Fisheries Journal, 15 (4), 1838-1852 (2025)
http://doi.org/10.29303/jp.v15i4.1584

ANALYSIS OF POTENTIAL SUSTAINABLE SHRIMP JERBUNG (*FENNEROPENEUS MERGUINSIS*) LANDED AT TPI PANGANDARAN WEST JAVA USING SCHAEFER AND WALTER HILBORN METHOD

Analisis Potensi Lestari Udang Jerbung (*Fenneropenaeus merguinsis*) yang Didaratkan di Tpi Pangandaran Jawa Barat Menggunakan Metode Walter Hilborn Dan Schaefer

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(Received May 23nd 2025; Accepted July 23th 2025)

ABSTRACT

TPI Pangandaran is a fishing base with the highest fish landing productivity in Pangandaran Regency, one of the commodities landed is jerbung shrimp (*Fenneropenaeus merguiensis*). High demand for jerbung shrimp leads to increased fishing intensity, so an analysis of sustainable potential is needed to maintain the sustainability of jerbung shrimp. Analysis of sustainable potential with the Maximum Sustainable Yeield (MSY) approach is important to maintain the sustainability of shrimp resources. The purpose of this study was to analyze the value of CPUE, FPI, and MSY of jerbung shrimp. The method used to analyze the value of MSY is the surplus production method with the approach of Walter Hilborn and Schaefer. The results showed that the CPUE value fluctuated during 2017-2022, with the highest value of 88.67 kg/trip in 2018 and the lowest value of 23.44 kg/trip in 2022. The standard fishing gear with the highest value of FPI is Trammel net. The MSY value using the Schaefer method is 917,990.50 ky^{-1} with a Total Allowable Catch (TAC) of 734,392.4 ky^{-1}, while the Walter Hilborn method produces an MSY value of 418,065.50 ky^{-1} with a TAC of 334,452.4 ky^{-1},. The exploitation of jerbung shrimp in TPI Pangandaran is still a safe condition. The R square value with Walter Hilborn method is greater than the Schaefer method, which is 0.90254. The value of R square which is greater or close to 1 indicates that in this study the Walter Hilborn method is more relevant to determine MSY and TAC of jerbung shrimp.

Keywords: CPUE, FPI, *Maximum Sustainable Yeield*, Surplus production, TAC

ABSTRAK

TPI Pangandaran merupakan *fishing base* dengan produktivitas pendaratan ikan tertinggi di Kabupaten Pangandaran, salah satu komoditas yang didaratkan salah satunya adalah udang jerbung (*Fenneropenaeus merguiensis*). Permintaan yang tinggi akan udang jerbung menyebabkan intensitas penangkapan meningkat, sehingga diperlukan analisis potensi lestari untuk menjaga kelestarian dari udang jerbung. Analisis potensi lestari dengan pendekatan *Maximum Sustainable Yeield* (MSY) penting untuk menjaga kelestarian sumber daya udang. Tujuan dari penelitian ini adalah menganalisis nilai CPUE, FPI, dan MSY dari udang jerbung. Metode yang digunakan untuk menganalisis nilai MSY adalah metode surplus produksi dengan pendekatan *Walter Hilborn* dan *Schaefer*. Hasil penelitian menunjukkan bahwa nilai CPUE mengalami fluktuasi selama tahun 2017–2022, dengan nilai tertinggi sebesar 88,67 kg/*trip* pada tahun 2018 dan nilai terendah sebesar 23,44 kg/*trip* pada tahun 2022. *Trammel net* ditetapkan sebagai alat tangkap standar dengan nilai FPI tertinggi. Nilai MSY menggunakan metode *Schaefer* yaitu 917.990,50 kg/tahun dengan *Total Allowable Catch* (TAC) sebesar 734.392,4 kg/tahun, sedangkan metode *Walter Hilborn* menghasilkan nilai MSY sebesar 418.065,50 kg/tahun dengan TAC sebesar 334.452,4 kg/tahun. Eksploitasi udang jerbung di TPI Pangandaran masih dalam kondisi aman. Nilai *R square* dengan metode *Walter Hilborn* lebih besar dibanding dengan metode *Schaefer*, yaitu 0,90254. Nilai *R square* yang lebih besar atau mendekati 1 menunjukkan bahwa pada penelitian ini metode *Walter Hilborn* lebih relevan untuk menentukan MSY dan TAC udang jerbung.

Kata Kunci: CPUE, FPI, *Maximum Sustainable Yeield*, Produksi surplus, TAC

INTRODUCTION

The Pangandaran Fish and Wildlife Service (TPI) in Pangandaran Regency, West Java, is one of the fishing bases with the highest fish landing percentage in Pangandaran Regency. This TPI boasts the highest productivity in the Pangandaran region (Dewanti et al., 2018). One of the potential capture fisheries resources at the Pangandaran TPI is the jerbung shrimp (Kartika et al., 2020).

The jerbung shrimp is a species native to Indonesia and Southeast Asia (Kusrini, 2011). Currently, demand for jerbung shrimp for export and domestic consumption is increasing. This has led to increasingly intensive jerbung shrimp fishing, which raises concerns about the sustainability of the jerbung shrimp resource (Suman et al., 2020).

The jerbung shrimp landed at the Pangandaran Fish Farm (TPI) is one of the capture fisheries activities in the Pangandaran area. Every capture fishery activity must comply with responsible and sustainable capture fisheries regulations and principles, ensuring proper management and sustainability of resources in the future (Dewanti et al., 2018). A sustainable potential analysis is necessary as a means of managing fisheries in a given water area. This sustainable potential analysis is a fishing effort that can produce the maximum sustainable catch, or MSY (Maximum Sustainable Yield) (Sari & Nurainun, 2022).

MSY (Maximum Sustainable Yield) can be determined using several methods, including the Schaefer, Fox, Gulland, Pella Tomlinson, Walter Hilborn, Schnute, and Clarke Yoshimoto Pooley (CYP) methods (Ardani et al., 2019). In this study, the Walter Hilborn and Schaefer methods were used. The Walter Hilborn method was chosen because it does not depend on the equilibrium conditions of a fishery biomass stock and is able to estimate parameter values in the model, so this method is able to predict the actual conditions in the field more accurately (Alfarizi & Setyo Leksono, 2016). Meanwhile, the Schaefer method was chosen because this method is one of the fisheries analysis methods that is easily applied in fisheries management to measure the level of utilization of fishery resources (Noordiningroom et al., 2012). The purpose of this study was to analyze the CPUE (Catch per Unit Effort), FPI (Fishing Power Index), and analyze the MSY (Maximum Sustainable Yield) values of jerbung shrimp landed at the Pangandaran TPI, Pangandaran Regency, West Java.

RESEARCH METHODS

Place and Time

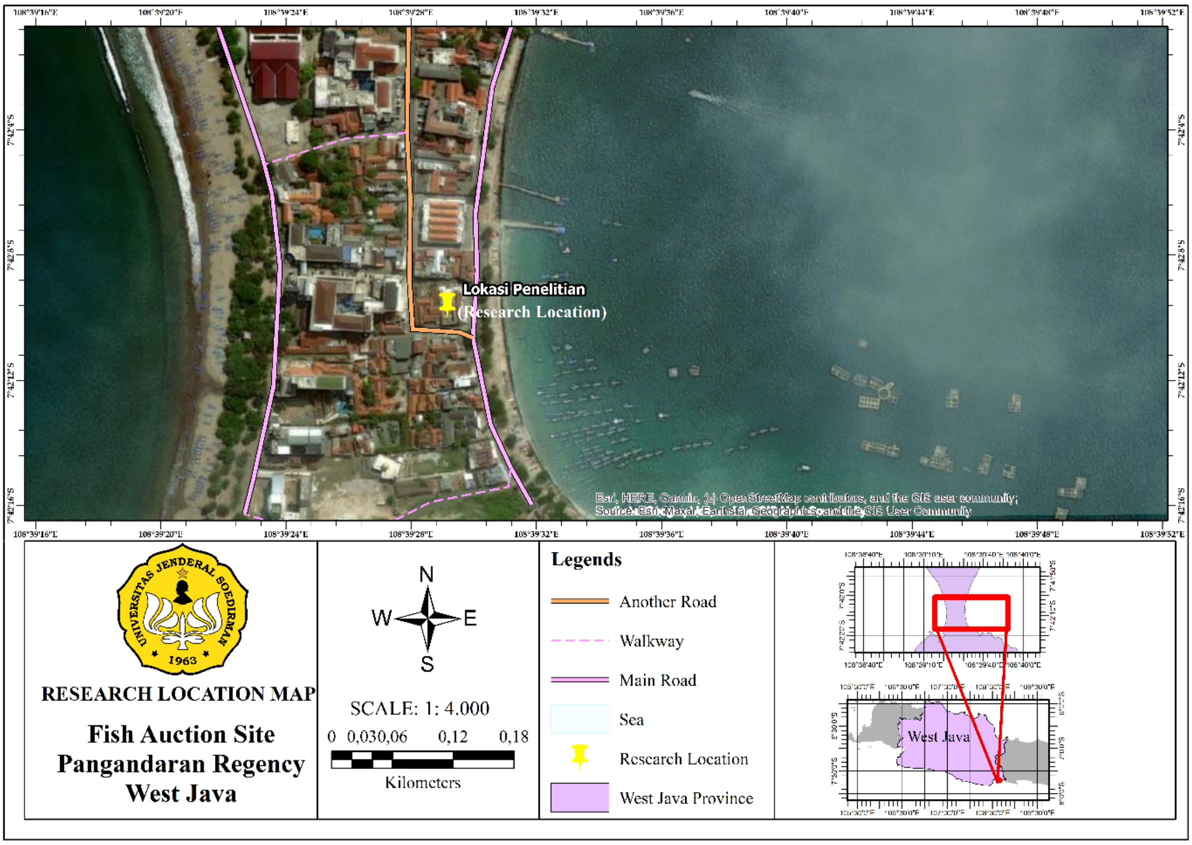

Figure 1. Map of Pangandaran TPI

This research was conducted from July 2024 to April 2025. Data collection was conducted at the Pangandaran Fish Farming Center (TPI), which is under the Department of Marine Affairs, Fisheries, and Food Security (DKPKP) of Pangandaran Regency, West Java, and data analysis was conducted at the Pescica Marina Laboratory, FPIK Unsoed. Figure 1 shows a map of the research location.

Tools and Materials

The tools used in this study were stationery, a cell phone, a laptop, and a questionnaire. The materials used in this study were the jerbung shrimp (Fenneropenaeus merguiensis), primary data obtained from interviews or questionnaires, and secondary data obtained from the Department of Marine Affairs, Fisheries, and Food Security (DKPKP) of Pangandaran Regency, West Java.

Data collection and calculation methods

The methods used in this study were survey and interview. Interviews were conducted with fishermen at the Pangandaran Fish and Fish Farming Fish Farm (TPI) and the TPI manager, namely the Marine, Fisheries, and Food Security Service (DKPKP) of Pangandaran Regency, West Java. The interviews were conducted in a structured manner, using pre-prepared and systematically ordered questions. The number of respondents in this study was determined using the Slovin method (Henggu et al., 2021) with the following formula:

$$n = \frac{N}{1+N\,(a)^2}$$

Information:
n = Sample Size
N = Population Size
a = Tolerable standard error 10%

Primary Data

Primary data was collected through direct interviews with jerbung shrimp fishermen at the Pangandaran TPI. Then the interview results were entered into a questionnaire.

Secondary Data

Secondary data was obtained from the Department of Marine Affairs, Fisheries and Food Security (DKPKP), Pangandaran Regency in the form of data on jerbung shrimp catches and the number of jerbung shrimp fishing vessels from 2017 to 2022.

Catch per Unit Effort (CPUE)

According to Liswahyuni et al., (2021), to obtain the CPUE value, the following formula is used:

$$CPUE = \frac{C}{E}$$

Information:
C = Catch (Kg)
E = Arrest attempt (Trip)

Fishing Power Indeks (FPI)

According to Nugraha et al., (2012), to obtain the FPI value, the following formula is used:

$$FPI = \frac{CPUEi}{CPUEs}$$

Information:

CPUEi	=	Annual catch per fishing effort of other fishing gear (Kg/Trip)
CPUEs	=	Annual catch per effort of standard fishing gear (Kg/Trip)

A standard fishing unit is a unit that has the highest average catch rate per CPUE in a certain time period and has a fishing power index (FPI) factor value equal to one..

Schaefer Methods

The model used for data that tends to be linear is the Schaefer model. The following is the formula for calculating MSY using the Schaefer method according to (Rahmawati et al., 2013).

1. The maximum sustainable effort (E_{MSY}) is obtained from the derivative of equation (2) = 0, namely:

$$C = aE - bE^2$$
$$C' = a - 2bE = 0$$
$$a = 2b \times E$$
$$E_{MSY} = \frac{a}{2b}$$

2. Maximum sustainable production (C_MSY) is obtained by substituting the E_MSY value into equation (2), thus obtaining the formula:

$$C_{MSY} = a\left(\frac{a}{2b}\right) - b\left(\frac{a^2}{4b^2}\right)$$
$$= \left(\frac{a^2}{2b}\right) - \left(\frac{a^2 b}{4b^2}\right)$$
$$= \left(\frac{2a^2 b}{4b^2}\right) - \left(\frac{a^2 b}{4b^2}\right)$$
$$= \frac{a^2}{4b}$$

Based on the intercept parameter a and slope b, mathematically, it can be found using a simple linear regression equation, namely Y = a + bx. The formulas for the surplus production model (MSY) are only valid if the parameter b has a negative value, meaning that increasing fishing effort will cause a decrease in CPUE.

Walter Hilborn Method

The magnitude of parameters a and b can be systematically found using regression equations. The formulas for this surplus production model are only valid if parameter (b) is negative, meaning that increasing the amount of effort will cause a decrease in CPUE. Walter & Hilborn can estimate the parameters of the surplus production function r, q, and k.

$$P_{(t-1)} = P_t + \left[rP_t - \left(\frac{r}{k}\right) {P_t}^2\right] - qe_tP_t$$

Information:

$P_{(t-1)}$ = The size of biomass stock at time t+1
P_t = The size of biomass stock at time t
r = Intrinsic growth rate of biomass stock (Constant)
k = Maximum carrying capacity of the natural environment
q = Capture coefficient
e_t = Number of fishing attempts to exploit biomass in year t (trips/fishing gear))

Then the values of $C_{\_MSY}$ and $E_{\_MSY}$ are determined using the formula:

$$C_{MSY} = \frac{rK}{4}$$
$$E_{MSY} = \frac{r}{2q}$$

Information:
r = Intrinsic growth rate
q = Capture coefficient
K = Maximum carrying capacity of the natural environment
(Yusfiandayani et al., 2023).

Total Allowable Catch (TAC)

According to Kwon et al. (2020), the Total Allowable Catch (TAC) value or the amount of catch allowed can be calculated using the following formula:

$$TAC = 80\% \times MSY$$

Information:
MSY = Maximum Sustainable Yield

Utilization Rate

According to Nugraha et al. (2012), the level of utilization of jerbung shrimp can be determined using the following formula:

$$TP = \frac{Ci}{MSY} \times 100\%$$

Information:
TP = Percentage of Utilization Level of Jerbung Shrimp
Ci = Catch Results in the i-th year
MSY = Maximum Sustainable Yield

Data Analysis

The results of the CPUE and FPI values were analyzed descriptively, then displayed in tabular form, and compared with previous studies. The determined MSY values were analyzed descriptively, then compared with the actual catch results from 2017 to 2022 to determine whether the condition of the jerbung shrimp landed at the Pangandaran TPI had experienced overfishing or was still within safe and sustainable standards. Then, these fishing conditions were also compared with the fishing conditions in previous studies.

RESULT

Catch per Unit Effort (CPUE)

Catch per Unit Effort (CPUE), often referred to as catch per unit effort, is a measure used to assess the efficiency and productivity of fishing efforts. Catch data is needed to determine CPUE. The catch of jerbung shrimp from 2017 to 2022 can be seen in Figure 2.

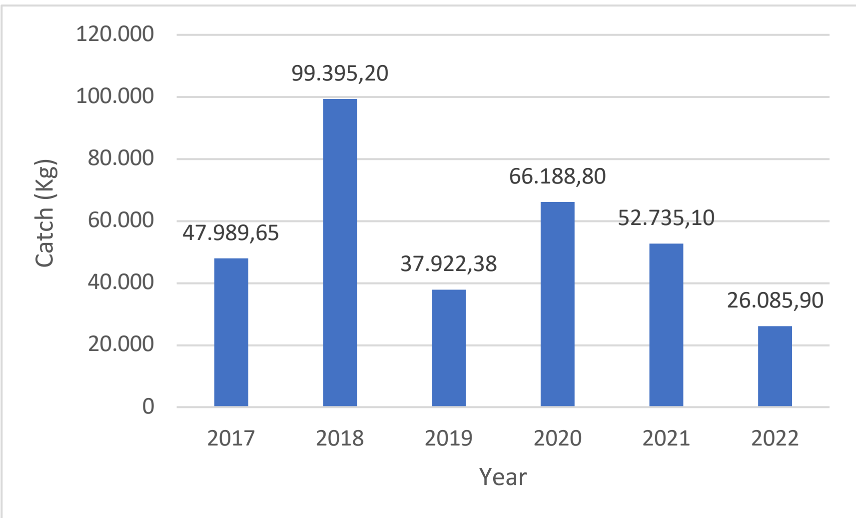

Diagram 1. Production of jerbung shrimp catches landed at the Pangandaran TPI

The catch of jerbung shrimp landed at the Pangandaran Fish Farm (TPI) from 2017 to 2022 fluctuated annually. The highest catch was in 2018, with a catch of 99,395.2 kg; and the lowest catch was in 2022, with a catch of 26,085.9 kg.

In addition to catch data, fishing effort data is also required. Fishing effort is used as a divisor of the catch, which results in the CPUE value. Jerbung shrimp fishing effort from 2017 to 2022 can be seen in Table 1.

Table 1. Jerbung Shrimp Fishing Effort

Years	Catch (Kg)	Effort (Trip)
2017	47.989,65	1121
2018	99.395,2	1121
2019	37.922,38	1112
2020	66.188,8	1113
2021	52.735,1	1113
2022	26.085,9	1113

Fishing effort for jerbung shrimp landed at the Pangandaran Fish Farm (TPI) fluctuated. The lowest fishing effort occurred in 2019, with 1,112 trips, and the highest fishing effort occurred in 2017 and 2018, with 1,121 trips.

The CPUE value for jerbung shrimp from 2017 to 2022 also fluctuated, as did catch and fishing effort. The CPUE value for jerbung shrimp from 2017 to 2022 can be seen in Figure 3..

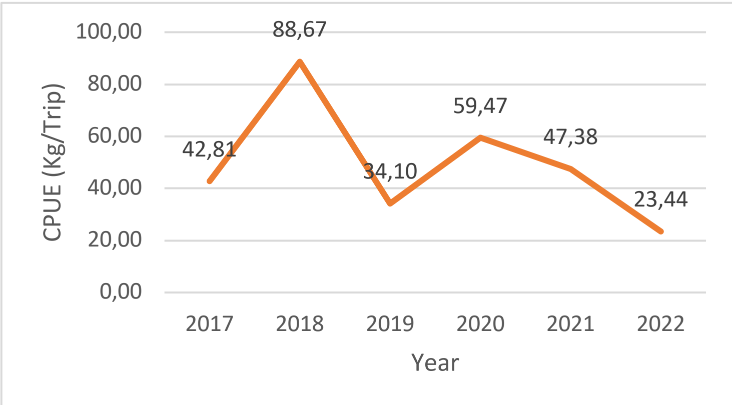

Diagram 2. CPUE value of jerbung shrimp from 2017 to 2022

The highest CPUE value was 88.67 kg/trip in 2018, while the lowest CPUE value was 23.44 kg/trip in 2022.

Fishing Power Indeks (FPI)

Fishing gear standardization can be achieved by calculating the FPI, or Fishing Power Index. The FPI values for each gear used can be seen in Table 2.

Table 2. FPI (Fishing Power Index) Values

Years	Trammel net	Nylon gill net	Gill net string	Rawe Fishing Rod
2017	1	0,00027	0,00087	0,00027
2018	1	0	0	0
2019	1	0	0	0
2020	1	0	0	0
2021	1	0	0	0
2022	1	0	0	0
Total	6	0,00027	0,00087	0,00027

The annual FPI value of the trammel net is 1, the highest compared to other fishing gear, namely nylon gill nets, string gill nets, and rawe fishing. This proves that the trammel net is the standard fishing gear for catching jerbung shrimp.

Maximum Susteinable Yield (MSY) andTotal Allowable Catch (TAC)

Estimating the sustainable fisheries potential in a body of water can be done using the Schafer and Walter Hilborn methods. Both methods can estimate the MSY condition from the sustainable catch (C_MSY) and sustainable fishing effort (E_MSY). Before determining the C_MSY and E_MSY values, the intercept and slope values are required. The intercept and slope values are shown in Table 3.

Table 3. Intercept, Slope, and R-square values for each method

Parameter	Schaefer	Walter hilborn
Intercapt	3340,4	0,20756
Slope	-3,0387	-0,00014
R square	0,3251	0,90254

The intercept and slope values help in determining the C_MSY and E_MSY values of jerbung shrimp. The C_MSY and E_MSY values of jerbung shrimp using the Schaefer and Walter Hilborn methods can be seen in Figures 4 and 5.

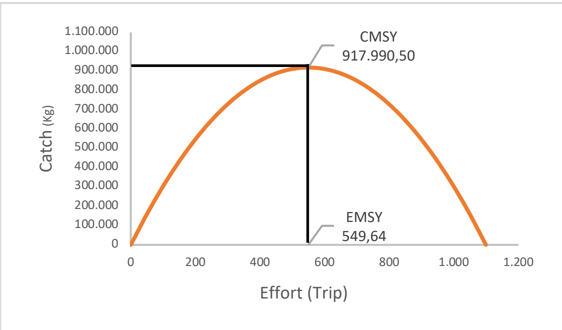

Diagram 3. Schaefer method MSY graph

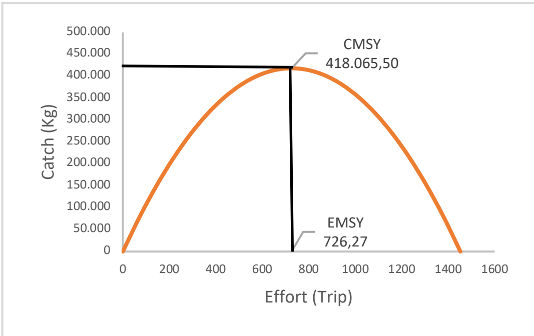

Diagram 4. Walter Hilborn method MSY graph

The Schaefer method yielded a C_MSY of 917,990.50 kg/year and an E_MSY of 549.64 trips/year. The Walter Hilborn method yielded a C_MSY of 418,065.50 kg/year and an E_MSY of 726.27 trips/year. These values represent the maximum production level for the utilization of jerbung shrimp resources that can be achieved without threatening the sustainability of jerbung shrimp resources.

The Total Allowable Catch (TAC) of fish resources that may be caught is 80% of the existing potential, this is to maintain the sustainability of jerbung shrimp. The TAC results, or allowable catch, can be seen in Table 4.

Table 4. Total Allowable Catch (TAC) of jerbung shrimp

Sustainable potential	Schaefer	Walter Hilborn
MSY (Kg/years)	917.990,50	418.065,50
TAC (Kg/years)	734.392,4	334.452,4

The TAC value for jerbung shrimp, based on sustainable potential using the Schafer method, is 734,392.4 kg/year, while the TAC value for jerbung shrimp, based on sustainable potential using the Walter Hilborn method, is 334,452.4 kg/year. The TAC value helps determine the upper limit of jerbung shrimp utilization. To ensure the sustainability of jerbung shrimp resources, utilization levels must not exceed the TAC value. The utilization levels for jerbung shrimp from 2017 to 2022 can be seen in Table 5.

Table 5. Utilization Level of Jerbung Shrimp

Years	Catch (Kg/year)	Utilization rate	
		Schaefer	Walter Hilborn
2017	47.989,65	5,2%	11,5%
2018	99.395,2	10,8%	23,8%
2019	37.922,38	4,1%	9,1%
2020	66.188,8	7,2%	15,8%
2021	52.735,1	5,7%	12,6%
2022	26.085,9	2,8%	6,2%

Table 5. Explains that the highest utilization rate of shrimp using the Schaefer method was in 2018 at 10.8% of MSY, then the lowest utilization rate was in 2022 at 2.8% of MSY. Meanwhile, the highest utilization rate of shrimp using the Walter Hilborn method was in 2018 at 23.8% and the lowest utilization rate was in 2022 at 6.2%.%.

DISCUSSION

Catch per Unit Effort (CPUE)

The large catch in 2018 was inseparable from the role of the Pangandaran Regency Marine, Fisheries, and Food Security Service, which was recently established in 2017. Training programs, outreach, and the provision of fisheries infrastructure such as boats and fishing gear have helped increase catch productivity. This is in accordance with research by Loe (2025), which states that the existence of a fisheries service can help increase catch production. Then in 2019, there was a drastic decline in catches from 99,395.2 kg to 37,922.4 kg. This condition was caused by the Covid-19 pandemic and the government's policy of quarantine (lockdown) to reduce the spread of Covid-19 infection, resulting in a decrease in fishing activity. The decrease in fishing activity also resulted in a decrease in catches that year. Bubun et al. (2022) explained that the impact of Covid-19 caused changes in the frequency of fishing operations and a decrease in the number of crew members, resulting in reduced catch production. Then, in 2020, catch production increased again, from 37,922.4 kg to 66,188.8 kg. The increase in catch production in 2020 was due to the government's new normal policy and increased fishing efforts in the form of fishing fleets. According to research by Sangadji et al. (2013), increasing catch production can be achieved by adding or developing fishing fleets, expanding fishing grounds, and improving fishing technology. After the increase in 2020, catches decreased from 2021 to 2022. This decrease in catch was due to suboptimal fishing efforts, resulting in small catches. This is consistent with research by Herka Mayu et al. (2018), which found that fish availability, number of fishing attempts, and catch success rates influence catch increases or decreases.

The fluctuating annual catch of jerbung shrimp at the Pangandaran Fish Farming Site (TPI), West Java, is similar to that in Bintuni Bay, West Papua. According to Yarangga et al. (2023), in Bintuni Bay, West Papua, the catch of jerbung shrimp also experienced fluctuations from 2010 to 2020. Environmental conditions, seasonal influences, the size of fishing effort, and the condition of jerbung shrimp stocks in the waters are suspected to be factors that cause jerbung shrimp production to differ or fluctuate each year. This is consistent with research by Mayalibit et al. (2014), which found that environmental factors and fishing effort cause catch fluctuations.

Fishing effort is a series of efforts undertaken to obtain or capture jerbung shrimp from their natural habitat. Increasing or decreasing fishing effort does not always result in a decrease or increase in catch, as can be seen in Table 1. In 2017 and 2018, the same fishing effort resulted in different catches. Then in 2020, 2021, and 2022, the same fishing effort resulted in different catches. This means that increasing or decreasing fishing effort does not always result in a decrease or increase in catch; several other factors influence jerbung shrimp catches. This is consistent with research by Lantang & Merly (2017), who explained that in addition to fishing effort, several other factors, such as temperature, clarity, and seasonal factors, can influence catches.

Similar to catch production (Catch) and effort (Effort), the CPUE (Competitive Efficiency) of jerbung shrimp also fluctuates. This fluctuation in CPUE for jerbung shrimp is not unique to the Pangandaran Fish Farming Fish Farming Center (TPI) but also occurs at the Sorong City Fishing Port (PPP). Rajagukguk & Aenal (2023) explained in their research that the CPUE value in the Sorong City Fishing Port (PPP) fluctuated over the past five years, from 2014 to 2018.

This fluctuating CPUE value is influenced by the availability of shrimp in a given water body and the effort required to catch them. This is consistent with research by Lestaluhu et al. (2023), which found that different CPUE values are caused by the ability of fishing gear to catch jerbung shrimp and the availability of jerbung shrimp in a given water body. The greater the ability of fishing gear to catch jerbung shrimp and the greater the availability of shrimp in the sea, the higher the CPUE value. Nugraha et al. (2012) also added that increased fishing effort without a corresponding increase in catch volume will result in a decrease in CPUE..

Fishing Power Indeks (FPI)

Trammel nets are the standard fishing gear for catching shrimp, as they have the highest CPUE and FPI of 1. Rosana et al. (2015) explain that the standard fishing gear is the one with the highest CPUE and FPI of 1.

The calculated FPI results are similar to previous research conducted by Yarangga et al. (2023) in Bintuni Bay, Sorong Regency, West Papua, which found that trammel nets are the standard fishing gear commonly used to catch shrimp. Sembiring et al. (2016) explain that trammel nets are quite effective shrimp catching tools, having three layers of netting: one inner layer with smaller mesh sizes and two outer layers with larger mesh sizes. A float is placed at the top, while a weight is attached to the bottom. This tool is operated at the bottom of the water to catch shrimp.

Maximum Susteinable Yield (MSY) and Total Allowable Catch (TAC)

Before determining the C_{MSY} and E_{MSY} values, the intercept and slope values are required. Using the Schaefer method yields an intercept of 3340.4 and a slope of 3.0387. These two values are constants in a linear equation, meaning that each unit increase in effort will increase the CPUE value by 3.0387 units. The R-square value is 0.3251, meaning 32.51% of the change or variation in CPUE can be explained by changes or variations in fishing effort. Meanwhile, using the Walter Hilborn method yields an intercept of 0.20756 and a slope of 0.00014. The intercept and slope values are constants in a linear equation. The Walter Hilborn method yields an R-square value of 0.90254, meaning 90% of the change and variation in CPUE can be explained by changes in fishing effort.

The R-square value using the Walter Hilborn method is greater than the Schaefer method, at 0.90254. The greater the R-square value, or the closer it is to 1, the closer the estimated sustainable potential will be to the reality in the field. This is consistent with research by Sulaiman (2021), who stated that R-square is the correlation between variables x and y. The closer the R-square value is to 1, the closer the estimate will be to actual field conditions. The R-square value indicates that, compared to the Schaefer method, the Walter Hilborn method is the best method for estimating the sustainable condition of jerbung shrimp landed at the Pangandaran Fish Farming Center (TPI), West Java. This is in line with research by Zulkarnaini et al. (2022), which found that the Walter Hilborn method is the best method for estimating the sustainable condition of fish in a given body of water.

The MSY results for jerbung shrimp using the Schaefer and Walter Hilborn methods differed. The Schaefer method yielded a C_{MSY} of 917,990.50 kg/year and an E_{MSY} of 549.64 trips/year. Meanwhile, the results of the Walter Hilborn method obtained a C_{MSY} value of 418,065.50 kg/year and an E_{MSY} value of 726.27 trips/year. This is because the Walter Hilborn method does not depend on the equilibrium conditions of a fishery biomass stock and this method can estimate the values of population parameters in the model (Andriyani, 2009). Rosalia et al. (2024), in their research also explained that the Walter Hilborn method is more dynamic and closer to real conditions in the field.

The MSY value of jerbung shrimp landed at the Pangandaran Fish Farming Center (TPI), West Java, using both the Schaefer and Walter Hilborn methods, differs from the MSY value of jerbung shrimp in Bintuni Bay, Sorong Regency, West Papua. Research by Yarangga et al. (2023) reported that the MSY value of jerbung shrimp in Bintuni Bay, Sorong Regency, is 10,943.1 tons per year. This value is greater than the MSY value in Pangandaran Regency, West Java. This difference is caused by several factors, including environmental factors such as temperature, salinity, and habitat of jerbung shrimp. Gwyther (1982) explained that different regions have different environmental conditions such as temperature, salinity, and habitat types, which can affect the growth and reproduction rate of jerbung shrimp. These factors affect overall fisheries productivity and consequently, the MSY value in each region varies. Jerbung shrimp is an important fishery resource for the people of South Sorong Regency due to its abundance. The abundance of jerbung shrimp in South Sorong waters is supported by the extensive mangrove forest ecosystem (Sala et al., 2021). Mangrove forests serve as a critical habitat for many marine species, including jerbung shrimp. Mangrove roots provide shelter and feeding areas for jerbung shrimp, especially larvae and juveniles. Furthermore, mangrove forests help maintain water quality by filtering sediment and pollutants, creating a conducive environment for jerbung shrimp life (Rajendran & Kathiresan, 2004).

Based on the Total Allowable Catch (TAC), the catchable fish resource is 80% of the potential (Manik et al., 2022), this is to maintain the sustainability of jerbung shrimp. The TAC value of jerbung shrimp from sustainable potential using the Schafer method is 734,392.4 kg/year, while the TAC value of jerbung shrimp from sustainable potential using the Walter Hilborn method is 334,452.4 kg/year. The TAC results from the two methods are different. The TAC value with the Shaefer method is higher than the Walter Hilborn method. This is because the MSY results from these two methods are different, the different results are because the Schafer method in determining the MSY value only regresses CPUE against the amount of jerbung shrimp fishing effort (Waileruny et al., 2024), in contrast to the Walter Hilborn method in determining the MSY value using multiple linear regression calculations with the concept of least squares (Banten et al., 2011).

The TAC value helps determine the upper limit of the utilization rate of jerbung shrimp. To ensure the sustainability of jerbung shrimp resources, utilization rates must not exceed the TAC. From 2017 to 2022, utilization rates did not exceed 100%, indicating that utilization of jerbung shrimp resources remained safe because they did not exceed the sustainable potential of jerbung shrimp landed at the Pangandaran Fish Farming and Fishery Terminal (TPI) in West Java. According to Harjanti et al. (2012), a utilization rate below 100% indicates that resource utilization has not exceeded the sustainable potential, meaning that the resource's utilization status is still considered safe.

In contrast to the TPI in Pangandaran, West Java, jerbung shrimp utilization in the Aru Islands, Arafura Sea, is experiencing overfishing. Declining shrimp catches indicate overfishing in this area. The decline in jerbung shrimp catches in the Aru Islands is due to several factors. These factors include predation of an organism by another organism, changes in the oceanographic environment of waters that occur daily, monthly, seasonally, or annually, and other factors that have a direct influence are uncontrolled fishing activities, especially charter vessels with crews from abroad (mostly from Thailand) (Badrudin & Sumiono, 2022).

CONCLUSION

1. The Catch per Unit Effort (CPUE) value of jerbung shrimp landed at the Pangandaran TPI, Pangandaran Regency, West Java from 2017 to 2022 experienced fluctuations, with the highest CPUE value in 2018 at 88.67 kg/trip and the lowest CPUE value in 2022 at 23.44 kg/trip.
2. The Fishing Power Index (FPI) value of the Trammel net fishing gear shows a figure of 1 every year. This value is higher compared to other fishing gear, so the Trammel net fishing gear is used as the standard fishing gear for catching shrimp.
3. The MSY value using the Schaefer method is 917,990.50 kg/year with a TAC value of 734,392.4 kg/year, then the MSY value using the Walter Hilborn method is 418,065.50 kg/year, with a TAC value of 334,452.4 kg/year. From 2017 to 2022, the catch conditions for jerbung shrimp landed at the Pangandaran TPI are still safe because no catches exceed the MSY value.

ACKNOWLEDGEMENT

The author realizes that in completing this writing he received a lot of help from various parties, therefore the author would like to thank:

1. Allah SWT has given mercy and grace so that this writing can be finished.
2. I myself have been able to survive and be strong in completing this writing.
3. The author's parents, Mr. Jarwono and Mrs. Naeli, who always pray for him and give him full support.
4. The supervisor is Mrs. Dr. Ani Suryanti, S.Pi., M.Si. who has guided and provided direction from the beginning until this writing was completed well.
5. My friend Mufidah Rohmatun Nisa who always supports and encourages me in writing this.
6. The parties that I cannot mention one by one, who have provided support in completing this writing.

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