Optimization of purse seine fishing gear on skipjack tuna (*Katsuwonus pelamis*) landed at Kutaraja fishing port

Imelda Agustina[1*], *Nur* Maulidar[1], *Salmarika* salmarika[3], and *Rizwan* Thaib[1]

[1]Department of Fisheries Resources Utilization, Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh, 23111, Indonesia
[2]Research Center for Marine and Fisheries, Faculty of Marine and Fisheries, Syiah Kuala University, Banda Aceh, 23111 Indonesia
[3]Department of Marine Sciences, Faculty of Agriculture, Malikussaleh University, Aceh Utara, 24355 Indonesia

Abstrak. Aceh waters are an area with abundant fishery resources, where Skipjack tuna (*Katsuwonus pelamis*) is one of the leading commodities. This study aims to assess the optimization of purse seine fishing gear on skipjack tuna catch at the Kutaraja Fishing Port (Type A). The research was conducted in August 2024 using observation and interview methods to collect primary and secondary data. The results showed that skipjack tuna production fluctuated during the 2019-2023 period, with the highest production of 9,704 tons in 2023 and the lowest of 6,103 tons in 2021. The highest fishing effort reached 2,676 trips in 2022, while the lowest was 2,112 trips in 2021. The catch per unit effort (CPUE) value reached 3.69 tons/trip in 2023, indicating that purse seine gear is able to operate optimally in supporting the increase in skipjack tuna catch. Optimization of purse seine gear significantly contributes to skipjack tuna catch at PPS Kutaraja, although production fluctuations are still affected by environmental challenges. Good and ecosystem-based management is needed to maintain the sustainability of skipjack tuna stocks and meet the needs of fishermen and markets.

1 Introduction

Aceh waters are waters that have high fishery resources. As recorded by KKP in 2022, the value of production in both WPPs reached 8,964,651.00 tons [1], with the amount of fishing in the Aceh Waters region being high, the production of catches landed at the Kutaraja Fishing Port (PPS) is also high [2]. Based on the logbook data of Kutaraja Fishing Port in 2023 stated that the fishing gear available at the port consisted of 3 types of fishing gear, namely purse seine, longline and longline. Meanwhile, the dominant fishing gear used by fishermen at the Kutaraja Fishing Port is purse seine with a total of 279 units with a percentage of 46%, longline with a percentage of 38% and longline with a percentage of 16% [3].

* Corresponding author: imeldaagustina@usk.ac.id

Purse seine fishing gear is included in active fishing gear with the method of operation of circling a swarm of fish quickly and then immediately pulling the furrowed rope so as to make the net which was originally square become bag-shaped [4]. Purse seine includes fishing gear for pelagic fish species that are clustered (schooling fish), one of the catches of purse seine fishing gear is skipjack tuna (*Katsuwonus pelamis*) [5]. Skipjack tuna (*Katsuwonus pelamis*) resources are included in one of the leading commodities in PPS Kutaraja [6]. Based on PPS Kutaraja logbook records, the number of purse seine fishing gear fleets from 2019 to 2023 has decreased in 2019 the number of units reached 300 units, the number has decreased every year so that in the last record in 2023 the purse seine fleet at PPS Kutaraja was 217 units. The purse seine catch on skipjack tuna catches from 2019 to 2021 did not experience a significant decline, it can be seen in one CTF data that the catch only decreased in 2020, namely 47,294,030,000 tons, but in 2021 it has risen again at 82,063,450,000 [7]. The number of purse seine fishing gear in the PPS Kutaraja logbook has fluctuated with a decreasing number of fleets but the volume of skipjack tuna production from purse seine catches has not decreased so drastically.

The process of catching skipjack tuna can be done throughout the year without any control from various parties will cause fish stocks to be disturbed, so it is not known how the population and stock of skipjack tuna (*Katsuwonus pelamis*) in Aceh waters [8]. Optimization is an approach to optimizing purse seine catches that aims to manage fishing efficiency, technical and economic as a reference for policies in determining the processing of skipjack tuna catch stocks [9]. Previous research conducted by [10], namely skipjack tuna production which decreased by 20.60% from 2016 in Perigi Mountong district, Central Sulawesi. Optimization studies on the fishing gear used can increase the catch of skipjack tuna so that it is necessary to study the optimization of purse seine fishing gear on skipjack tuna catches at PPS Kutaraja. Therefore, this study aims to assess the optimization of purse seine fishing gear on skipjack tuna catch at PPS Kutaraja so that it can support sustainable management of fisheries resources.

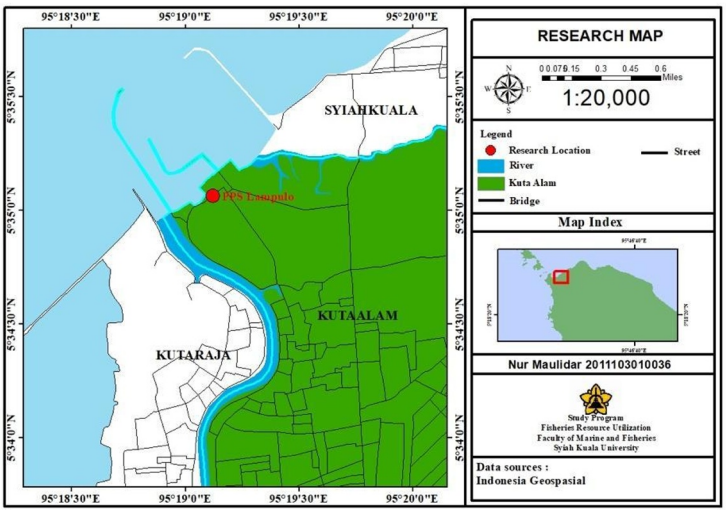

Fig. 1. Research location.

2 Research methods

2.1 Time and place

This research was conducted in August 2024 at the Kutaraja Fishing Port, Kuta Alam District, Banda Aceh City. Aceh.

2.2 Tools and materials

The tools used in this research include laptops for data processing and analysis, digital cameras for field documentation, stationery for data recording and interviews. The materials used consist of questionnaires as research materials.

2.3 Data collection method

This research uses observation and interview methods. Data collection was carried out for 30 days in August 2024 at the Kutaraja Fishing Port (PPS), Kuta Alam District, Banda Aceh. Primary data include the type of skipjack tuna catch, the number of fishing trips, skipjack tuna fishing grounds, and the number of crew members, which were obtained through interviews with fishermen and direct observation. Secondary data include skipjack tuna catch production for five years (2019-2023) at PPS Kutaraja [7], the number of purse seine fleet at PPS Kutaraja and the number of purse seine fishing trips, obtained from the PPS Kutaraja agency through interviews.

2.4 Data analysis

The data analysis used to measure the efficiency of purse seine gear in fishing activities is CPUE (Catch Per Unit Effort). CPUE (Catch Per Unit Effort) CPUE is a calculation commonly used to determine the development of fish stocks, and as an indicator of the efficiency of fishing operations fishing operations without the need for as much data as other methods. The CPUE value is calculated based on the ratio between fish catch and fishing effort, which is measured in the number of trips. In this study, CPUE is used to assess the level of optimization of purse seine gear on skipjack tuna catch in Kutaraja Fishing Port. Mathematically, it can be written in the calculation formula as follows [11]: Catch Rate Calculation (CPUE):

$$CPUE = \frac{Catch_t}{Effort_t} \quad (1)$$

CPUE value is obtained by dividing the total production (kg) of skipjack tuna with the number of purse seine fishing trips. CPUE data were then analyzed from year to year to see fluctuations in fishing efficiency. CPUE value is used as the main indicator to assess the optimization of purse seine fishing gear. A decrease or increase in CPUE will reflect the effectiveness and efficiency of the use of purse seine fishing gear.

3 Results and discussion

3.1 Results

Based on research on the optimization of purse seine fishing gear on skipjack tuna (Katsuwonus pelamis) catches conducted at the Kutaraja Fishing Port (PPS). The results of this study indicate that skipjack tuna production fluctuated during the 2019-2023 period. The trend graph of catch production can be seen in Figure 2 below.

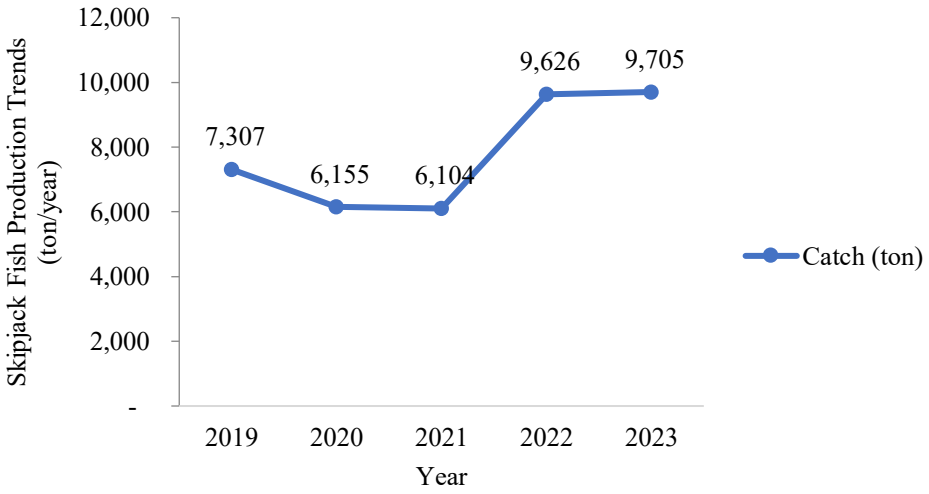

Fig. 2. Trend production chart of skipjack tuna catches 2019-2023 at the Kutaraja fishing port.

The highest production was achieved in 2023 at 9,704 tons, while the lowest production occurred in 2021 at 6,103 tons. Skipjack tuna production decreased by 15.76% in 2019-2020 and 0.84% in 2020-2021. However, production increased sharply by 57.71% in 2021-2022, indicating a significant recovery. In 2023, there was another increase of 0.82%, although not as large as the previous year. These fluctuations reflect the dynamics of fish availability and the effective use of fishing gear, influenced by environmental conditions and management policies [2].The trend graph of skipjack tuna fishing effort (trip) in 2019-2023 at Kutaraja Fishing Port can be seen in Figure 3 below.

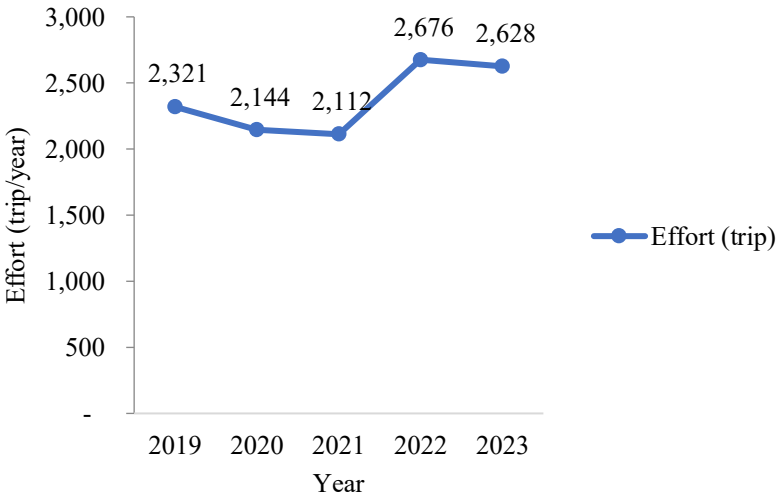

Fig. 3. Chart of trend catch effort (trip) of skipjack tuna fish in 2019-2023 at the Kutaraja fishing port.

Based on Figure 3, the highest fishing effort occurred in 2022 with a total of 2,676 trips, while the lowest effort occurred in 2021 with 2,112 trips. Figure 3 shows small fluctuations in purse seine fishing effort. Effort dropped 7.63% from 2019 to 2020, then dropped another 1.49% in 2020-2021. However, there was a sharp increase of 26.70% in 2021-2022, followed by a decrease of 1.79% in 2023. These fluctuations reflect the influence of weather, fisheries policy, and fish availability on fishing effort [4]. The Catch Per Unit Effort (CPUE) value is calculated to assess the effectiveness of purse seine gear in catching skipjack tuna. The CPUE graph from 2019 to 2023 is shown in Fig 4.

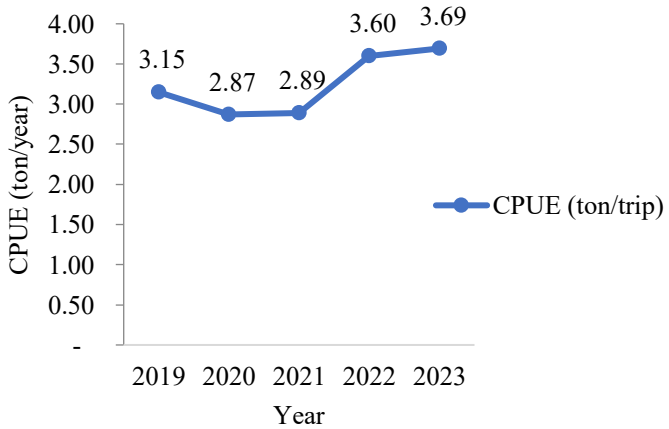

Fig. 4. CPUE chart (ton/trip) of skipjack tuna fish 2019-2023 at Kutaraja fishing port.

The highest CPUE value was achieved in 2023 with a value of 3.69 tons/trip, while the lowest value occurred in 2020 with a value of 2.87 tons/trip. Meanwhile, the CPUE value decreased by 8.81% in 2019-2020, but increased slightly by 0.66% in 2020-2021. Furthermore, there was a significant jump of 24.47% in 2021-2022, reflecting improved fishing efficiency. A smaller increase of 2.66% in 2022-2023 signaled the successful of fishing and fisheries management strategies. Fluctuating CPUE values indicate changes in the effectiveness of fishing gear, which may be due to changes in fish stock numbers, fishing techniques, and environmental factors.

3.2 Discussion

Purse seine is an effective gear for catching pelagic fish with schooling behavior. It is rectangular in shape, and the main part is made of mesh material, with pockets forming when the device is operated. The design and construction of the purse seine affects the sinking speed of the net, the coiling of the net, and the pulling of the collar rope. The purse seine fishing method is aggressive because it catches pelagic fish that live in schools [12].

Time series data on skipjack tuna production and fishing effort at PPS Kutaraja Lampulo between 2019 and 2023 were obtained from the Aceh Provincial DKP Fisheries Statistics. The graph in Figure 2 shows that the highest production occurred in 2023 with 9,704 tons, while the lowest production was in 2021 with 6,103 tons. Production decreased from 2019 to 2021, but increased dramatically in 2022 and 2023. Research by [13] at PPS Kutaraja Lampulo showed that the level of skipjack tuna production from 2016 to 2020 peaked in 2019 at 13,724,527 kg, then decreased in 2020, while the lowest production was recorded in 2016 at 8,533,551 kg. Production increased from 2016 to 2019, but decreased in 2020. The catch at Sibolga VAT [14] shows that the highest production occurred in 2018 with 15,353 tons, while the lowest was in 2022 with 7,831 tons. The data shows fluctuations in skipjack tuna catches that tend to decrease, especially in 2022, which is caused by extreme weather and the frequency of large waves, becoming a challenge for fishermen to reach the fishing ground [15]. Annual production at fishing ports also fluctuates, as is the case at Muara Angke Fish Landing Port [16] and Tegalsari Beach Fishing Port [17].

Figure 2 shows a graph of fishing effort (effort) which fluctuates because the value of effort increases and decreases every year. The highest effort value was recorded in 2022 with 2,676 trips/year, while the lowest was in 2021 with 2,112 trips/year. According to the head of UPTD PPS Kutaraja, purse seine boat trips vary every month and year because the number of ships entering and departing is uncertain. The level of effort that exceeds the optimum effort can cause overfishing, characterized by a decrease in catch, fishing in increasingly distant areas, and smaller fish sizes [18]. In addition, the capital cost of fishing will be higher than the revenue due to lower catches.

Research in Southeast Sulawesi [19] showed that the total effort of small pelagic fishing in 2016 amounted to 146.92 tons, increasing to 216 units in 2020. The results of this total effort calculation can be used to calculate CPUE. In contrast, research at Sibolga VAT [14] showed that the highest level of skipjack tuna effort occurred in 2019 with 80% and the lowest in 2022 with 31%. This shows that the higher the effort, the more it affects the yield. In determining the CPUE of skipjack tuna, the

formula of catch divided by fishing effort is used. Based on the calculation, the highest CPUE value occurred in 2023 with 3.69 tons/trip, while the lowest was in 2020 with 2.87 tons/trip. The high and low production of catches is highly dependent on the stock of fish resources in the aquatic environment [20]. Fluctuations in CPUE from 2019 to 2023 were caused by the increasing distance of fishing grounds and the influence of changes in natural conditions, such as storms that endanger the safety of fishermen [21], which caused trips to fluctuate. The increase in CPUE reflects the recovery of fish resources [22].

It is important to understand how purse seine gear optimization contributes to skipjack tuna catch in Kutaraja Fishing Port. It is highly effective in catching schooling pelagic fish, and the design and construction of the net affect its catching efficiency. Fluctuations in skipjack tuna production over the period 2019 to 2023 show complex dynamics. The highest production was recorded in 2023 with 9,704 tons, while the lowest was in 2021 with 6,103 tons. This trend reflects fluctuations influenced by fishing effort and environmental conditions, including climate change and extreme weather affecting fishers' access to fishing grounds. The decline in production from 2019 to 2021 by 15.76% shows the challenges faced by fishers in maintaining the sustainability of the catch, while the significant jump in 2022 and 2023 by 0.82% reflects the success of optimization efforts.

Analysis of CPUE values over the same period showed that although there was a decrease in CPUE from 2019 to 2020 by 8.81%, recovery occurred with an increase of 24.47% from 2021 to 2022. The highest increase in CPUE in 2023 of 3.69 tons/trip indicates that the optimization strategy implemented was effective in increasing catches despite environmental challenges. Research conducted by [13] at PPS Kutaraja Lampulo and [14] at PPN Sibolga showed that good management can encourage the recovery of fish stocks, which is expected to be a reference in sustainable fisheries resource management. Furthermore, fluctuations in fishing effort in Figure 3 show that fishing trips are not always directly proportional to catches. The increased fishing effort in 2022 with a value of 2,676 trips/year shows that although fishermen are trying harder, the results obtained are not always optimal. The increase and decrease in effort values is influenced by various factors, including management policies and fish market conditions. Overfishing due to fishing effort that exceeds the optimal limit needs to be watched out for, because it can result in a sustainable decline in catches. Therefore, maintaining a balance between fishing effort and the sustainability of fish resources is essential. An ecosystem-based management approach needs to be applied so that the use of purse seine gear can be optimized without threatening the sustainability of skipjack tuna populations in Aceh waters.

The results of this study indicate that the optimization of purse seine fishing gear in Kutaraja Fishing Port depends not only on gear design, but also on holistic and sustainable fisheries resource management, including close monitoring of environmental conditions as well as regulation of the number of trips and catch quotas to ensure catches can meet the needs of fishermen and markets without compromising the sustainability of aquatic ecosystems.

4 Conclusion

The conclusion of this study shows that the operational level of purse seine gear in catching skipjack tuna (*Katsuwonus pelamis*) at the Kutaraja Fishing Port can be declared optimal. This is indicated by the increasing catch of skipjack, with the highest production of 9,704 tons in 2023 and the highest Catch Per Unit Effort (CPUE) value of 3.69 tons/trip in the same year. This trend reflects that purse seine gear is able to contribute significantly to the fulfillment of catch targets. Purse seine gear operations have reached an optimal level, reflecting efficiency that is in accordance with the potential of fishery resources and the characteristics of the aquatic environment in the Kutaraja Ocean Fishing Port area.

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