International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 42 No. 2 January 2024, pp. 447-457

Level Of Utilization Of Trunk Fish (Euthynnus SP) Landed In Ocean Fishery Ports Belawan, North Sumatra

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Abstract – This research aims to determine the level of utilization and cultivation of tuna fish at the Belawan Ocean Fishing Port, North Sumatra. This research was conducted on July 10 2023-August 10 2023. The research method used was a survey method with quantitative descriptive analysis. The data collected includes time series data on catches of large pelagic fish and fishing effort data for 2020-2022 which will be processed using Microsoft Excel. The results of this research show that the maximum sustainable potential (MSY) of tuna resources in Belawan waters in the last 3 year period is 1927.83 tonnes with an optimum effort of 278.54 trips. The level of utilization of tuna resources reached its peak in 2021, namely 60.90% and the lowest utilization rate occurred in 2022, namely 35.58%. Meanwhile, the highest level of effort occurred in 2022, namely 177.75% and the lowest in 2020, namely 163.33%. From the results of the research above, it can be concluded that the level of utilization and cultivation of tuna (Euthynnus Sp) at the Belawan Ocean Fishing Port, North Sumatra during 2020-2022 is still in a sustainable state with a maximum sustainable potential of 1927.83 tonnes/year, optimum effort of 278.54 trips. / year, the average utilization rate is 50.44% and the effort rate is 170.15%.

Keywords – Level of Utilization, Level of Effort, Tuna.

I. INTRODUCTION

Belawan Ocean Fishing Port is one of the largest fishing ports in North Sumatra, which plays an important role in catch fishing activities and its marketing. Belawan PPS is located between the East Sumatra Waters (Malacca Strait), the Indonesian Exclusive Economic Zone (ZEEI) and the South China Sea. (Siahaan, et al, 2016).The province of North Sumatra is a land territory with waters directly bordering the Strait of Malacca to the east and the Indian Ocean to the west. There are two fishing ports in Sumut Province that are listed in the Department of Marine, Farm, and Sumut Fishing, namely the Sibolga Nusantara Fishing Port (PPN) and the Belawan Ocean Fishing Harbour. The Belawans Oceanian Fishing port (PPS) is one of the largest ports of the North Sumatra Province and is the starting point of economic activity of several countries in Asia, Indonesia, Malaysia, Singapore, Thailand, and Hong Kong. (Subhechanis, et al, 2012)

The port is one of the important factors in the success of catch fishing activities, it is related to its function that is directly linked to the handling of catches, so that the results can also be maximized. One of the fishing ports in the province of North Sumatra that is still functioning is the Marine Fishing Port (PPS) Belawan Sumatra North (Santi, et al, 2015) which is one of the Technical Implementing Units (UPT) of the Centre in the Fisheries Port area which is under construction and is responsible to the Director General of Catch Fishing (DJPT) in accordance with the Regulation of the Minister of Marine and Fisheries of the Republic of Indonesia No:20PERMEN-KP/2014, dated May 16, 2014 on the Organization and Operating Regulations of the technical Execution Unit of the Fishing Harbour by integrating the entire program and its activities so that it can be properly operated and produced output according to the established Performance Indicators. As well as a centre of fish capture activities that includes landing, marketing of fish and processing of catches by fishermen in particular fisherman in Sumatra in the area of

development of outer circle fishing ports. As the largest port in the North Sumatra Province, it is expected to contribute to the fishing sector of northern Sumatra, but it is not known how large the Fighting Fishing Harbour of North Sumatera is.

The level of exploitation of fish is intended to generate information about the abundance of fish stocks in a waters, recommendations of the amount of optimal catch effort, and the number of allowed catches. According to operational data, PPS Belawan is one of the predominantly caught fish and does not experience significant increase in production every month. In fishing activities, the instruments used in the PPS Belawan to catch stick fish are Bouke Ami, Pancing, Cumi Panching, Gurita Pancing, Transporter, Pspk (Decree of the Minister of Maritime Affairs and Fisheries No. KEP. 06/MEN/2010) on fishing instruments. Fastness and accuracy in predicting the extent of the sustainable potential of fish resources in the sea is one of the key elements of successful fish resources management. When this happens, the available fish resources will be subjected to greater pressure, the fish that have not fished will be caught a lot, and eventually reach over-fishing. (Widodo, 2016).

The exploitation of stalk fish resources is expected to meet market needs in the future, so that the species does not suffer overfishing and can wake up to its sustainability. It is intended to be able to make optimal use of the stick fish that exists in nature. Based on the above description, it is necessary to know the level of exploitation and level of fertilization of stalk fish landed in the North Sumatra Marine Fishing Port.

II. METHODOLOGY

The method used in this study is a survey method with quantitative descriptive analysis to obtain a picture that can represent the potential and level of utilization of stalk in the North Sumatra Sea Fishing Port. The approach is carried out by analyzing the stalk catch data from various units of fishing gear landed in the South Sumatra Ocean Fishing Harbour. The data collected in the study are secondary data. Secondary data obtained from the Office of the North Sumatera Sea Fisheries Port, which includes series data from the year 2020 – 2022, data on the catch of stakkels, the type of catch vessel and type of gear operating in the West Sumatra Marine Fishing port.

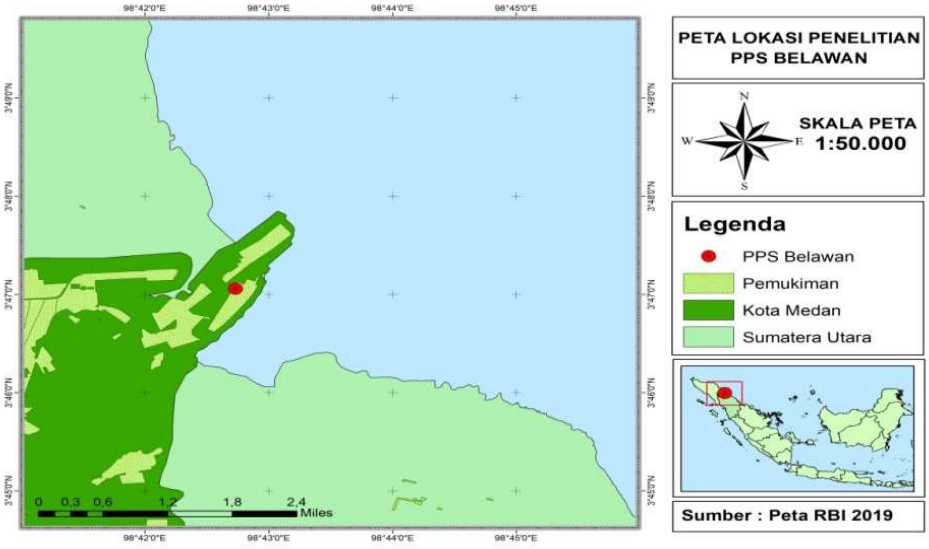

Figure 1: Research location map

Data analysis to obtain the level of exploitation of Tongkol fish is by performing the standardization of the catch gear, Catch Per Unit Effort, maximum sustainable catch output (MSY) and effort optimum, Total Allowable Catch (TAC), prediction of the rate of utilization and reliability.

Standardization of barrel fishing gear

Capture devices with the highest capture effort result value (CPUE) are specified as standard capture devices. (Badrudin, et al., 2016). To find such values using the following equation :

$$\text{CPUE} = \frac{Catch}{Effort}$$

Keterangan :

CPUE = The result of the arrest attempt (ton/trip)

Catch = Capture results (ton)

Effort = Arrest attempt (trip)

Conversion of catch tools is important in this study because the catch devices used to catch stick fish in the Fighting North Sumatra Ocean Fishing Harbour are more than one type of catcher. Each type of catcher has a different capability to catch a particular species of fish, so the catch effort must be done before counting the CPUE. This transformation aims to balance the catching effort of the dominant catcher with all the catches used in catching the stick. Therefore, the standardization of the capture attempt is carried out prior to the calculation of the CPUE so that it can be assumed that an attempt to capture some sort of capture device results in the same capture as standard capture devices. The process of standardization of the capture device is carried out with the following provisions:

Maximum Sustainable Yield (MSY) dan Effort Optimum (Fopt)

Then the management of the Maximum Sustainable Yield (MSY) which is a regression result using Schaefer and Fox models against CPUE and Effort data, shows the estimated optimum effort allowed in fishing efforts. (Piscandika, et al, 2013).

The relationship between C (capture outcome) and f (attack attempt) is:

$$C = af + b(f)^2$$

CPUE's relationship to f (attempted arrest) is:

$$CPUE = a + bf$$

The optimum effort value (f optimum) is:

$$f\ opt = \frac{-a}{2b}$$

The maximum potential value of Lestari (MSY) is:

$$MSY = \frac{-a^2}{4b}$$

Description:

C = Number of catches per capture attempt unit (ton)

a = Intercept (konstanta)

b = Slope (kemiringan)

f = Capture efforts (trip) in period–i

f opt = Optimum fishing effort (trip)

MSY = Maximum Sustainable Yield (ton).

Total Allowable Catch

The number of captures allowed is used as a basis in determining how much capture is allowed. The formula for the number of captures allowed (Imron, 2008) is :

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

Description:

TAC/JTB = Number of captures allowed (ton)

MSY = Maximum Sustainable Yield (ton)

Usage and Trust Level

An estimate of the level of exploitation was made to determine the extent of the exploitation of the Tongkol fish resources landed in the North Sumatra Sea Fishing Port. The formula of the utilization rate (Paul, et al, 2005):

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

Description:

TPc = Utilization rate in year-i (%)

Ci = Fish catch in year-I (ton)

MSY = Maximum Sustainable Yield (ton)

The level of catch effort was assessed to determine the level of tuna catch that was landed in the North Sumatra Fighting PPS. Evaluation is done by showing a specific year's standard effort with an optimal effort value. (fopt). The formula of the trust rate is (Wahyudi, 2010) :

$$TP_f = \frac{f_i}{f_{opt}} \times 100\%$$

Description:

TPf = Level of Effort in year-i (%)

fi = Capture effort in year-i (trip)

fopt = Optimum capture effort (trip)

The level of utilization and the level of reliability of fisheries resources used by the National Marine Fish Stocks Assessment Commission (1997) in Purniati (2011) consists of four levels, namely:

1. Low rates when capture is still a small fraction of the potential sustainable yield (0-33.3%), where capture efforts still need to be enhanced.
2. Moderate levels when capture results are already a significant part of the sustainable potential (33.4%-66.6%) increased effort is still possible to optimize results.
3. Optimum level When the capture has reached a portion of the sustainable potential (66.7% - 99.9%), the additional effort cannot improve the result.
4. Overfishing or overfishing when catches exceed sustainable potential (> 100%) and additional effort may be dangerous to the extinction of resources.

III. Results And Discussion

Based on the Decree of the Minister of Transportation dated December 25, 1975 Gabion-Belawan was designated as a special location for fishing vessels. In January 1978 the management of Gabion-Belawan was handed over from the Ministry of Transportation to the Ministry of Agriculture, then in May 1978 based on the Decree of the Minister of Agriculture Number: 310 of 1978 Belawan Fishing Port was inaugurated as Belawan Nusantara Fishing Port. In 2000 there was a transfer of management of the Belawan Nusantara Fishing Port from the Ministry of Agriculture to the Ministry of Maritime Affairs and Fisheries. Furthermore, on May 1, 2001 based on the Decree of the Minister of Maritime Affairs and Fisheries Number: KEP.26.I / MEN /

2001 Belawan Nusantara Fishing Port experienced an increase in institutional status to become Belawan Ocean Fishing Port.

Catches of Tongkol (Euthynnus affnis) Per Type of Fishing Gear at PPS Belawan

Estimation of potential fish resources is processed using data on tuna catches and fishing efforts made during the last 3 years. The following is a graph of the number of mackerel catches per type of fishing gear at the Belawan Ocean Fishing Port in 2020-2022. Based on Figure 2 and table 1, the highest catch of mackerel with Pspk fishing gear occurred in 2020 at 658.61 tons and the lowest in 2022 at 302.40 tons, the highest catch in fishing gear occurred in 2021 at 513.01 tons and the lowest in 2020 at 311.76 tons, the highest catch in Bouke Ami fishing gear occurred in 2021 at 124.80 tons and the lowest in 2022 at 60 tons, 42 tons, the highest catch in the Carrier fishing gear occurred in 2021 which was 19.40 tons and the lowest in 2022 which was 1.25 tons, the highest catch in Octopus fishing gear occurred in 2021 which was 12.70 tons and the lowest in 2022 which was 0.35 tons, the highest catch in Squid fishing gear occurred in 2022 which was 1.58 tons and the lowest in 2021 which was 0.50 tons. The downward trend in catches that occurs requires good management of fishing efforts so as to optimally utilize fish resources or potential catches.

Belawan Ocean Fishing Port is one of the ports in North Sumatra that is productive in the field of fisheries, especially capture fisheries. One of the fish commodities caught and landed at PPS Belawan is Tongkol (Eutynnus affinis). Based on the data in Figure 1, the catch of Tongkol fish based on the fishing gear unit that produces the most dominating catch in the 3-year period (2020-2022) is Pspk fishing gear. Pspk fishing gear is a type of fishing gear used to catch various types of pelagic fish, one of which is tuna. Fluctuating catches are influenced by the number and efficiency of fishing gear, the length of fishing operations, the availability of fish stocks, and also by internal and external factors (Simanjuntak, 2018). The difference in catches is also caused by fishing areas that are not too far away which causes very little catch. This is in accordance with the opinion of Nurhayati (2013) which states that the fishing operation area is limited, so the intensity of fishing is high which causes pressure on fish resources to be very large, which in turn results in a decrease in catches.

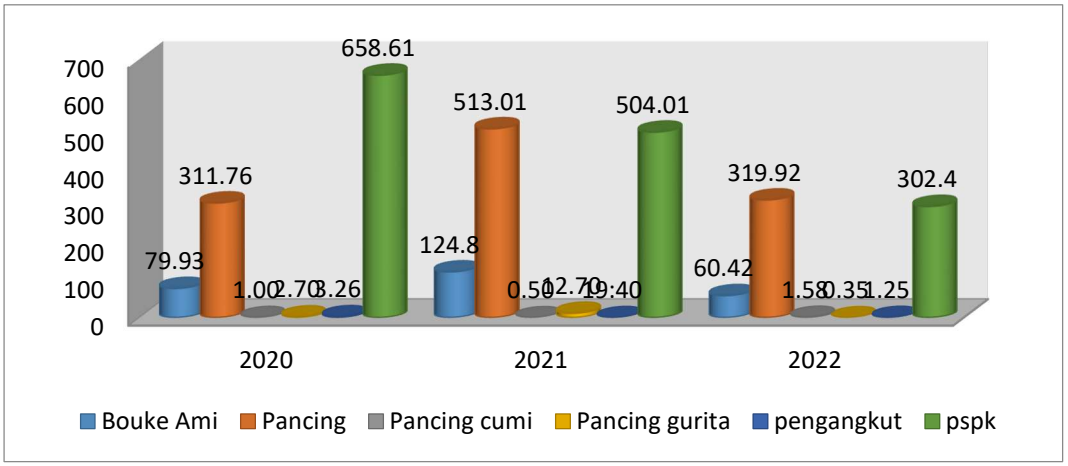

Figure 2. Catches of Tuna per Type of Fishing Gear at PPS Belawan in 2020-2022

Table 1. Number of Efforts to Catch Tuna Resources at PPS Belawan Based on Fishing Gear During 2020-2022.

No	Fishing Gear	Number of Capture Attempts (trip)			Total
		2020	2021	2022	
1	Bouke Ami	110	130	126	366
2	Pancing	281	471	602	1354
3	Pancing Cumi	2	1	4	7
4	Pancing Gurita	2	5	1	8
5	Pengangkut	4	9	1	14
6	Pspk	290	212	187	689

Standardization of Fishing Gear

Each type of fishing gear has different fishing capabilities from one another. Therefore, before further analysis is carried out, first standardize the ability of fishing gear with the Fishing Power Index (FPI) indicator as proposed by Pauly (Pauly, 1979; Stephens & MacCall, 2004). The data used are time series data of tuna catch and fishing effort data conducted at Belawan Ocean Fishing Port from 2020-2022.

Table 2. Gear Productivity and FPI Value

No	Fishing Gear	Fishing Gear Productivity (ton/trip)			Average	FPI
		2020	2021	2022		
1	*Bouke Ami*	0,73	0,96	0,48	0,72	0,35
2	*Pancing*	1,11	1,09	0,53	0,91	0,44
3	*Pancing Cumi*	0,50	0,50	0,40	0,47	0,22
4	*Pancing Gurita*	1,35	2,54	0,35	1,41	0,68
5	*Pengangkut*	0,82	2,12	1,25	1,39	0,67
6	*Pspk*	2,27	2,38	1,62	2,09	**1,00**
	Total	6,77	9,58	4,62	6,99	

Fishing gear with a value of FPI = 1 is standard fishing gear that has the highest average productivity (dominant). Based on table 1 above, Pspk fishing gear is the most instrumental fishing gear in mackerel resources at Belawan Ocean Fishing Port, it can be concluded that Pspk is a standard fishing gear with a capture ratio which means that in one unit of Pspk fishing gear is able to produce more mackerel production compared to other fishing gear. The following is a table of the results of the calculation of the standard total effort made to catch mackerel in the Belawan Ocean Fishing Port during 2020-2022.

Table 3. Standardized Total Effort Calculation Results

No	Year	Total Effort Standar (Trip)
1.	2020	455
2.	2021	472
3.	2022	495

The effort value is obtained from the result of multiplying the number of fishing gear with FPI. Based on table 1, the highest

standardized total effort was in 2022 with 495 trips while the lowest occurred in 2020 with 455 trips. Tuna fishing effort at PPS Belawan from 2020-2022 is unstable due to changing weather factors affected by the west wind season where it is difficult for nelaan to go to sea due to high rainfall and high sea waves so that fishermen do not get the maximum catch. This is in accordance with the opinion of Nugraha et.al (2012) which states that the dominant factors that cause unstable fishing efforts include the demand and price of fish in the market, weather factors, capital, fishermen's conditions, and the ship itself.

Catch Per Unit Effort (CPUE)

The productivity of a fishing gear can be estimated by looking at the relationship between catch and effort, called CPUE. Before determining the maximum sustainable potential (MSY) of a fish resource, we must first find the CPUE value. Calculating the standard standard CPUE value is by dividing the total catch by the total standard effort. The following table shows the results of the calculation of CPUE of tuna at PPS Belawan during 2020-2022:

Table 4. CPUE Calculation Results of Tuna Fish in 2020-2022

Y	Results (ton)	Total Effort Standar (Trip)	CPUEn (ton/ trip)
2020	1057,27	454,94	2,32
2021	1174,05	471,78	2,49
2022	685,93	495,10	1,39
Total	2917,25	1421,82	6,20

The data in table 4 shows that the CPUE value has increased and decreased fluctuating. In 2020 the CPUE value was 2.32 tons/trip, in 2020 the CPUE value increased to 2.49 tons/trip which then in 2022 the CPUE value decreased to 1.39 tons/trip. Based on table 4 that the lowest CPUE value occurred in 2022 but had a fairly high fishing effort, this indicates that the addition of fishing effort that is not followed by an increase in catch will result in a decrease in CPUE. The decline in CPUE value is an indicator that the fishing effort for mackerel resources in 2022 in these waters is already high. While the highest CPUE value occurred in 2021, this means that a high CPUE value indicates that the catch in a particular year is also high but has a low fishing effort.

The above phenomenon is in accordance with the opinion of Cahyani et.al (2013) which states that the correlation between CPUE and the fishing effort of a fish species shows a negative relationship, namely the higher the fishing effort made, the lower the CPUE value and indicates that the productivity of fishing gear will decrease if the fishing effort increases.

The Schaefer model only applies if the parameter value (b) is negative, meaning that any additional fishing effort causes a decrease in CPUE value. If the calculation obtained a positive coefficient value (b), then the calculation of potential and optimum fishing effort does not need to be continued, because this indicates the addition of fishing effort is still possible to increase the catch (Wahyudi, 2010). The following is a curve of the relationship between catch per unit effort (CPUE) and fishing effort (effort):

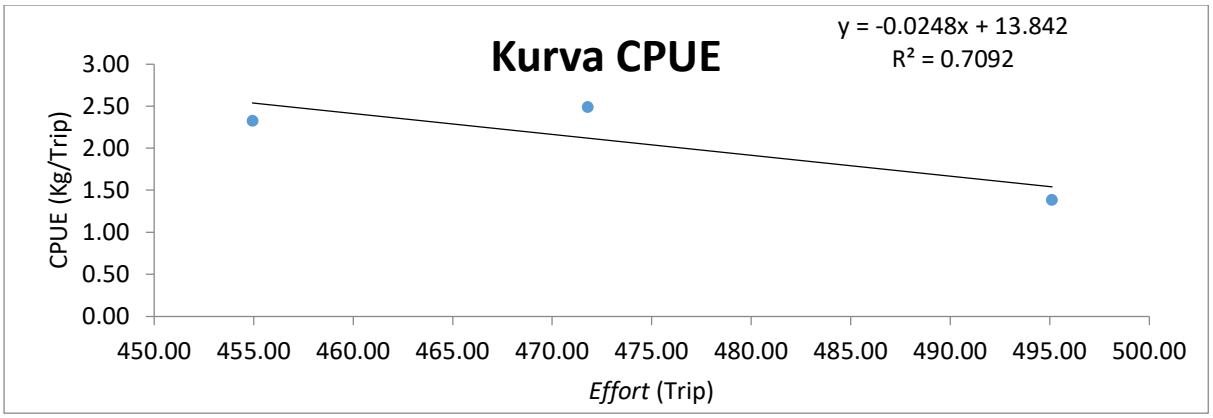

Figure 3. Curve of CPUE Relationship with Effort of Tongkol Fish

The linear equation of tuna CPUE is CPUE = 13.842, 0.0248x and obtained a constant value (a) of 13.842 and a regression coefficient (b) of - 0.0248x. According to the equation, it can be explained that every addition of fishing effort by 1 unit of effort will reduce the CPUE of tuna by 0.0248 CPUE units (tons/trip). If there is no effort, then the potential of mackerel available in nature is still 13.842 tons/trip and the value of the coefficient of determination (R2) is 0.7092 which means that the decrease in CPUE value by 70.92% is caused by the increase and decrease in effort value while the remaining 29.08% is caused by other factors not discussed in this study.

The decrease in CPUE value is due to increased fishing effort, so it is suspected that the abundance of fish resources in these waters has decreased. According to Badrudin et.al. (2012), the upward trend of CPUE is an illustration that the level of exploitation of fish resources can be said to be still at a developing stage. The flat CPUE trend is an illustration that the level of exploitation of fish resources is approaching saturation of effort, while the declining CPUE trend is an indication that the level of exploitation of fish resources if left unchecked will lead to a situation called "overfishing".

Maximum Sustainable Yield* dan *Effort Optimum

Maximum sustainable potential (MSY) is a fishing effort that can produce maximum catches sustainably without affecting long-term stock productivity (Sparre & Venema 1999). While the optimum fishing effort (fopt) is the amount of fishing effort made by the fishing unit to get maximum results without damaging the sustainability of existing resources. The following is a graph of Maximum Sustainable Yield (MSY) and Optimum Effort (Fopt):

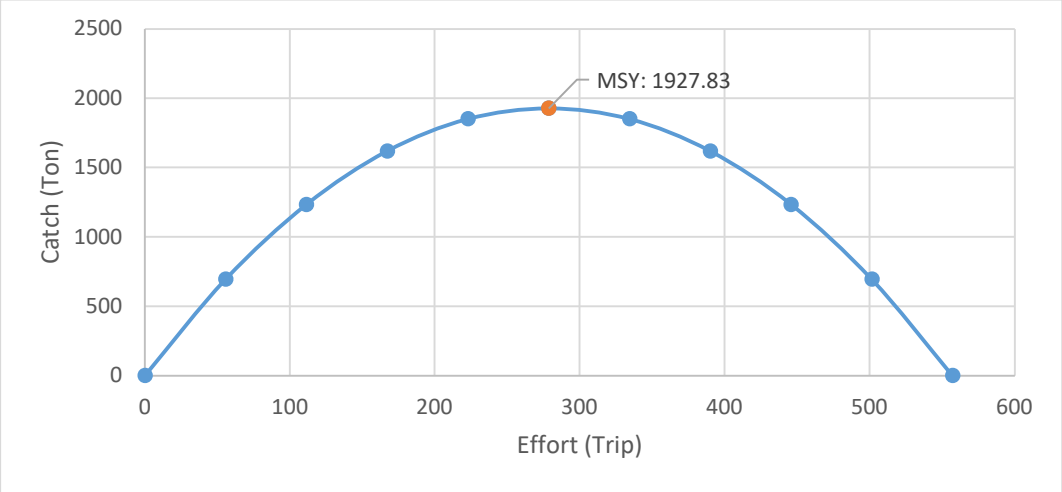

Figure 4. *Maximum Sustainable Yield* dan *Effort Optimum*

The maximum sustainable potential (MSY) of mackerel resources in Belawan waters in the last 3 years is 1927.83 tons with an optimum effort of 278.54 trips, which means that if the effort exceeds the optimum effort it will reduce the value of catch

production. The total catch of mackerel in that time period has not exceeded MSY, this means that the amount of catch obtained in that year is still sustainable. However, the fishing effort in 2020-2021 has exceeded the optimum effort value and resulted in the lowest catch in that year. This indicates that if the effort exceeds the optimum effort, the prediction of future catch production will decrease.

Total Allowable Catch/JTB

The allowable catch of mackerel is known based on the MSY value of mackerel. The amount of JTB shows the amount of production of mackerel catches that can be utilized at 80% of the sustainable potential of mackerel each year, taking into account the sustainability of the species through recruitment in fishing grounds (Setyohadi 2009). The following is a table of the allowable catch (JTB) of mackerel at PPS Belawan during 2020-2022:

Tabel 5.Total Allowable Catch / JTB

Year	Tongkol Catch (Ton)	MSY (ton)	TAC/JTB (ton)
2020	1057,27		
2021	1174,05	1927,83	1542,26
2022	685,93		
Total	2917,25		

The TAC/JTB value of tuna at PPS Belawan during 2020-2022 was 1927.83 tons. This value is obtained based on the maximum presumption of utilization by multiplying the percentage of 80% of the MSY value. The establishment of a fishing quota is a restriction to fish up to the maximum limit and the amount of fishing allowed (JTB). Fishing quota is one way to manage fisheries resources so that the available fish resources are not depleted and can be renewed.

Utilization and Enrichment Level

The calculation of utilization rate aims to determine the percentage of fish resources utilized in a body of water. The level of utilization that exceeds the sustainable potential (MSY) can threaten the sustainability of fish resources, the availability and continuity of their life cycle will be disrupted and have an impact on fish stocks which will decrease. The following figure presents a graph of the percentage level of utilization and exploitation of tuna resources at PPS Belawan in 2020-2022:

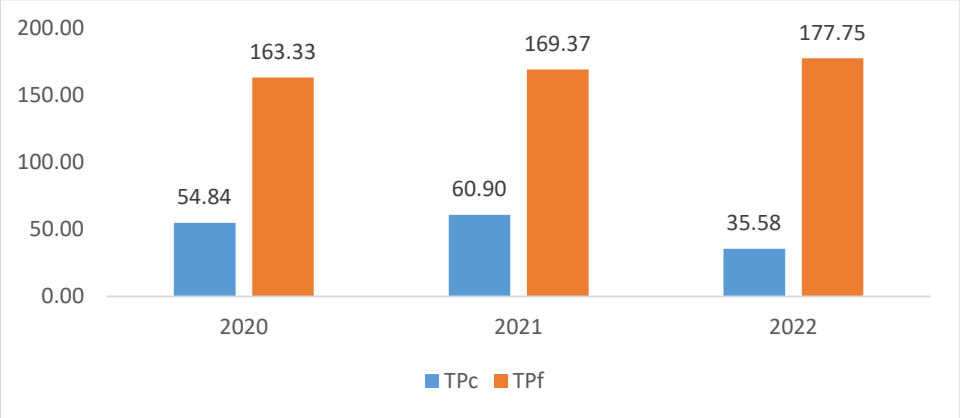

Figure 5. Utilization and Enrichment Level

Based on the figure above, the value of the utilization and exploitation rate of mackerel resources in the last three years has fluctuated. The utilization rate of tuna resources reached its peak in 2021 at 60.90% and the lowest utilization rate occurred in 2022 at 35.58%. Meanwhile, the highest level of enrichment occurred in 2022, which amounted to 177.75% and the lowest

occurred in 2020, which only amounted to 163.33%.

Based on the results of the calculation of the average percentage of the utilization rate of mackerel in 2020-2022 at the Belawan Ocean Fishing Port is 50.44%, the average value of the level of effort is 170.15%. This shows that the level of utilization of mackerel resources at PPS Belawan during the three-year period is at a developing level, meaning that the number of fish resource group catches per year has not reached 80% of the estimated potential set and the addition of fishing effort is still possible to increase catches but does not exceed the optimum effort that has been determined. If the fishing effort is excessive, it can cause overfishing conditions which are usually characterized by symptoms in a fish resource, including: (1) the catch of fishermen is decreasing over time; (2) the fishing ground is getting farther away; and (3) the size of the fish caught is getting smaller (Widodo, 2002). In addition, the capital cost of fishing will be greater than the cost of revenue, because the catch is getting smaller.

Alder et al. (2001) explained that in order for the utilization of fisheries resources to be carried out in a sustainable and environmentally sound manner, it is necessary to make management efforts that can balance the level of utilization. Management that can be done so that the sustainable potential of tuna can be increased is the regulation of the fishing season, the number of fishing fleets operating and the mesh size can be adjusted to the adult size of the target fish. The level of utilization that exceeds the sustainable potential (MSY) can threaten the sustainability of fish resources, the availability and sustainability of its life cycle will be disrupted, which in turn will reduce fish stocks.

IV. Conclusion

The utilization rate of tuna (Euthynnus Sp) in the Belawan Ocean Fishing Port of North Sumatra during 2020-2022 is still in a sustainable state with a utilization rate value of 58.84% (2020), 60.90% (2021), 35.58% (2022) respectively with a msy value of 1927.83 tons, but inversely proportional to the level of effort which has a value of 163.33% (2020), 169.37% (2021), 177.75% (2022) but exceeds the fopt value of 278.54 trips.

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