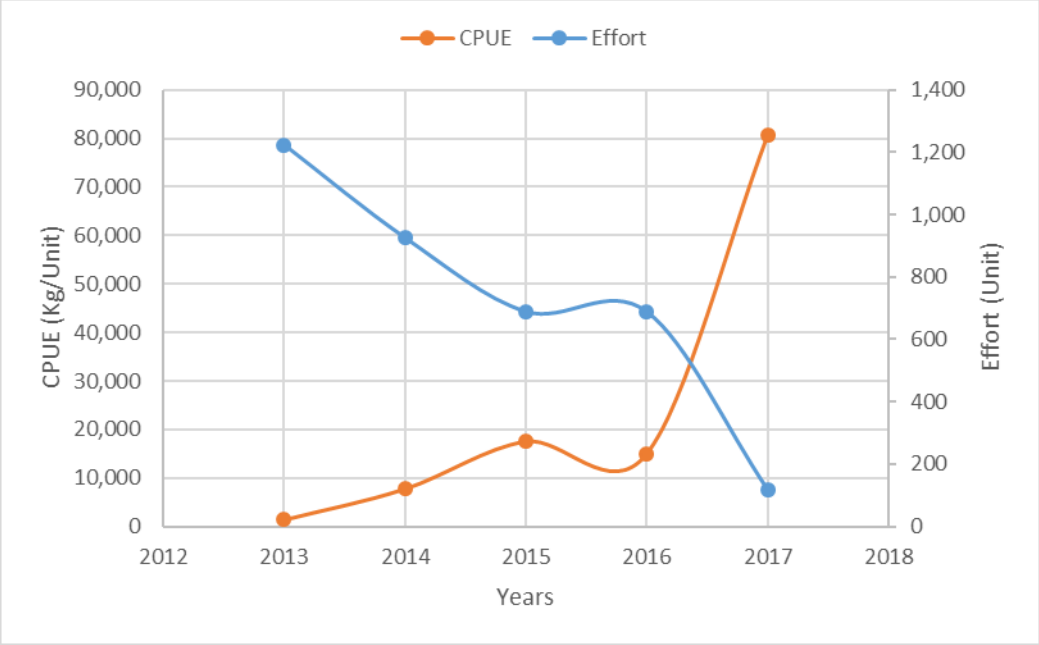

Figure 2. CPUE Relations with effort concerning *Nemipterus japonicus* exploitation.

Based on linear regression analysis effort with CPUE obtained an intercept value (a) = 7,7963.58 and slope value (b) = -73.3022. From these results the optimum effort value (fopt) and maximum sustainable potential (MSY) can be obtained.

Figure 3 shows that the sustainable potential (MSY) is 20,730,325.97 kg/unit with optimum effort (fopt) of 532 units. Based on the Total Allowable Catch (TAC), fisheries resource utilization above 80% does not support the sustainability of the resource (Bafagih 2014), the total allowable catch amount is 16,584,260.77 kg/unit. Thus the level of utilization of *N. japonicus* resources in the Brondong waters of the last five years is still below the value of (TAC).

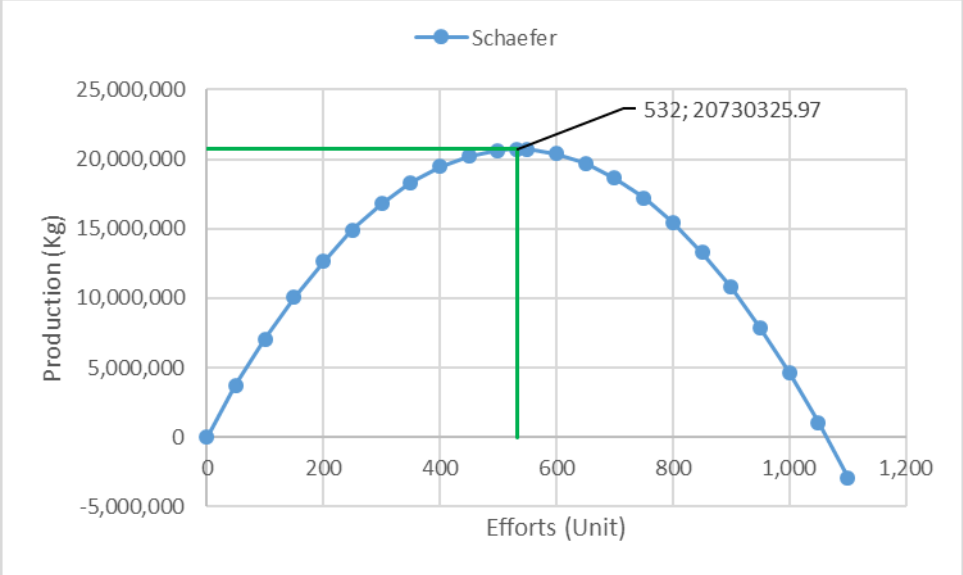

Figure 3. *Nemipterus japonicus* MSY.

Comparison between the maximum sustainable potential and annual production during the 2013-2017 period is presented in Table 2.

Table 2

Utilization level of *Nemipterus japonicus*

Years	*Production (Kg)*	*Utilization Level (%)*
2013	1,721,400	8.30
2014	7,223,689	34.85
2015	12,125,158	58.49
2016	10,357,000	49.96
2017	9,597,000	46.29
Average	8,204,849.40	39,58

From the calculation results, it was found that the utilization of *N. japonicus* in the last five years was still below the MSY value.

Conclusions. The results of the stock assessment using the Schaefer Model obtained MSY's potential sustainable survival of *N. japonicus* in the Brondong waters of 20,730,325.97 kg/unit with optimum efforts of 532 cantrang "Danish seine" units. Based on the provisions of the number of total allowable catch which is equal to 80% of the MSY value, TAC of *N. japonicus* in the Brondong water is 16,584,260.77 kg/unit.

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*** Brondong Archipelagic Fishing Port, 2017 Brondong AFP Fisheries Production Data.

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