Asian Journal of Aquatic Sciences, August 2025. Vol 8, Issue (2) 291-299

e-issn: 2716-4608
p-issn: 2655-366X

MAXIMUM SUSTAINABLE YIELD (MSY) ESTIMATION AND CATCH POTENTIAL OF JINGA SHRIMP (*Metapenaeus monoceros*) IN WEST TANJUNG JABUNG WATERS, JAMBI PROVINCE

Lauura Hermala Yunita[1*], Diah Maulani Saputri[2], Yoppie Wulanda[1], M. Hariski[2], Wulandari[1], Hasanah[1]

[1]Department of Fishery Products Technology, Faculty of Animal Science, University of Jambi, Mendalo Indah, 36361 Indonesia

[2]Department of Fisheries Resource Utilization, Faculty of Animal Science, University of Jambi, Mendalo Indah, 36361 Indonesia

*lauurahermala@unja.ac.id

ABSTRACT

One of the key commodities in the capture fisheries sector is the Jinga Shrimp (*Metapenaeus monoceros*), which is widely distributed in tropical waters, including the coastal area of Tanjung Jabung Barat, Jambi Province. This study aims to estimate the Maximum Sustainable Yield (MSY) and the fishing potential of Jinga Shrimp in the waters of Tanjung Jabung Barat. The data used are secondary data on annual catch and fishing effort from 2017 to 2023, obtained from the local Fisheries Office. The analysis was conducted using the Schaefer model approach, which includes calculations of Catch per Unit Effort (CPUE), MSY, optimum effort (EMSY), Allowable Catch, utilization rate, and exploitation rate. The results showed an MSY value of 2,189.60 tons/year and an EMSY of 68.19 trips/year. As the safe harvest limit, the allowable catch was set at 1,751.68 tons/year (80% of MSY). The average utilization rate was 88%, indicating that the resource has not yet experienced overfishing. However, the exploitation rate has exceeded the optimum limit (124%) and is considered overfishing. The negative relationship between CPUE and effort (R^2 = 96.72%) indicates a decline in stock due to high fishing intensity. Therefore, adaptive and stock-based management policies are necessary to ensure this region's sustainable conservation of Jinga Shrimp populations.

Keywords: *Metapenaeus monoceros*, MSY, Overfishing, Tanjung Jabung Barat.

1. INTRODUCTION

The coastal waters of Indonesia hold a vast and diverse potential of biological resources, including various species of shrimp that have high economic value[1]. One of the crucial commodities in the capture fisheries sector is the jinga shrimp (*Metapenaeus monoceros*), which is widely distributed in tropical waters, including the coastal areas of Tanjung Jabung Barat, Jambi Province. Local fishers widely harvest this shrimp due to its relatively high market value both domestically and internationally, and it serves as a primary source of livelihood for coastal communities[2].

However, the increasing intensity of fishing activities over the past decades, which sustainable management practices have not accompanied, has raised concerns about the sustainability of shrimp stocks in these waters. Overfishing has become a real threat, potentially leading to population decline, ecosystem imbalance, and long-term reduction in fishery productivity[3]. Therefore, a scientific approach is urgently needed to assess the stock condition and to determine sustainable catch limits.

Received: 15 July 2025
Accepted: 2 August 2025

One commonly used method to determine sustainable catch limits is the estimation of Maximum Sustainable Yield (MSY), which refers to the maximum amount of catch that can be taken from a fish stock without compromising its ability to replenish naturally[4]. Given the artisanal nature of shrimp fishing and limited monitoring capacity in the region, MSY provides a practical foundation for community-based and adaptive fisheries management. MSY estimation serves as an important basis for fisheries management policy-making, aiming to balance utilization and conservation of resources[5].

This study aims to estimate the MSY value and the catch potential of *Metapenaeus monoceros* in the waters of Tanjung Jabung Barat. By identifying the maximum sustainable catch capacity, shrimp fisheries management in this region can be directed toward optimal and sustainable utilization[6]. Furthermore, the findings of this research are expected to contribute to regional fisheries policy planning and support adaptive, science-based stock management programs. Considering its strategic geographic location and aquatic potential, Tanjung Jabung Barat is vital for developing capture fisheries. However, the availability of data on stock assessment studies and MSY estimation in Jambi waters remains very limited, making this research essential in providing scientific information that can serve as a basis for sustainable fisheries management. Therefore, estimating the MSY of brown shrimp is crucial to ensuring resource sustainability and improving the long-term welfare of fishing communities.

2. RESEARCH METHOD

Time and Place

The study was conducted in the waters of Tanjung Jabung Barat Regency from October to December 2024.

Method

Data collection in this study began by formulating the research problem to obtain information related to shrimp catch volumes and the number of fishing trips. The data were collected using a direct field survey method. The primary data source was secondary data obtained from official government institutions, such as the Department of Fisheries. The secondary data utilized included records of the annual catch of jinga shrimp and the frequency of fishing trips from 2017 to 2023 in the Tanjung Jabung Barat Regency. These data served as the basis for estimating catch potential and conducting stock assessment analyses.

Procedures

Catch per Unit Effort

The Catch per Unit Effort (CPUE) value is commonly used to monitor fish stock dynamics and indicates the efficiency of fishing activities. Despite requiring less data than other estimation methods, it is considered a potentially effective tool[7].

$$CPUE_t = \frac{Catch_t}{Effort_t}$$

Description:

$CPUE_t$ = Catch per unit effort in year t (kg/trip)

$Catch_t$ = Total catch in year t (kg)

$Effort_t$ = Fishing effort in year t (trip)

Maximum Sustainable Yield (MSY)

The stock estimation of Jinga Shrimp can be conducted through a Maximum Sustainable Yield (MSY) analysis by applying one of the common approaches, the Schaefer model. The calculation of sustainable potential (CMSY) and optimal fishing effort (EMSY) was performed using a linear regression equation based on the formula proposed by Marinding et al.[8].

$$Y = a + bx$$

Description:

a = intercept

b = slope (gradient)

x = fishing effort for Jinga Shrimp in period i (independent variable)

y = Catch per unit effort (CPUE) of jinga shrimp in period i (dependent variable)

Total Allowable Catch

The estimation of Total Allowable Catch, or allowable catch, is a calculation of the harvest amount that considers the sustainability of fish stock populations to ensure their continued utilization in the future. The JTB value is calculated using the following formula:

$$JTB = MSY \times 80\%$$

Explanation:

JTB = Total Allowable Catch
MSY = Maximum Sustainable Yield

The values of *a* and *b* can be mathematically estimated using a simple linear regression approach. The calculation formula is as follows:

$$Y = a + bx$$

Explanation:

a = intersep
b = slope
x = Fishing effort (independent variable)
y = Catch per unit effort (CPUE) (dependent variable)

Badiuzzaman et al.[9] stated that when the Allowable Biological Catch exceeds the Maximum Sustainable Yield (MSY), it indicates the occurrence of overfishing. Conversely, if the ABC remains below the MSY, it suggests that the utilization of fishery resources in the area can still be increased. However, such an increase must stay within the established MSY's limits to ensure the sustainability of fishery stock resources.

Utilization Rate and Exploitation Level

Fishery resources that are currently being exploited must be managed promptly under a sustainable-utilization approach. Without proper management, these resources risk becoming overexploited, and their populations may decline sharply due to uncontrolled harvesting and ineffective governance. Estimating the utilization rate of fishery resources is essential for determining how extensively these resources have been used.

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

Explanation:

TPc = Percentage of jinga shrimp utilization rate in period *i*
Ci = Catch of jinga shrimp in period *i*
MSY = Sustainable potential of jinga shrimp / Maximum Sustainable Yield (MSY).

3. RESULT AND DISCUSSION

Catch of Jinga Shrimp (*Metapenaeus monoceros*)

The catch data of jinga shrimp in the waters of Tanjung Jabung Barat over seven years (2017–2023) are presented in Table 1. The catch volume during this period showed fluctuations, with increases and decreases occurring from year to year.

Table 1. Catch of jinga shrimp in 2017–2023

Fishing Gear	Catch (Tons/Year)						
	2017	2018	2019	2020	2021	2022	2023
Gillnet	1.875,2	1.852,7	1.496,7	2.013,4	2.019,4	2.059,79	2.101,02

Source: Data from the Fisheries Department of Tanjung Jabung Barat

Based on the data, the catch of jinga shrimp increased by 12% from 2017 to 2023. The highest recorded catch occurred in 2023, amounting to 2,101.02 tons, while the lowest was in 2019, with only 1,496.7 tons. The annual catch fluctuated throughout the years, showing both increases and decreases. These fluctuations may be attributed to various factors, both natural and anthropogenic. Natural factors include weather, seasons, oceanographic, and climate change. Anthropogenic factors refer to overfishing, increased fishing effort, and changes in fishing grounds. For example, changes in water temperature or climate disturbances may affect shrimp's life cycle and migration patterns, influencing catch volumes.

On the other hand, human activities also play a significant role in determining catch volumes. Excessive exploitation beyond the resource's capacity (overfishing), an increase in the number of fishing fleets and effort, and changes in the location and intensity of fishing activities are anthropogenic factors that can exert considerable pressure on shrimp stocks. Bousquet et al.[10] noted that if exploitation is uncontrolled and exceeds the Maximum Sustainable Yield (MSY), fishery stocks risk significant decline.

Fishing Effort for Jinga Shrimp (*Metapenaeus monoceros*)

The fishing gear used to catch jinga shrimp is the trawl net, as defined in Ministerial Regulation of Marine Affairs and Fisheries No. 36 of 2023, which was previously referred to as mini trawl or gillnet. The fishing effort recorded annually has shown both increases and decreases over time. The fishing effort using gillnet gear is presented in Table 2.

Table 2. Fishing effort (number of fishing gears) in 2017–2023

Fishing Gear	Fishing Effort (Trips/Year)						
	2017	2018	2019	2020	2021	2022	2023
Gillnet	43	97	96	88	90	90	90

Source: Data from the Fisheries Department of Tanjung Jabung Barat

The statistical data in Table 2 show that the fishing effort for jinga shrimp fluctuated during 2017–2023. The number of fishing trips experienced a significant increase from 43 trips in 2017 to 97 in 2018. Although there was a slight decrease in the following years, the effort remained relatively high and stable, ranging from 88 to 90 trips per year between 2020 and 2023. This surge reflects the increasing exploitation pressure on the Jinga Shrimp stock.

The catch percentage approaching 100% per trip indicates that the stock availability remains relatively healthy, at least in the short term. However, if this intensified fishing effort is not accompanied by proper management, it may lead to overexploitation. According to Badiuzzaman et al.[9], if fishing effort continues to rise without maintaining a balance between catch volume and the stock's regenerative capacity, the fishery stock could face a significant population decline.

This concern is echoed by Zhou et al.[11], who stated that uncontrolled increases in fishing effort are among the primary drivers of global stock depletion, especially for high-value species such as shrimp. Furthermore, the FAO5 emphasizes that in practical fisheries management, high fishing pressure must be accompanied by continuous monitoring and evaluating of stock conditions to prevent overexploitation.

Catch Per Unit Effort (CPUE)

In estimating the population of a species, direct observation in its natural habitat is often not feasible. One alternative method is to use CPUE (Catch per Unit Effort) data as a proxy for population abundance. Changes in either an increase or decrease in fishery production can be assessed through CPUE calculations. The CPUE value is determined by comparing the annual catch with the yearly fishing effort. The CPUE values for jinga shrimp are in Table 3.

In Table 3, the highest CPUE value was recorded in 2017, while the lowest occurred in 2019. According to Wulandari et al.[12], CPUE values tend to fluctuate from year to year, and the fewer fishing units used, the higher the CPUE value tends to be indicating a greater catch per unit of effort. This is consistent with the findings of Nabunome[13], who stated that when CPUE and effort are analyzed together, an increase in fishing effort generally leads to a decrease in CPUE, resulting in a lower overall production. In this context, CPUE is inversely related to fishing effort.

Table 3. Catch per Unit Effort (CPUE) of jinga shrimp from 2017 to 2023

Year	Catch (Ton)	Effort (Trip)	CPUE (Ton/Trip)
2017	1875.2	43	43.61
2018	1852.7	97	19.1
2019	1496.7	96	15.59
2020	2013.4	88	22.88
2021	2019.4	90	22.44
2022	2059.79	90	22.89
2023	2101.02	90	23.34
Amount	13418.21	594	169.85
Average	1916.89	84.86	24.26

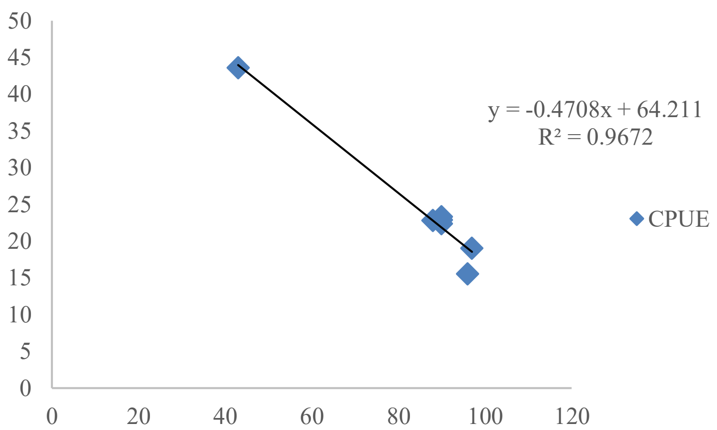

Figure 1. CPUE trend for jinga shrimp

Based on Figure 1 showing the relationship between fishing effort and CPUE of jinga shrimp from 2017 to 2023, a linear regression equation was obtained: $y = -0.4708x + 64.211$, with an R^2 value of 0.9672. This equation indicates a negative relationship between catch per unit effort and fishing effort, meaning that for every 1-unit decrease in fishing effort, the CPUE is expected to increase by 0.4708 tons per effort. Conversely, if fishing effort increases by one unit, CPUE is predicted to decrease by 0.4708 tons per effort. The negative sign (-) in the relationship between effort and CPUE indicates an inverse relationship, where any increase in fishing effort leads to a decline in CPUE. The R^2 value of 0.9672 (96.72%) suggests that changes in fishing effort explain 96.72% of the variation in CPUE, while the remaining 3.28% is attributed to other variables not included in the model. The decline in catch can be influenced by fishing effort, natural factors, and biological factors, implying that fluctuations in CPUE are caused by a combination of these variables[14].

The relationship between CPUE and effort shown in the graph indicates a downward trend in CPUE, suggesting that the exploitation level of Jinga Shrimp could lead to overfishing if left unmanaged. According to Elis & Nurul[15], an upward trend in CPUE implies that the fishery is still in a developing exploitation phase. In contrast, a flat CPUE trend indicates that the resource has reached a saturation point, and a declining CPUE trend signifies that the fishery is approaching or already experiencing overfishing or even an overfished state[16].

Maximum Sustainable Yield (MSY)

The Schaefer model is one of the estimation methods that offers the advantage of simplicity and requires relatively little data, yet it can provide essential information for resource management. Based on the Schaefer model formula graph shown below, which was processed using Microsoft Excel, the Maximum Sustainable Yield (CMSY) was obtained at 2,189.59 tons/year, and the optimum fishing effort (EMSY) was 68.19 trips/year. These values represent the maximum production level of jinga shrimp that can be harvested without jeopardizing the sustainability of the resource.

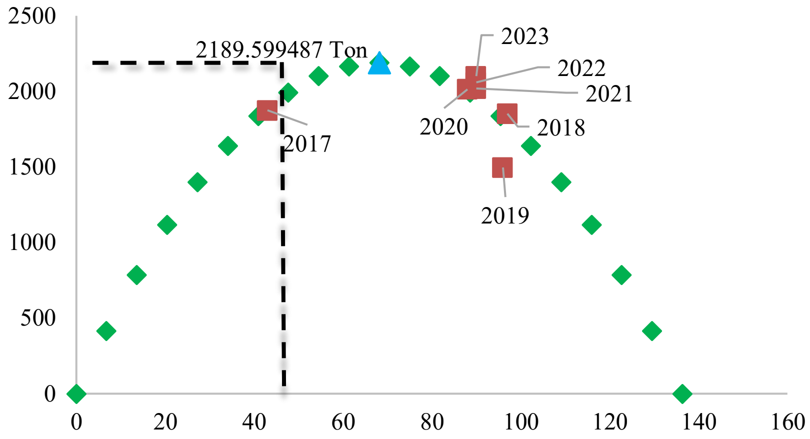

Figure 2. Maximum Sustainable Yield (MSY) Curve of Jinga Shrimp

Figure 2 shows that during 2017–2019, the catch of jinga shrimp in Tanjung Jabung Barat waters remained below the MSY value, indicating that overfishing had not yet occurred. However, during 2020–2023, the catches approached the MSY threshold. This suggests the need to reduce fishing efforts to ensure that catch productivity does not exceed the limit or lead to overfishing. In this period, fishing effort had already surpassed the maximum threshold, but the catches had not yet fully experienced overfishing, although they were close to such a condition. Therefore, controlling fishing intensity is essential to maintain the sustainability of Jinga Shrimp resources in Tanjung Jabung Barat waters and prevent resource depletion.

According to Anas[17], overfishing on fishing grounds is characterized by a decline in catch volume, a reduction in the size of shrimp caught, and an increase in the distance to fishing grounds, raising fishing costs. During 2018–2023, although Jinga Shrimp catches remained below the MSY (sustainable potential), fishing effort exceeded the optimum effort value. This occurred due to the high intensity of fishing operations during the period. Therefore, managing fishing operation intensity is crucial to ensure the sustainability of Jinga Shrimp resources, as excessive fishing operations can lead to overfishing and damage marine ecosystems.

The results of this study align with findings from other regions. For example, a survey conducted in Indian waters by Mohanty et al.[18] demonstrated that *Metapenaeus monoceros* stocks declined significantly when fishing exceeded the optimum effort, even though catches remained below the MSY. Meanwhile, research in Bangladesh by Rahman et al.19 reported that increasing penaeid shrimp fishing intensity without adequate regulation reduced individual size and resulted in overfishing within five years. This comparison highlights that the condition observed in Tanjung Jabung Barat waters follows a similar pattern to other regions, reinforcing that controlling fishing effort is crucial to prevent permanent overfishing.

Allowable Catch (JTB)

In utilizing fishery resource potential, only about 80% of the Maximum

Sustainable Yield (MSY) is commonly used as the basis for sustainable exploitation, as the FAO recommends. Based on the processed data, the allowable catch (Total Allowable Catch, TAC) for jinga shrimp in the waters of Tanjung Jabung Barat is estimated at 1,751.68 tons per year.

Table 4. Total allowable catch of jinga shrimp

MSY Value (Tons/Year)	Formula	Allowable Catch (JTB)
2.189,60	80 % x MSY	1.751,68

Fishing effort is considered to have entered an overfishing condition when the allowable catch (JTBH) exceeds the Maximum Sustainable Yield (MSY). Conversely, fishing effort may still be increased to achieve higher catches if the JTB remains below the MSY value. However, such efforts must not exceed the maximum threshold to avoid compromising the sustainability of the resource population. In the context of exploitation, the allowable catch not only serves to regulate harvest levels but also indirectly helps control the rate of resource exploitation in fisheries.

Based on the available data, jinga shrimp resources are currently under high fishing pressure, increasing production levels. Nevertheless, if this condition continues unchecked, it may lead to stock depletion or even local extinction of the species in the waters of Tanjung Jabung Barat. Therefore, it is necessary to establish a catch quota to safeguard the sustainability and continuity of the Jinga Shrimp stock in the region.

Level of Utilization and Effort

The utilization rate of jinga shrimp resources is determined after estimating the CMSY value. The calculation is performed by expressing the catch at a given time as a percentage of the CMSY. The processed utilization rates can be seen in Table 5.

Table 5. Utilization rate of jinga shrimp in Tanjung Jabung Barat Waters (2017–2023)

Year	Catch (Ton)	CMSY	Utilization Rate	Description
2017	1875.2		86%	Not Yet Overfished
2018	1852.7		85%	Not Yet Overfished
2019	1496.7		68%	Not Yet Overfished
2020	2013.4		92%	Approaching Overfishing
2021	2019.4	2189.599487	92%	Approaching Overfishing
2022	2059.79		94%	Approaching Overfishing
2023	2101.02		96%	Approaching Overfishing
Amount	13418.21		613%	
Average	1916.887143		88%	Not Overfished

The processed data in Table 5 show that the average utilization rate of jinga shrimp resources over the past seven years is 88%. This indicates that the utilization level in the waters of Tanjung Jabung Barat has reached an optimum level and has not yet entered an overfishing condition. However, exploitation levels that exceed the maximum threshold may threaten the sustainability of Jinga Shrimp stocks and could result in a decline in their population.

This aligns with the statement by Simbolon et al.[20], which emphasized that a utilization rate exceeding the Maximum Sustainable Yield (MSY) endangers fishery resources. It disrupts stock availability and the continuity of their life cycles, ultimately leading to a decline in resource abundance.

Table 6. Fishing effort level for jinga shrimp in Tanjung Jabung Barat Waters (2017–2023)

Year	Effort (Trip)	Eopt	Utilization Rate	Description
2017	43		63%	Not Overfished
2018	97		142%	Overfished
2019	96		141%	Overfished
2020	88		129%	Overfished
2021	90	68.19980174	132%	Overfished
2022	90		132%	Overfished
2023	90		132%	
Amount	594		871%	
Average	84.85714286		124%	Overfished

The calculation of the fishing effort utilization percentage for brown shrimp in Tanjung Jabung Barat over the past seven years showed an average of 124%. This indicates that the fishing effort level has entered an overfishing condition. Therefore, any further increase in fishing effort would pose a serious threat to the sustainability of the brown shrimp resource.

This situation also demonstrates that increased fishing gear does not necessarily produce more. Although fishing effort has increased, catch levels have declined, most likely because the fishing effort has exceeded the maximum limit necessary for stock recovery. This rise in fishing effort can be attributed to several factors, such as policy changes that encourage fishery intensification, advancements in fishing gear technology that enhance exploitation capacity, and the high market demand for shrimp products[5].

According to Simbolon et al.[20], when exploitation levels exceed the Maximum Sustainable Yield (MSY), the sustainability of fish stocks is threatened, and their populations face the risk of decline. Therefore, the findings of this study are crucial for guiding local fishery management strategies, such as implementing catch quotas, limiting the number of fishing gears, and enforcing science-based monitoring, to prevent overexploitation and ensure the long-term sustainability of the brown shrimp stock.

4. CONCLUSION

The results of this study indicate that the average utilization rate of jinga shrimp in the waters of Tanjung Jabung Barat during the period 2017–2023 was 88%, which falls within the category of not yet overfished. However, the average fishing effort reached 124%, indicating that fishing pressure has exceeded the optimum limit and poses a risk of overfishing. The estimated Maximum Sustainable Yield (MSY) for jinga shrimp is 2,189.59 tons per year, with a Total Allowable Catch (TAC) of 1,751.68 tons per year. Continuous increases in fishing effort without data-driven and sustainable management could significantly reduce the stock. Therefore, controlling fishing effort and establishing quotas based on MSY are necessary to maintain the sustainability of Jinga Shrimp stocks and support the economic sustainability of coastal communities dependent on this resource.

REFERENCES

1. Suman, A., Lestari, P., & Damora, A. Pengelolaan Udang Mantis (*Harpiosquilla raphidea*) di Perairan Tanjung Jabung Barat dan Sekitarnya, Jambi. *Jurnal Kebijakan Perikanan Indonesia*, 2021; 13(1): 43–58.
2. Fauzi, A., & Anna, S. *Pemodelan Sumber Daya Perikanan dan Kelautan untuk Analisis Kebijakan*. PT. Gramedia Pustaka Utama. Jakarta. 2020.

3. Purwanti, P., Sofiati, D., Intyas, C., & Fattah, M. Resource Sustainability Assessment Using Resource Utilisation and Catch Projection: Case of Prigi Gulf, Indonesia. *Journal of Sustainability Science and Management,* 2023; 19(7): 57–69.
4. Kementerian Kelautan dan Perikanan. Peraturan Menteri Kelautan dan Perikanan Republik Indonesia No. 22 Tahun 2021 Tentang Penyusunan Rencana Pengelolaan Perikanan dan Lembaga Pengelola Perikanan di WPP. Jakarta. KKP. 2021.
5. FAO. *The State of World Fisheries and Aquaculture 2020: Sustainability in Action*. Rome: Fao. (Dokumen Kebijakan MSY). 2020.
6. Widodo, J., & Suadi, S. *Pengelolaan Sumberdaya Perikanan Laut.* Yogyakarta: Gadjah Mada University Press. 2006.
7. Kristiana, H., Malik, J., & Anwar, N. Pendugaan Status Sumberdaya Perikanan Skala Kecil di Kota Semarang. *Journal of Tropical Fisheries Management*, 2021; 5: 51–58.
8. Marinding, J.C., Labaro, I.L., & Pamikiran, R.D.Ch. Catch per Unit Effort Perikanan Tuna Handline dalam Kurun Waktu Lima Tahun di Pelabuhan Perikanan Samudera Bitung. *Jurnal Ilmu dan Teknologi Perikanan Tangkap*, 2023; 8(2): 59–67
9. Badiuzzaman, B., Wijayanto, D., & Yulianto, T. Analisis Potensi Tangkap Sumberdaya Rajungan (Blue Swimming Crab) di Perairan Demak. *Journal of Fisheries Resources Utilization Management and Technology*, 2014; 3(3): 248–256
10. Bousquet, N., Duchesne, T., & Rivest, L.-P. Redefining the Maximum Sustainable Yield for the Schaefer Population Model Including Multiplicative Environmental Noise. *Journal of Theoretical Biology*, 2023.
11. Zhou, S., Smith, A.D.M., Punt, A.E., Richardson, A.J., Gibbs, M., & Fulton, E.A. Ending Overfishing while Catching More Fish. *Fish and Fisheries*, 2015; 16(4): 716–733.
12. Wulandari, R., Lestari, P., & Firmansyah, H. Analisis CPUE (Catch per Unit Effort) Terhadap Upaya Penangkapan Ikan di Perairan Pesisir Kalimantan Timur. *Jurnal Ilmu Perikanan Tropis*, 2020; 25(3): 145–153
13. Nabunome, J. Analisis Tingkat Pemanfaatan Sumberdaya Ikan di Perairan Teluk Ambon. *Jurnal Perikanan dan Kelautan*, 2018; 9(2): 112–119
14. Mayu, M., Syamsuddin, M., & Latama, G. Analisis Pengaruh Faktor Lingkungan dan Biologis terhadap Nilai CPUE di Perairan Teluk Bone. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 2018; 10(1): 37–44
15. Elis, E., & Nurul, H. Analisis Tren CPUE Sumberdaya Ikan Demersal di Perairan Pesisir Kalimantan Barat. *Jurnal Perikanan dan Kelautan*, 2013; 4(2): 123–130
16. Rochmah, M., Wulandari, D., & Prasetyo, S. Tren CPUE dan Tingkat Pemanfaatan Sumberdaya Ikan di Perairan Selatan Jawa. *Jurnal Sumberdaya Perikanan Indonesia*, 2013; 8(1): 45–52
17. Anas, M.I. Indikator Overfishing dan Strategi Pengelolaan Sumberdaya Perikanan Berkelanjutan di Wilayah Pesisir. *Jurnal Kebijakan Perikanan Indonesia*, 2011; 3(2): 95–104.
18. Mohanty, B.P., Behera, B.K., & Sharma, A.P. Assessment of Marine Shrimp Stock Using Surplus Production Models Along the East Coast of India. *Indian Journal of Fisheries*, 2019; 66(3): 1–9.
19. Rahman, M.M., Hossain, M.I., & Alam, M.F. Stock Status and Overfishing Risks of Penaeid Shrimps in Coastal Bangladesh. *Journal of Applied Ichthyology*, 2021; 37(5): 760–770
20. Simbolon, D.R., Gafa, N.R., & Suman, A. Kajian Pemanfaatan Sumber Daya Ikan terhadap Potensi Lestari di Wilayah Pengelolaan Perikanan (WPP) Indonesia. *Jurnal Kebijakan Perikanan Indonesia*, 2011; 3(1): 45–56.