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PRODUCTIVITY OF PURSE SEINE FISHING TOOLS OPERATING IN THE WATERS OF OUTER AMBON BAY, MALUKU

Produktivitas Alat Tangkap Purse Seine yang Beroperasi di Perairan Teluk Ambon Luar, Maluku

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ABSTRACT

The decline in fish populations can negatively impact the livelihoods of fishermen and local food security. Therefore, maintaining the sustainability of fisheries is an urgent necessity. Evaluating the productivity of purse seine catches in the outer waters of Ambon Bay is crucial in this context. This study aims to measure the productivity level of purse seine fishing gear and identify the factors that influence it. The research was conducted from June 2023 to May 2024 in Laha Village, Outer Ambon Bay, Ambon Island. The research method used is a quantitative descriptive method, which aims to describe the productivity of purse seine fishing gear in detail based on data obtained in the form of graphs and tables. Data collection was carried out through field surveys and direct observations during fishing activities. The data analysis results showed that the highest volume and number of trips were in November, with 18 trips and a production volume of 644 kg/trip, while the lowest was in May, with 12 trips and a production volume of 184 kg/trip.

Keywords: Ambon Bay, Fishing Season, Productivity, Purse Seine

ABSTRAK

Penurunan populasi ikan dapat berdampak negatif pada mata pencaharian nelayan dan ketahanan pangan lokal. Oleh karena itu, menjaga keberlanjutan perikanan adalah suatu keharusan yang mendesak. Evaluasi produktivitas hasil tangkapan *purse seine* di perairan Teluk Ambon luar menjadi sangat penting dalam konteks ini. Penelitian ini bertujuan untuk mengukur tingkat produktivitas alat tangkap *purse seine* serta mengidentifikasi faktor-faktor yang mempengaruhinya. Penelitian ini berlangsung pada bulan Juni 2023 sampai Mei 2024 di Desa Laha, Teluk Ambon Luar, Pulau Ambon. Metode penelitian yang digunakan adalah metode deskriptif kuantitatif, yang bertujuan untuk mendeskripsikan produktivitas alat tangkap *purse seine* secara rinci berdasarkan data yang diperoleh dalam bentuk grafik dan tabel. Pengambilan data dilakukan dengan metode survei lapangan dan observasi langsung selama kegiatan penangkapan ikan. Hasil analisis data yang diperoleh menunjukkan volume dan jumlah trip tertinggi berada pada bulan November yaitu sebanyak 18 trip dengan volume produksi sebesar 644 kg/trip sedangkan paling rendah pada bulan Mei sebesar 12 trip dengan volume produksi

sebesar 184 kg/trip.

Kata Kunci: Teluk Ambon, Musim Penangkapan, Produktivitas, *Purse Seine*

INTRODUCTION

The waters of the outer Ambon Bay are one of the potential fishing areas for fish resources in the archipelago (Matrutty, 2021), and have an important role in supporting the economic and social life of the local community (Herdiansyah *et al*., 2021). The lives of most of the population of Ambon Island, both directly and indirectly, are highly dependent on fish catches from these waters (Nugroho *et al*., 2021; Rahman & Hermanto, 2023). The fishery resources of Laha Village have long been the main livelihood for local fishermen, and the economic potential generated from this fishery cannot be ignored. One of the fishing methods commonly used by fishermen in Laha Village is to use purse seine fishing gear. This fishing gear has become the main choice because of its efficiency in catching fish in bulk in one fishing process (Basurko *et al*., 2022). The operation of this fishing gear is by slowly releasing the net which is spread in the waters, then pulled together to catch fish in large numbers. The practicality of using purse seine makes it a tool that is in demand by fishermen, especially in catching small pelagic fish such as mackerel, scad, and tuna.

However, although the fishing method using purse seine fishing gear has advantages in terms of efficiency, its use also presents several environmental and sustainability issues (Murua *et al*., 2023). One of the most striking issues is the decline in the fish population ratio in the outer Ambon Bay waters. This phenomenon raises serious concerns about the sustainability of fisheries in the Ambon Bay waters. The decline in fish populations can have a negative impact on fishermen's livelihoods and local food security. Therefore, maintaining the sustainability of fisheries is an urgent need. Evaluation of purse seine catch productivity in the outer Ambon Bay waters is very important in this context. This study aims to measure the level of purse seine fishing gear productivity and identify the factors that influence it. By understanding productivity and contributing factors, better and more sustainable fisheries management strategies can be formulated. At the same time, it can evaluate the use of purse seines on marine ecosystems and find solutions to minimize negative impacts.

Several previous studies have shown that unmanaged fishing can lead to overfishing (Wiadnyana *et al*., 2017; Atmaja *et al*., 2017; Danielsen & Agnarsson 2018; Restiangsih & Amri 2019; de Mitcheson *et al*., 2020) which in turn can result in a drastic decline in fish stocks in certain waters. This decline has begun to be felt in several parts of Ambon Bay Waters. Reports from the local Marine and Fisheries Service indicate a decline in the number of annual catches and a decreasing size of fish caught, indicating a decreasing population of adult fish that can reproduce. In addition, research by Lezama-Ochoa *et al*. (2018) shows that purse seine fishing gear often catches non-target fish (bycatch) which can have a negative impact on marine biodiversity. Through a comprehensive analysis, it is hoped that ways can be found to increase productivity without sacrificing the sustainability of fishery resources, so that the welfare of fishermen and the sustainability of the marine ecosystem can be maintained properly. This research is important to provide a scientific basis for making the right decisions in fisheries management in Ambon Bay waters and to ensure that fishing activities can take place sustainably and support the welfare of local communities in the long term. The purpose of this study was to analyze the productivity level of purse seine fishing gear in the outer Ambon Bay waters.

METHODS

Place and Time

This research took place from June 2023 to May 2024 in Laha Village, Outer Ambon Bay, Ambon Island.

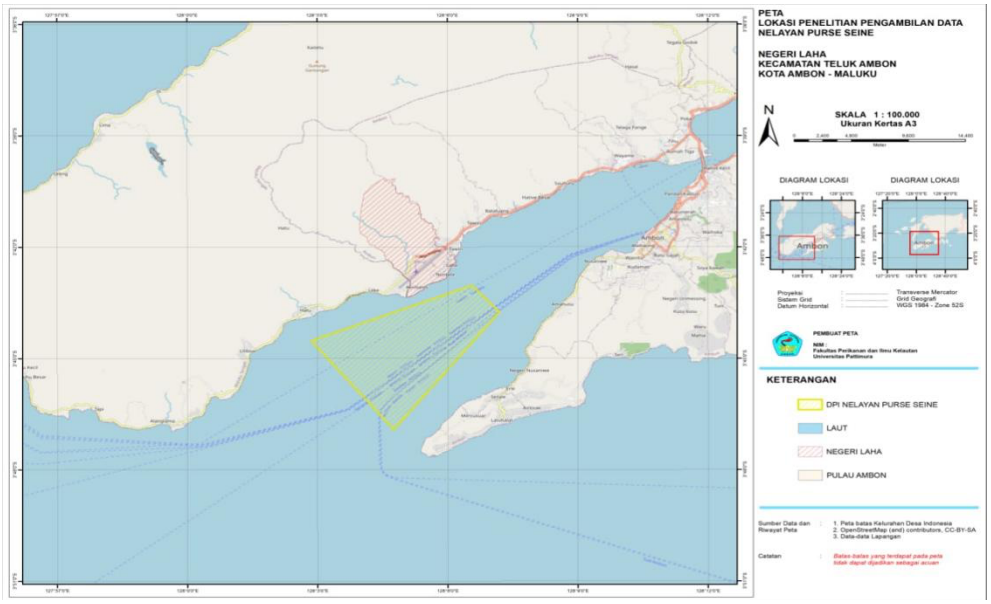

Figure 1. Research Location

Collecting Data Methods

The tools and materials used in this study include fishing vessels equipped with purse seine fishing gear, Global Positioning System (GPS) devices to determine fishing locations, sonar fish finders to detect the presence of fish. In addition, a daily catch recording form, a camera for visual documentation, and a computer device for data analysis were also used.

The research method used is a quantitative descriptive method, which aims to describe the productivity of purse seine fishing gear in detail based on the data obtained. Data collection was carried out using field survey methods and direct observation during fishing activities (Tuapetel *et al*., 2022; Tuapetel *et al*., 2024).

Productivity data is calculated as the weight of fish caught per trip (kg/trip). Data analysis was carried out using descriptive statistics (Laoda *et al*., 2022) to calculate the average productivity per month, as well as correlation analysis to identify the relationship between productivity and environmental variables such as water temperature and salinity.

Data Analysis Methods

Technical aspects that are used as benchmarks to determine the effectiveness of purse seine fishing operations include purse seine construction, fishing methods, catch composition, season and fishing area (Mardiah *et al*., 2020). The assessment of technical aspects is more focused on the assessment of fishing gear productivity as seen from secondary data (Silalahi *et al*., 2020). Productivity is a measuring tool to determine whether a fishing gear is technically efficient or not (Caronge *et al*., 2024). Productivity is also a comparison between catch results and all resource inputs used (Ardi, 2022). The calculation of purse seine fisheries productivity values uses secondary data using the following equation:

$$\text{Productivity per trip} = \frac{\text{Production volume (kg)}}{\text{Number of trips (trips)}}$$

Capture fisheries productivity refers to the productivity of the ship or boat used in fishing activities. Fishing vessels are measured based on how effective the ship is in catching fish for one year (Damayanti, 2020). To calculate the annual productivity of fishing vessels, we can divide the total catch per vessel in one year by the number of vessels used. The high or low productivity will determine the feasibility of the fishing business (Saputra *et al*., 2011). In addition, the annual productivity of fishing vessels can also be calculated by dividing the total catch per vessel in one year by the size of the vessel's GT (Kholizah *et al*., 2023).

RESULT

Characteristics of Purse Seine

The number of mini purse seine fishing gear in Maluku Province in 2018 was 462 units. Currently, there are 121 fishing gear on Ambon Island, consisting of 43 units in Central Maluku Regency (Salahutu District 10 units, Leihitu 25 units, and West Lehitu 8 units) and 78 units in Ambon City, consisting of Sirimau District 10 units, South Leitimur 10 units, Ambon Bay 23 units, Ambon Baguala Bay 7 units, and Nusaniwe 28 units (Pattipeilohy & Talakua, 2019). Purse Seine nets are generally used to catch pelagic fish in groups (Sabe *et al*., 2021). The operating technique of this fishing gear involves blocking and encircling a group of fish. Furthermore, the purse line is pulled to the ship until the net forms a bowl-like shape. The fish catch is then transferred to the ship using a scoop (Made *et al*., 2023).

Ship Description

The fleet of mini purse seine fishing vessels around Ambon Island have relatively the same shape, but slightly different sizes. The sizes of these purse seine vessels vary and are made of wood and wood coated with fiber glass. The shape of the mini purse seine vessel in Laha Village can be seen in Figure 2.

Figure 2. The Shape of a Mini Purse Seine Boat in Laha Village

Polhaupessy *et al*. (2020) explained that the mini Purse Seine boats used by fishermen operating in the waters of Ambon Island are made of wood, some are coated with fiber or not coated. With a length of between 14-23.2 m, a width of 2.8-4.1 m, and a height/depth of 1.2-1.8 m. On average, each ship is equipped with 2-3 driving engines, namely a Yamaha engine with a power of 40 HP/unit. The fuel used is kerosene, gasoline, and oil. The size of the purse seine varies, namely the total length (LoA) of 18 - 25 meters with an average of 20.25 meters, width (B) 3 - 4 meters, and height (D) 2 - 3 meters. The Gross Tonnage (GT) size of the purse

seiner ranges from 18.90 GT to 46.20 GT with an average of 26.49 GT. The smallest ship is 18.90 GT and the largest is 46.20 GT. According to the classification made by Nomura & Yamazaki (1977), it is included in the Japanese type purse seine with one ship. Figure 3 shows the construction of the purse seine net body on Ambon Island. In general, the materials that form the mini purse seine consist of:

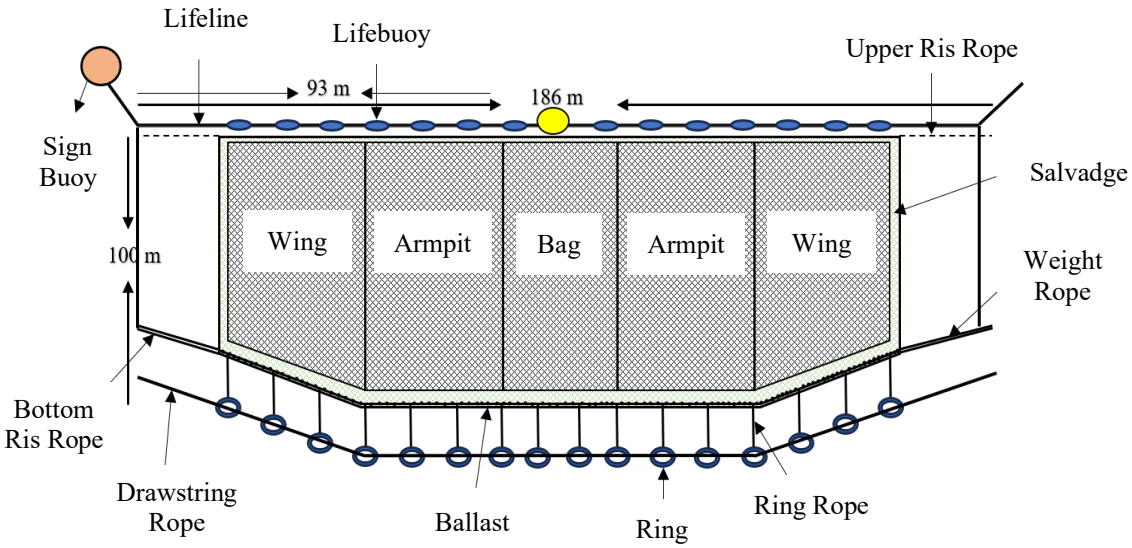

Figure 3. Purse Seine Construction and Its Parts

Total Catch

Various factors, including the season and oceanographic factors such as currents, winds, and waves that occur in the waters around the fishing location, affect the number and types of fish caught. This condition results in different catches for each trip. The types of fish that are the main target of purse seine fishing are small pelagic fish that form schools. The results of observations during the study showed that the types of fish caught in the outer Ambon Bay waters were: Mackerel (*Decapterus* sp.) (41%), Selar (*Selar* sp.) (8%), Skipjack Tuna (*Euthyinus affinis*) (21%), Skipjack Tuna (*Katsuwonus pelamis*) (15%) and several other types in small quantities.

Table 1. Total Fish Catch for the Period June 2023 – May 2024

No	Family	Species	Local Name	Amount (kg)
1	Carangidae	*Decapterus macrosoma* (Bleeker, 1851)	Momar Putih	31762
2	Scombridae	*Auxis thazard* (Lacepede, 1800)	Komu	16260
3	Carangidae	*Selar boops* (Cuvier, 1833)	Kawalinya	5876
4	Scombridae	*Thunus albacares* (Bonnaterre, 1788)	Putilai	11650
5	Scombridae	*Katsuwonus pelamis* (Linnaeus, 1758)	Cakalang	11852

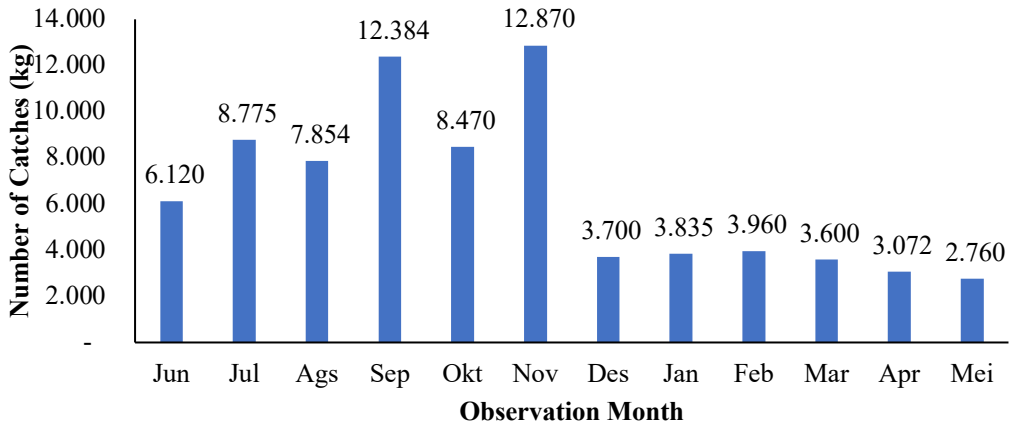

Figure 4. Number of Catches per Month

Productivity of Catch

The productivity of the catch is actually fluctuating, where there is a significant increase in productivity in July, September, and November, where the highest peak is reached in November with 644 kg/Trip. However, after November, there was a decrease in productivity in December to 247 kg/Trip. This decrease continued until January to May with the lowest productivity recorded in May at 184 kg/Trip. Productivity of the catch can be seen in Figure 5.

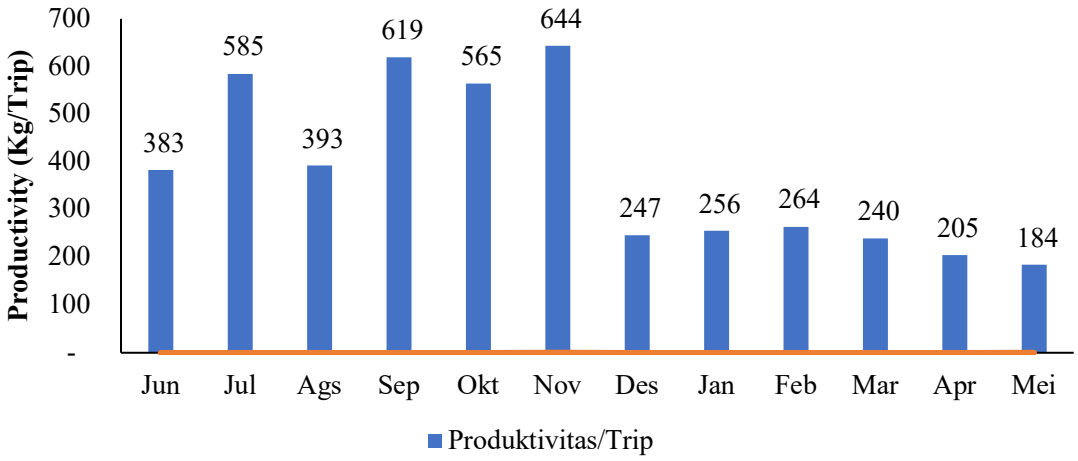

Figure 5. Productivity of Catch Results

This graph provides an overview of the fluctuations in catch productivity throughout the year, showing peak catches in certain months and declines in others. This can be influenced by various factors such as weather conditions, fishing season, or food availability. The graph showing the fluctuations in catch productivity per month can be explained by several scientific factors that affect fishing activity and catches. In general, fish catch productivity is thought to be greatly influenced by environmental factors such as water temperature, fish migration patterns, and weather conditions. In months with high productivity such as July, September, and November, warmer water temperatures can increase fish metabolic activity (Fujioka *et al*., 2021), encouraging them to forage more aggressively and thus be more easily caught. In addition, some fish species have seasonal migration patterns that make them more abundant in the catchment area in certain months (Imron *et al*., 2022), especially during the spawning season (Tuapetel *et al*., 2019; La Ima *et al*., 2023). Productivity based on the interval scale can be seen in Table 2.

Table 2. Productivity of Catch Results Based on Interval Scale

Month	Low (0-300 kg/trip)	Medium (301-500 kg/trip)	High (501-700 kg/trip)
June	-	383	
July	-	-	585
August	-	-	513
September	-	-	619
October	-	-	644
November	147	-	-
December	256	-	-
January	264	-	-
February	256	-	-
March	240	-	-
April	205	-	-
May	184	-	-

Based on the monthly catch productivity graph in the outer waters of Ambon Bay, the productivity of purse seine fishing gear can be grouped into three categories: low, medium, and high. High productivity (501-700 kg/trip) was recorded from July to October, with the peak occurring in October reaching 644 kg/trip. This period shows that environmental conditions are very supportive of fishing activities. According to Arevalo *et al*. (2023); Itsukushima (2023); Menon *et al*. (2023); Rutterford *et al*. (2023), this may be due to a combination of several factors such as optimal water temperature, suitable salinity, and abundant food availability.

Medium productivity (301-500 kg/trip) occurred in June with a catch of 383 kg/trip. This month marks the transition from low to high productivity conditions, which may be influenced by seasonal changes and increasing fish movements. Low productivity (0-300 kg/trip) was recorded from November to May, with the lowest point in December at 147 kg/trip. Low productivity during this period was most likely caused by unfavorable weather conditions, such as strong winds and high waves, which reduced the efficiency of fishing operations. In addition, ecological factors such as reduced fish numbers due to seasonal migration patterns also played a role.

DISCUSSION

Oceanographic conditions of the waters such as currents, waves, and high waves, fishermen do not catch during the east season (Hukubun *et al*., 2023; Pelasula *et al*., 2023). The type of momar fish, or scad, is the main catch caught in the purse seine fishing gear. Scad catches usually vary from month to month. The highest results occur in November and the lowest in May, possibly due to water conditions (Tuapetel, 2021) and the right fishing time (Hehanussa *et al*., 2023).

During the study, the operation of the purse seine fishing gear produced the largest number of catches, consisting of 2 families and 3 species including *Decapterus macrosoma* (31762 tails), *Auxis thazard* (16260 tails) and *Katsuwonus pelamis* (11852 tails). According to Paillin *et al*. (2023), the composition of the mini purse seine catch on Ambon Island includes three families and twelve species. With sizes that change every month, the Carangidae, Scombridae, and Engrailidae families produce the most catches. However, *Decapterus macrosoma* and *Auxis thazard* are the most caught. The same thing was conveyed by (Ode *et al*., 2023; Tawari *et al*., 2024) that the dominant small pelagic fish species sold from the most to the least are *Decapterus* sp., *Rastreligger* sp., *Selar* sp., and *Auxis* sp.

September and November show very high catches. This could be due to the peak of pelagic fish migration in the catchment area, which allows the purse seine fishing gear to work

very efficiently. The same thing was conveyed by Sutono *et al*. (2022) that the migration of small pelagic fish peaks in September and November. This migration is caused by changes in water temperature and food availability, which causes schools of fish to gather in certain areas that can be easily reached by purse seine. In these months, environmental conditions may be very favorable for schools of fish to gather in certain areas to facilitate purse seine fishing. Favorable water conditions such as optimal water temperatures and high plankton availability in certain months can increase the productivity of purse seine fishing gear (Adharani *et al*., 2024). A significant decrease in the number of catches from December to May may indicate that pelagic fish have migrated to other places or are hiding in deeper waters that are more difficult to reach by purse seine.

Weather factors can also play a role with rainy or stormy seasons affecting fishing operations (Hehanussa *et al*., 2024; Hehanussa, 2024). Purse seine gear productivity is highly dependent on the season, fish migration, environmental conditions, and the technology used. The graph of monthly catches shows how these factors affect catches with significant fluctuations.

The significant decline in productivity after October to November and beyond could be due to lower water temperatures and more extreme weather changes, such as strong winds and storms, which reduce fishing activity. In addition, overfishing during high productivity months can also reduce the number of fish available for capture in subsequent months. Other factors such as fishing regulations that limit the season and catch amounts to protect fish stocks can also play a role (Erisman *et al*., 2017). Overall, the complex interaction between environmental and biological factors explains the fluctuations in fish catch productivity shown in the graph in Figure 5.

In addition, the decline in productivity from December to May could be due to the entry of the rainy and stormy seasons. The west monsoon, which usually occurs from December to March, is often accompanied by storms and heavy rains that make fishing operations more difficult and risky. Choppy sea conditions and bad weather reduce the number of effective fishing days and force fishermen to operate closer to the coast, where fewer fish are usually caught (Bull *et al*., 2023).

Scientifically, understanding this scale of productivity is important for planning more efficient fishing strategies. Fishing should be focused on months with high productivity to maximize yields. In months with low productivity, alternative strategies such as gear diversification or the development of more adaptive fishing technologies can be implemented to maintain the sustainability and efficiency of fishing operations in the outer Ambon Bay.

CONCLUSION

Based on this study, it can be concluded that the productivity of purse seine fishing gear in the waters of Outer Ambon Bay experienced a significant increase in certain months, namely July, September, and October. The highest productivity peak was reached in November. However, after October, there was a decline that continued until December, where productivity reached its lowest point. This downward trend continued until January to May, with the lowest productivity recorded in May. Therefore, the best time to carry out fishing activities in the waters of Outer Ambon Bay is between July and November.

Based on this study, the suggestion that can be taken is to conduct a comparative study between purse seine fishing gear and other fishing methods used in the waters of Laha Village, such as gill nets or handlines. This study can help understand the advantages and disadvantages of each method in the context of productivity and sustainability. Furthermore, a study of the reproductive biology of dominant pelagic fish caught in the waters of Outer Ambon Bay needs to be studied to determine whether the peak of fishing by fishermen coincides with the fish spawning season or not.

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