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ANALYSIS OF OPERATIONAL CHARACTERISTICS OF PURSE SEINE VESSELS BASED IN PPS NIZAM ZACHMAN USING VESSEL MONITORING SYSTEM DATA (Case Study at WPP 572)

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ABSTRACT

A purse seine is one of the effective fishing gear, especially for catching pelagic fish. The fishing vessel based at Nizam Zachman Fishing Port Type A (PPSNZJ) and has an arrest permit in WPP 572 is dominated by purse seine. The surveillance function by the Ministry of Marine Affairs and Fisheries (KKP) is carried out by looking at the position data of the ship recorded by the VMS, as well as looking at the fishing logbook by fishermen. The study aimed to identify the characteristics of purse seine vessels using VMS data derived from KKP and looked at the degree of conformity of VMS data with fishing logbooks. The method used in this research is descriptive analysis methods. Fishing ground data is mapped using spatial data processing software. The results showed that the characteristics of purse seine vessels in 2017 were most in operation in April - July, 2018 in January - June, and in 2019 in May. Cross-matching fishing logbook with VMS data from 2017 - 2019 increased by 68% in 2017, 80% in 2018, and 83% in 2019.

Keywords: VMS; logbook; Purse seine.

INTRODUCTION

The potential of marine and fisheries resources in Indonesia is a potential that can be optimized for management to realize the welfare of the people, the sustainability of marine resources and fisheries, and the increasing role of the marine and fisheries sectors in national economic development. The world's fisheries have become a dynamically growing sector. Many countries are trying to take advantage of the fishing sector because of these opportunities. It is a shared responsibility in maintaining fishery resources to make the sector under control (FAO, 1998).

Open access fishing shall be accompanied by an obligation to do so in a responsible manner to ensure the effective conservation and management of aquatic biological resources. Fisheries management is directed to achieve the continuity of aquatic biological resource productivity, implemented to achieve optimal utilization of fishery resources, and ensuring the sustainability of fish resources (Savitri, 2009).

A purse seine is one of the fishing gear based in PPSNZJ and operates in the waters of the Indian Ocean west of Sumatra, Fisheries Management Area (WPP) 572. The main catch of purse seine is large and small pelagic fish. The fish catches are reported in logbook form. According to the Ministerial Regulations Permen KP No.58/2020, a logbook is a daily report written by the skipper on activities in fisheries and activities on the daily operations of fishing vessels. The fishing logbook contains information about fishing boat data, fishing gear data, fishing operation data, and catch data. Logbooks are also used as a tool to monitor the movement of fishing vessels for vessels under 30 GT. It is necessary to conduct surveillance efforts on fishing vessels that are conducting fishing activities. Based on the description above, this research aims to find out the operational characteristics of purse seine vessels based in PPS Nizam Zachman using Vessel Monitoring System data in WPP 572.

RESEARCH METHODS

The research was conducted in January 2021 at the Control Center of the Directorate General of Marine and Fisheries Resources Monitoring (Pusdal Ditjen PSDKP) and Nizam Zachman Jakarta Fishing Port Type A (PPSNZJ). The research method used is the qualitative descriptive analysis.

The number of samples used in this study was categorized into 2 categories: purse seine vessels with a size of 30 - 100 GT, and purse seine vessels with a size of more than 100 GT. For purse seine vessels with a size of > 100 GT, the sampling method uses a disproportionate stratified random sampling method. The number of populations and samples taken in the study is presented in Table 1.

Table 1. Purse Seine Veseel Size

No.	Vessel Size (GT)	Total (unit)	Total Sample (Unit)
1.	30 – 100	2	2
2.	>100	167	17

Source: Data Sharing System PUSDAL, 2021.

Data logbook of arrival and departure of purse seine vessel taken from PPSNZJ, while VMS data taken from PUSDAL Ditjen PSDKP Jakarta. The number of purse seine vessels based in PPSNZJ and licensed in WPP-RI can be seen in Table 2 and Figure 1.

Based on the logbook data listed in Table 2, each WPP has a different number of purse seine vessels. This is because the purse seine vessels search the nearest fishing port to the fishing ground to save the fuel expenditure needed.

Therefore, only a few ships from WPP 712,713, and 718 are based in PPSNZJ. In this study, the data taken was a purse seine vessel only operating on WPP 572.

Table 2. The Number of Purse Seine Vessel Based at PPSNZJ

WPP	Jumlah Kapal *Purse Seine*
572	169 unit
573	140 unit
711	114 unit
712	5 unit
713	6 unit
718	8 unit

Source: Data Sharing System PUSDAL, 2021.

Data Analysis

The data analysis method used in this research is a descriptive percentage to describe the match between VMS data and logbook data at the PPSNZJ port. Data processing with this method has the aim of being able to present the final data results that are easy to understand by finding the percentage using the number of frequencies obtained in the study (Purwanto and Sulistyastuti, 2011). Descriptive percentage data processing using the number of frequency data divided by the total number multiplied by 100 percent, or it can be formulated as follows:

$$P = \frac{f}{N} \times 100\% \quad \text{..... (1)}$$

Note: P = Data Percentage; f = Data Frequency; N= Total Data; 100% = Constanta.

After all the data has been collected, it will then be analyzed and the percentage can be determined using the formula above to get the final result of matching the data on the VMS with the logbook data from the PPSNZJ port in the form of graphs or diagrams for easy understanding.

In the descriptive analysis using ArcGIS application as a spatial data processing application. VMS data is obtained from PUSDAL by downloading tracking on a ship which can be determined starting from daily, weekly, monthly ship data, up to which can be determined according to the desired needs. The downloaded VMS data is the coordinates of the vessel which has a time interval of 1 hour for each point and is downloaded in the Comma Separated Value (CSV) file format (Tawaqal et al., 2019).

RESULTS AND DISCUSSION

General Condition of the Directorate General of Marine and Fishery Resources Supervision (PSDKP)

The Directorate of PSDKP is located on Jl. Medan Merdeka Timur Number 16, Central Jakarta. PSDKP is under the responsibility of the Directorate-General for Supervision of Marine Resources and Fisheries, Ministry of Marine Affairs and Fisheries. Based on the Regulation of the Director-General of Marine and Fishery Resources Supervision Number 57/KEP-DJPSDKP/2015-2019 concerning the Strategic Plan of the Directorate General of Marine and Fishery Resources Supervision for 2015-2019, the vision of the Directorate General of PSDKP is "Indonesian Waters are Free of Illegal, Unreported and Unregulated (IUU) Fishing and activities that damage Marine and Fishery Resources to realize sovereignty in sustainably managing marine and fishery resources for the welfare of the community". Mission-based on the duties and functions to achieve the vision that has been set, the Mission of the Directorate General of Fisheries Resources Utilization are:

a. Increase the capacity and capability of supervision in the management of marine and fishery resources, increase the effectiveness of handling violations against the management of marine and fishery resources;
b. Increase the effectiveness of handling violations against the management of marine and fishery resources;
c. Realization of Bureaucratic Reform in the Directorate General of PSDKP.

General Condition of the Nizam Zachman Ocean Fishing Port Jakarta (PPSNZJ)

Nizam Zachman Jakarta Fishing Port Type A (PPSNZJ) is located in Muara Baru (Jakarta Bay), Penjaringan Subdistrict, North Jakarta. PPS Nizam Zachman is one of the largest fishing ports in Indonesia. The location of the port is bordered by the Java Sea in the north, Penjaringan in the south, Sunda Kelapa Harbor in the east, and Seruni Beach in the Pluit Reservoir area in the west. The function of a fishing port based on the Regulation of the Minister of Maritime Affairs and Fisheries Number 8/PERMEN-KP/2012 concerning Fishery Ports is a port that carries out government functions (covering services for quality development and processing of fishery products; collecting data on catches of fishery products; implementation of operational activities of fishing vessels; implementation of portability, environmental control; and others. PPS Nizam Zachman also has several fishing units including boats, fishing gear, and fishermen.

The Nizam Zachman Jakarta Ocean Fishery Port (PPSNZJ) is managed by the Integrated Service Unit (UPT), the Jakarta Ocean Fisheries Infrastructure Public Company (Perum), and other related agencies. These agencies cooperate in carrying out port operational activities, developing, and maintaining, as well as maintaining the cleanliness of all existing facilities, ranging from basic facilities, supporting facilities, and supporting facilities. The role of PPS Nizam Zachman in fishing business activities is supported by various facilities, namely the existence of facilities that play a role but some facilities do not play a role in fishing activities. The facilities that have been provided are accessible and can be used properly by every party who uses these facilities (PERMEN KP, 2012). The main facilities contained in PPS Nizam Zachman include docks, port area roads, sewers, and others. Then for functional facilities: administrative building, Fish Auction (TPI), service office, and others. And for supporting facilities such as mosques, toilets, post-entry buildings, cooperative offices, and others.

Factors Affecting The Operation of Fishing Vessels

Several factors affect the fertility of the waters. This can be seen from the parameters of biology and physics. Aquatic biology parameters include chlorophyll-a and physical parameters include elements of temperature, current,

salinity, and brightness. Aquatic fertility can be measured from 4 variables, namely chlorophyll-a, oxygen saturation, total N, and P. The productivity of the waters is also affected by the presence of phytoplankton. This was reinforced by Roma (2003), that phytoplankton contains the element chlorophyll which has an important role in the process of photosynthesis. Phytoplankton lives in layers of water that are still exposed to sunlight. Water is influenced by biological and physical factors where the higher the factor, the higher the water has high productivity.

The most influential physical parameters in the waters are temperature. Temperature plays an important role because of the survival of marine life. In addition, the waters are also affected by the intensity of sunlight and geographical height. Other differences are usually caused by factors such as differences in measurement time, in addition, there can also be differences in the content of nutrients or salt ions that can physically increase heat delivery. This is reinforced by Kantun (2012), that with the temperature of these waters there are various types of fish that have a tolerance to these temperatures.

Distribution of Purse Seine Based at PPSNZJ

Based on PPSNZJ logbook data, purse seine vessels operate not only on WPP 572 but also in other WPP. The number of purse seine vessels in each WPP is presented in Figure 1.

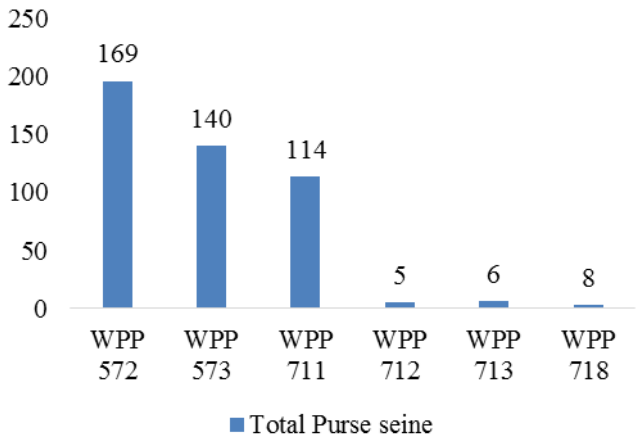

Figure 1. Number of Purse Seine Vessels Based at PPSNZJ
Source: PPSNZJ, 2021

The distribution of the Purse Seine vessels in WPP 572 has different criteria, for the GT size used. Based on research that has been done, the number of purse seine vessels that have a license to operate in the WPP 572, and based in PPSNZJ as many as 169 vessels. The purse seine vessel has different GT sizes, ranging from the smallest, which is 94 GT, to the largest, which is 200 GT. According to PERMEN-KP 10/2019 about the fishing vessel monitoring system, a vessel that has a size of more than 30 GT is required to install a VMS transmitter. Therefore, the data that will be sampled is vessel data with sizes above 30 GT.

Performance of Purse Seine Vessels Operating at WPP 572 in 2017 – 2019

In 2017 – 2019, there was a variation in the number of purse seine vessels operating on WPP 572. The data on the graph is obtained from the logbook which is the data of the arrival and departure of purse seine vessels from the port of base. The number of monthly purse seine vessel operations from 2017 – 2019 can be seen in Figure 2.

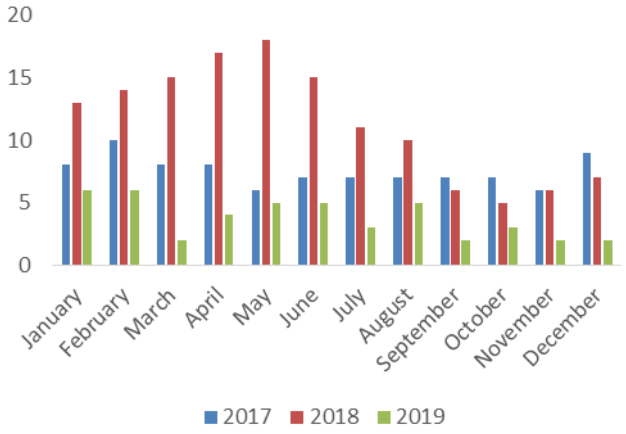

Figure 2. Graph of The Number of Purse Seine Vessels in 2017 – 2019

Based on Figure 2, it appears that the activity of the purse seine vessel fluctuates every month. The transitional season (April – June) is the largest number of operations compared to other months. While when viewed annual data, in 2018 is the most activity of purse seine vessels among other years. The amount of activity of the purse seine ship depends on the distribution of fish.

Purse seine fisheries are obtained from VMS data and processed using spatial data processing software. Output from data processing is fishing ground maps on purse seine fisheries. The position map of purse seine vessels in 2017 – 2019 is presented in Figure 3.

According to Figure 3, the red box is the point of fishing in 2017, the green one is fishing ground in 2018, and the blue one is fishing ground in 2019. Purse seine vessels based in PPSNZJ operate not only on WPP 572, but some of them operate on WPP 573. Fishing vessel's operational permits are allowed more than one WPP which can be seen in the Fishing License (SIPI).

There are three base ports: PPS Bungus, PPS Nizam Zachman, and PPN Pekalongan. This is because any fishing vessel can be allowed to dock at two port bases. According to 49/PERMEN-KP/2011 changes to 14/PERMEN-KP/2011 concerning fishing efforts that on fishing vessels from within the country are given two-port bases. On the largest fishing boat, the 200 GT is also granted permission for two base ports. While fishing vessels that are intended for export using foreign vessels are only given one port base.

The catch of large fishing vessels above 100 GT has an average catch of 4,000,000 kg/year. This is following the annual report of KKP in 2018 which is 4,936,332 kg per year. The high catch is due to large vessels equipped with high technology such as fish finders to determine the position of the fishing ground. Fishfinders provide information about the depth, temperature, speed of the ship, and the position of the schooling fish. This is the benchmark on the ship to determine the catch, and it can also be measured by its oceanographic conditions.

Oceanographic parameters include temperature conditions, water mass, and salinity on the surface of the water. Characteristics of waters that have good characteristics in temperature, salinity, water mass, chlorophyll-a, currents,

and other parameters are preferred by fish for life. So that in waters that have good characteristics and are liked by fish, will make the area more maximal fishing potential. Fishing areas have variations in oceanographic conditions (Zainuddin, et al., 2006).

Operational Distribution of Purse Seine in 2017 – 2019

The operational distribution of purse seine vessels in WPP 572 varies greatly. The number of vessels operating for fishing also varies. The results of VMS data processing of purse seine vessels operating in WPP 572 can be seen in Figure 4.

Based on the distribution map of purse seine vessels in 2017, it is known that purse seine vessels conduct many operations in April – July in the Indian Ocean. The data in the picture above is an area that is often used as a fishing ground on purse seine vessels. This is because the waters have an optimum value of chlorophyll-a and sea surface temperature (SST) in April - July. According to Allain et al., (2005), chlorophyll and SPL values were highest in May. Therefore, many ships operate in the Indian Ocean waters due to chlorophyll and SST including certain parameters for fishing ground.

The distribution of SST on WPP 572 can also be used as a parameter to determine the presence of fish in those waters. SST is very influential on the metabolism of fish biologically. Sea surface temperature can also cause upwelling that brings nutrients to the surface and makes a fishing ground for fish. According to Habib (2019) that has been done, the value of SPL in the field at WPP 572 is around 27.24°C, while the SST value based on the Aqua MODIS image is around 28.21°C in the eastern and western seasons. The range of SST values is the optimum condition for the existence of fish. The small difference in value between the measurement results in the field and aqua MODIS imagery data correlates to the distribution of purse seine vessels operating in WPP 572.

The operational distribution of the purse seine vessels in 2018 can be seen in figure 5. Based on the map of the distribution of purse seine vessels in 2018, May-August is the largest number of operations carried out by purse seine vessels. The slightest difference in 2017 and 2018 was due to oceanographic conditions such as SST and chlorophyll-a occurring continuously throughout the year periodically. According to Rasyid et al., (2014), fishing ground in spatial and temporal will be affected by the pattern of the west and east wind seasons. Both monsoon winds cause the transition in the season to continue throughout the year periodically. This can be expected in 2018 not to experience significant changes to the SPL.

Another cause of the number of ships in May-August is upwelling in the Southern Waters of Java that propagates to the western area of Sumatra (Demi et al., 2020). Upwelling is the process that occurs in the monsoon cycle. In June there was a Southeast Monsoon Wind that resulted in upwelling and thermocline siltation in the waters of East Java. In July – October the East Monsoon winds head north. In such cases, it will cause the water mass to cool and have high salinity. This occurs due to upwelling that spreads to the north (Waas, 2012). Waves in seawater generally occur due to the wind blow above sea level. So that the greater the wind speed and the longer the wind blows, the higher the waves produced in the seawater itself.

In 2019, purse seine vessels were more evenly distributed in WPP 572 than in 2017 & 2018. The distribution of purse seine vessels in 2019 is presented in Figure 6. Based on Figure 6, fishing operations on purse seine vessels were mostly carried out in July - December 2019. Fishermen can determine the time and place of fishing activities based on indicators of water fertility and weather. According to Tangke et al. (2015), temperature changes can affect the population of fish. Extreme temperature changes, low oxygen in the waters, and changes in water pH can result in death in fish. These changes can result in reduced populations of fish and will eventually affect fish stocks in the waters. The spread at sea surface temperature has a difference in each month. Factors that cause include air temperature, wind speed, and heat flux that alternate. As for the value of sea surface temperature is affected by tides and currents. According to Kasmi et al. (2017), the distribution of purse seine ships most July - December due to many fish that matured gonads in that period.

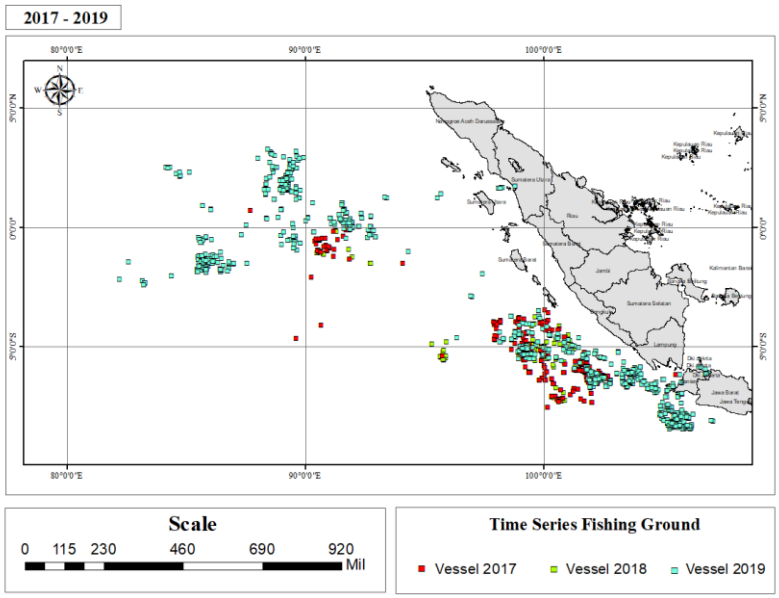

Figure 3. Time Series Map of Purse Seine Positions in 2017 - 2019

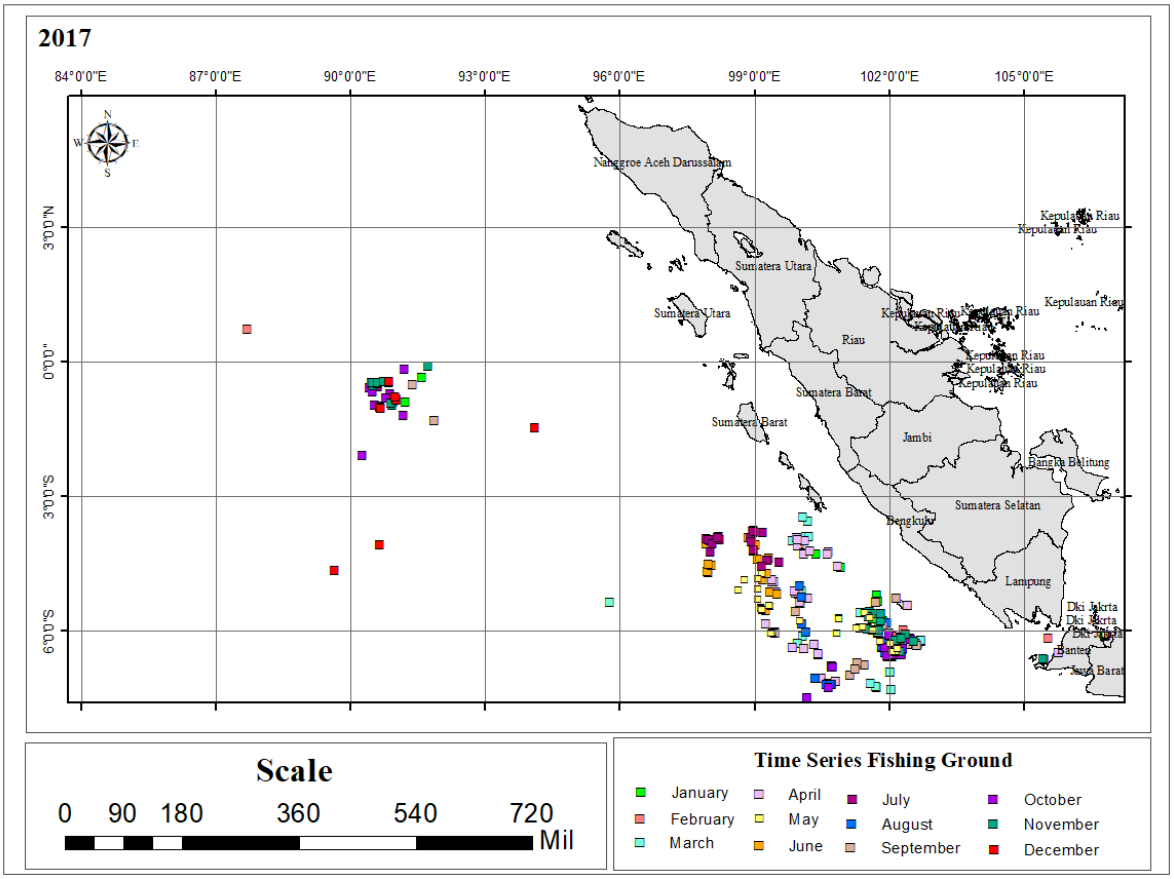

Figure 4. Purse seine Distribution Map 2017

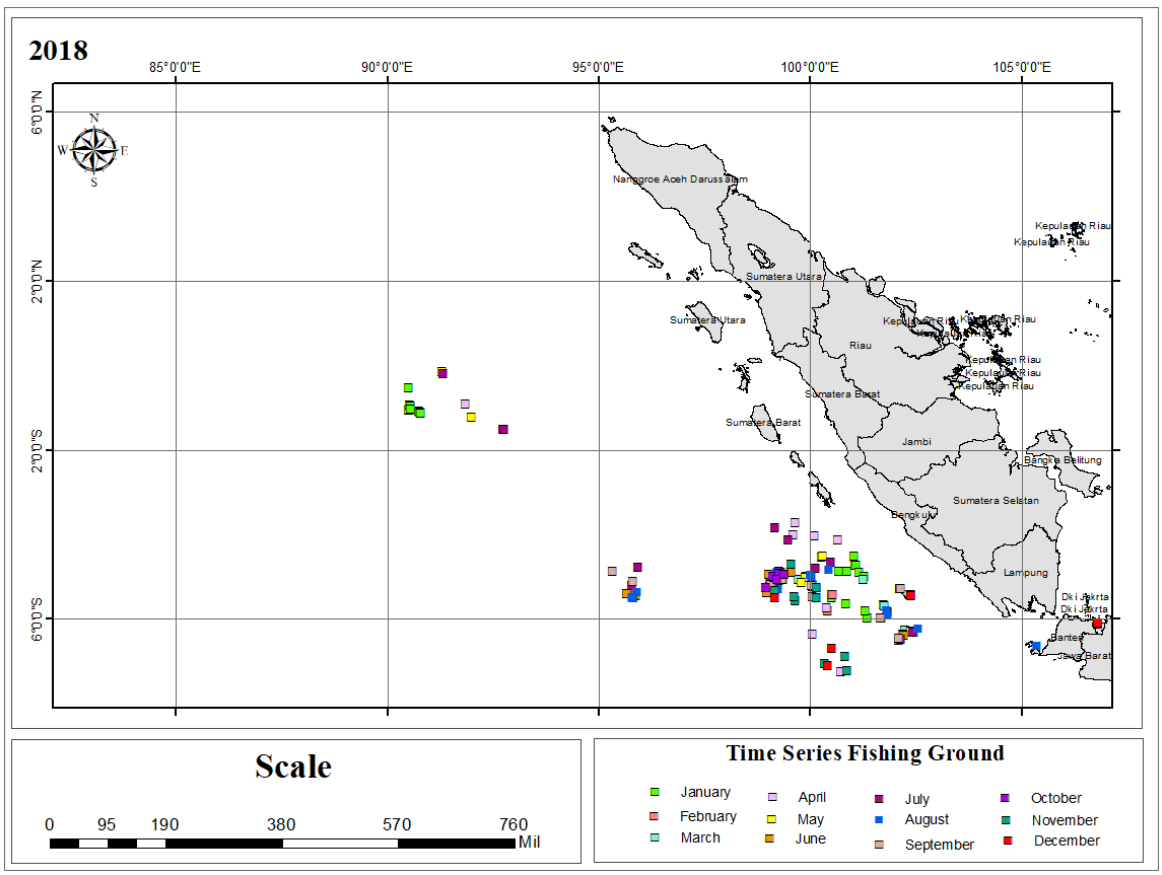

Figure 5. Purse seine Distribution Map 2018

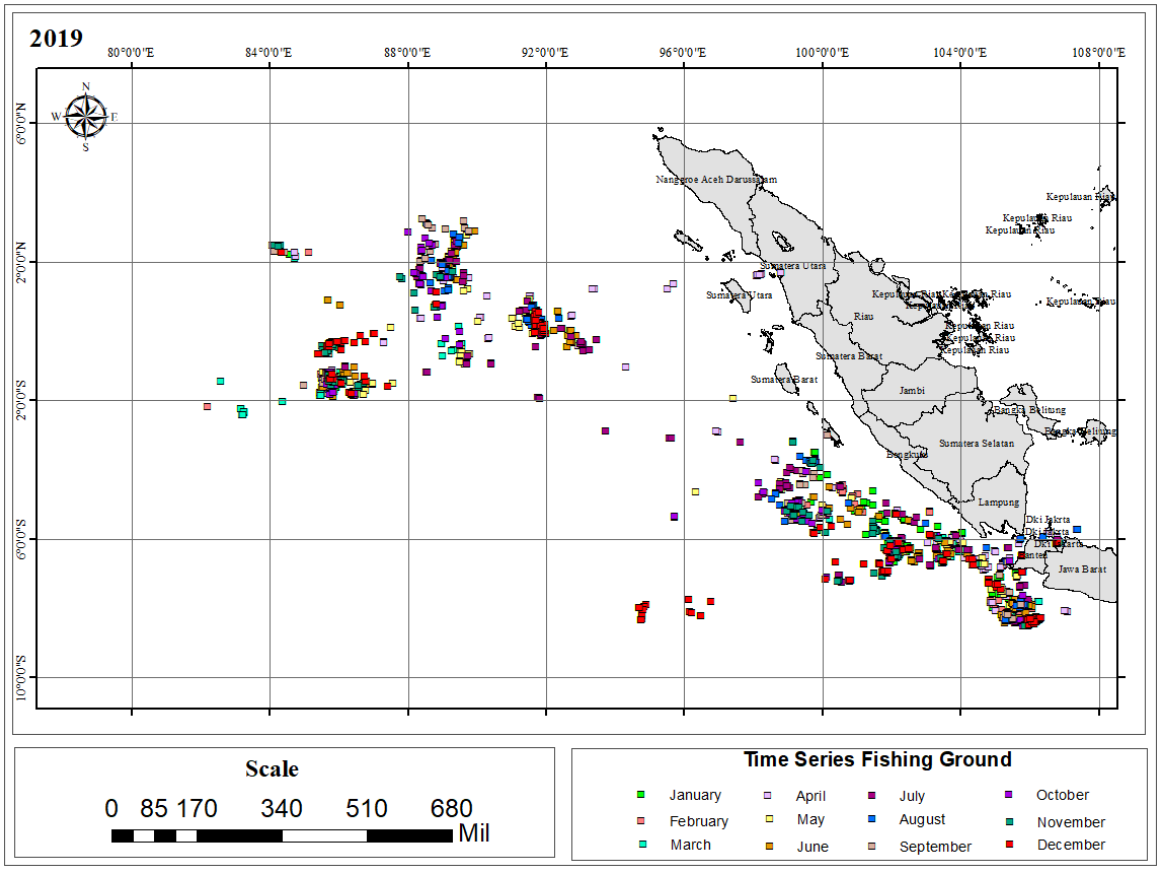

Figure 6. Purse Seine Distribution Map 2019

Total Catches in WPP 572

The catch of purse seine vessels operating in WPP 572 varies widely. The number of types of catches also varies. Based on logbook data captured by PPSNZJ can also be seen in Figure 7.

In WPP 572, the number of catches on purse seine ships each year fluctuates. In 2017 the catch amounted to 76,230,426 kilograms, then dropped to 74,440,956 kilograms in 2018, and again rose to 99,476,561 kilograms in 2019. The main catches on purse seine vessels are yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), albacore tuna (*Thunnus alalunga*), skipjack tuna (*Katsuwonus pelamis*), and shortfin scad (*Decapterus macrosoma*).

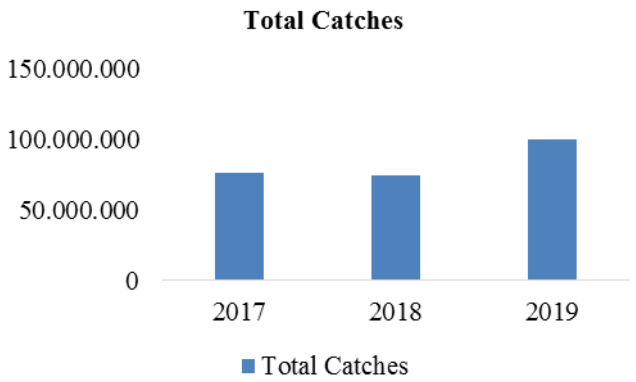

Figure 7. Chart Number of Catches

The utilization rate of fishery resources in WPP 572 falls into the category of overfishing. Fish that belong to the highest category of overfishing are in the group of lobsters, shrimp, blue swimming crab, and crab. According to Suman (2016), the group of fish that experience the highest overfishing conditions is the group of Penaeid shrimp, lobster, crab, and blue swimming crab, which account for 63% of the current overfishing conditions. Overall that of the 11 WPP in Indonesia, only WPP 717 has not been fully attempted, while the other 10 WPP are already in overfishing. There is excessive demand for export purposes and domestic consumption, so the use of shrimp and other crustaceans is intensive.

Comparison and cross-matching of logbook data with VMS data

The logbook data used consists of the name of the ship, the name of the captain, the name of the owner, fishing gear, the ship's departure date, the date of arrival of the ship, the number of trips, WPP, fishing area, and type of catch. The data used in this study is ship departure data and ship arrival data at the base port. The data will be matched with VMS data contained in PUSDAL. The match between logbook data and VMS data can describe the accuracy of the logbook data written. The percentage level accuracy range can be seen in Table 3.

Based on data from 2017 to 2019, the accuracy rate of purse seine ships at the time of landing catches is 58%. According to Basuki and Wuryandari, (2015), VMS data is more accurate because the transmitter installed on each fishing boat, which uses satellites will show transparency in the

management and utilization of marine resources by every fisherman in a country. Therefore VMS data can find out the whereabouts of the ship at the time of capture or at the time of landing. The analysis is very important because it will be a comparison between logbook data with VMS data. According to Russo (2018), stated that the logbook is reliable data and to represents the data by combining two sources of information, namely VMS data and ship arrival data (between loading and unloading).

Table 3. Percentage Level Accuracy Range

Range	Keterangan
<25%	Accuracy Percentage Low
25 % – 50%	Accuracy Percentage Medium
50 % – 75 %	Accuracy Percentage High
>75%	Accuracy Percentage Very High

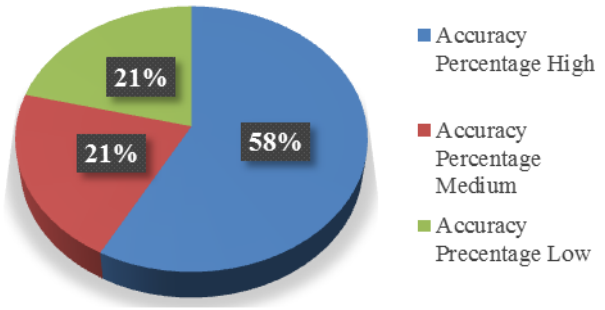

Figure 8. Purse seine Accuracy Percentage Diagram

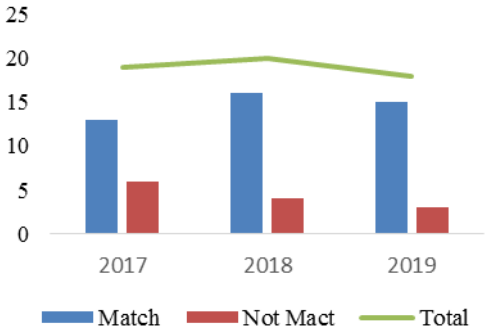

Figure 9. Number of Purse Seine Chart

Figure 9 shows the number of ships with a degree of discrepancy between logbook data and VMS. The number of ships used as samples was 19 purse seine ships. In 2017 there were 6 unsuitable vessels, in 2018 there were 4 vessels that were not suitable, while in 2019 there were 3 vessels that were not suitable. The percentage diagram per year can be seen in Figure 10.

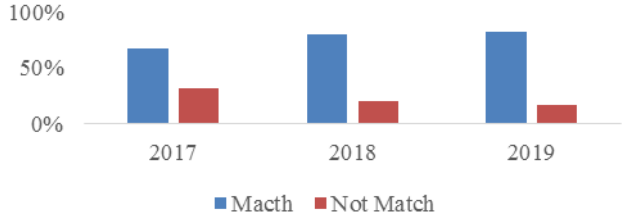

Figure 10. Cross-Matching Percentage Graph of Logbook Data with VMS

Based on the results of research conducted in 2017-2019 that data with a level of conformity experienced unstable results. The conformity rate in 2017 was 68%, in 2018 it was 80%, and in 2019 it was 83%. This is because with the data collection on the logbook using accurate data will be a better fishery in the future. The increase in the level of conformity of logbook data and VMS data can also reduce the presence of indications of violations committed by fishing vessels. Supervision on fishing vessels includes also monitoring the ship at the time of exit and entry into the base port. So if at the time of exit or entry of the fishing vessel to the base port that is not his permission, then the ship has been indicated to violate the regulations that have been set. Surveillance on fishing vessels is carried out on land and at sea. The supervision activities are expected to be able to prevent violations in the field of fisheries (Naim, 2016)

CONCLUSION

Based on research that has been conducted related to the analysis of operational characteristics of purse seine vessels based in PPSNZJ using Vessel Monitoring System data (WPP case study 572), it can be concluded that:

1. Operational characteristics of purse seine vessels in WPP 572 are with a range of GT ships ranging from 30 GT-200 GT with the largest size, and the most catches are large eye tuna, madidihang tuna, and albacore fish.
2. Conformity between logbook and VMS in 2017, 2018, and 2019 by 68%, 80%, and 83% respectively.

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