

ESTIMATING SEASONAL PATTERNS OF FISHING FOR ANCHOVIES (*Stolephorus Sp*) LANDED AT PPI PAOTERE, MAKASSAR, SOUTH SULAWESI: AN APPROACH TO FISHING BUSINESS EFFICIENCY

Muhammad Ridwan¹, Amir Hamzah Muhiddin², Mukti Zainuddin^{3*}

Submitted: September 20, 2023 Accepted: July 22, 2024

¹Department of Fisheries Agribusiness, Pangkajene Islands State Agricultural Polytechnic.

²Department of Marine Science, Faculty of Marine Science and Fisheries, University Hasanuddin.

³Department of Fisheries, Faculty of Marine Science and Fisheries, University Hasanuddin.

Corresponding author:

*Mukti Zainuddin

E-mail: muktizunhas@gmail.com

ABSTRACT

The exploitation level of fish resources should be based on effectiveness, efficiency and business sustainability. One of the efforts to implement these three aspects is to understand the seasonal pattern or the best time to catch the fish target. The aim of this research was to estimate the pattern of the anchovy fishing season based on production data landed at PPI Paotere Makassar, South Sulawesi. Data was collected from the PPI and analyzed using the moving average techniques. Results showed that the seasonal pattern of anchovy fishing is estimated to increase in the transition season to the eastern season (IMP > 100%) and reach a peak in September (IMP = 134.74%). Descriptively, the fishing season, especially the peak season, was thought to occur because these fish are probably associated with optimum conditions for oceanographic parameters such as sea surface temperature, chlorophyll-a concentrations and surface current conditions. Information on anchovy fishing season patterns is really needed by marine fisheries managers, both government and private, in managing efforts to exploit fish resources wisely and sustainably.

Keywords: IMP, anchovy, fishing season, moving average, oceanographic parameter

INTRODUCTION

The pelagic fishing season is an important discussion in the world of fisheries resource utilization. Information about fishing seasons can be used to determine temporal indicators of the abundance of small pelagic fish and so that fishermen have the opportunity to get high catches (Chodriyah and Hariati 2010). The abundant availability of fish at a certain time supported by optimum environmental conditions is considered the fishing season (Zainuddin et al. 2016). Fishing activities during the peak fishing season can provide better catch results (e.g. Zainuddin et al. 2016; Ridwan et al., 2022). Fishing season patterns can be used to maintain the availability of fish resource stocks by combining information regarding fish spawning, rearing and migration times. Fishing effort can be maximized during the peak fishing season and reduce fishing intensity during the spawning season (Rahmawati et al. 2013). One species of fish that is targeted for fishing in the waters of the Makassar Strait is anchovies (*Stolephorus sp*). At the Paotere Fish Landing Base (PPI), anchovies are one of the dominant fish landed. This fish is generally caught using boat fishing gear from various areas such as Pangkep, Barru and Takalar waters. The availability of these fish in fishing areas is influenced by oceanographic conditions which will directly affect the presence of fish. Changes in oceanographic conditions spatially and temporally influence the distribution pattern of fish resources. In tropical waters, the distribution of fish is influenced by

the seasonal wind patterns, namely the east and west monsoons, and the transition between these two seasons occurs continuously throughout the year periodically (Rasyid et al., 2014). Changing current and wind conditions greatly influence the fishing season because they can affect the availability of food sources for fish, where plankton as a food source for fish can move following the movement of ocean currents. One way to increase the efficiency and effectiveness of fishing is to know the fishing season as indicated by the fishing season index value. The fishing season index is a very important approach to show which fishing season is more dominant (Jumriani et al., 2020). The main problem with anchovy fishing in the southern waters of the Makassar Strait is that several fishing season patterns have experienced changes and shifts in recent years. Based on information from fishermen, fishing season patterns often change and can confuse fishermen. Shifts in fishing times and seasons are caused by unpredictable weather. Management of changes in seasonal patterns can increase fishing efficiency, so that fishermen can make good preparations before carrying out fishing operations.

The fishing season index (IMP) is an alternative that can be used to determine the right time to carry out fishing operations so that the level of profit obtained by fishermen can be maximized but anchovy resources remain sustainable. Therefore, the aim of this research is to estimate the anchovy fishing season index based on time series data on anchovy catches, and determine the

fishing season pattern of fish landed at the Paotere Makassar Fish Landing Base (PPI).

MATERIALS AND METHODS

Information regarding the fishing season was obtained by looking for the average monthly data for the last 5 years (2014-2018). If the fishing season is not clear, it can be determined using the fishing season index (IMP), namely by recalculating the average of the total number and the monthly average. Thus, fishing production above the general average is in the months of the fishing season, while fishing production below the general average is not in the months of the fishing season. The highest month is the peak season, while the lowest month is during the lean season.

Determination of the fishing season index using analysis (time series analysis) of anchovy catch data. Every month, it is followed by a moving average calculation. The simple stages of calculation are as follows:

- Compile production data
- Prepare a monthly production series
- Calculate the moving average value of production for 12 months for the 6th starting sequence
- Construct a centralized CPUE moving average before the i month
- Calculate the average production ratio for the i -th month
- Create an average value

To create an average value in an ixj matrix which is arranged for each month, starting from January to January of the following year. Then calculate the total value of the overall average ratio and fishing season pattern.

- Average ratio for month i
- Monthly average number of ratios
- Correction Factor
- Fishing Season Index for month i (IMP_i)

$$IMP_i = RBB_i \times FK$$

Where:

IMP_i : Fishing season index value for month i

RBB_i : Average Ratios for month i

i : 1,2,3,...,12

Determination of Fishing Season Categories

The fishing season index is an index value that shows the seasonal level of a type of fish at a fishing location, based on a certain time unit, the season index is used to determine the right time to carry out fishing operations

so that the level of profit obtained by fishermen is maximized with fixed sustainable fish resources (Imron et al., 2020).

According to Imron et al. (2020). The criteria for determining the fishing seasons are categorized into:

$IMP > 100\%$ is categorized as a fishing season

$IMP \leq 100\%$ is categorized as not a fishing season

The highest PMI is categorized into the peak season

The lowest PMI is categorized into the lean season.

RESULTS AND DISCUSSION

The fishing season is a condition where fishing activities are carried out more intensively compared to other periods of the year. Fish troops at that time were very abundant, exceeding troops in normal conditions. The fishing season index (IMP) is used to determine the right time to carry out fishing operations so that the level of profit obtained by fishermen can be maximized but anchovy resources remain sustainable.

Production of anchovies landed at PPI Paotere tends to increase in two phases, i.e., the first phase, in May (end of the west to east transition season). This is also observed in small pelagic fish in Barru Waters which start the fishing season during the transition season (Ridwan et al., 2022). Meanwhile, in the second phase, anchovy catches increased and reached a peak in September (the beginning of the east to west transition season) (Figure 1). In the first phase the catch reached an average of around 61 tons per month and in the second phase the highest anchovy catch was around 63 tons/month. The lowest catch occurs in January (west season). Monthly fluctuations in catch results are thought to be related to weather conditions, fishing techniques and changes in oceanographic parameters.

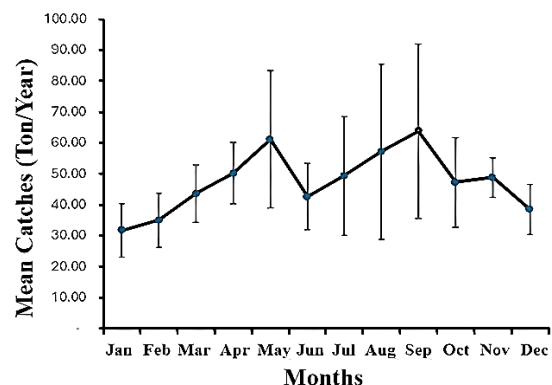


Figure 1. Temporal variations in average anchovy catches at PPI Paotere during the 2014-2018 period.

Based on the research results, it was found that the anchovy fishing season around the South Makassar Waters lasts for 6 months. The anchovy season begins in April and May which coincides with the first transition season (West-East) in the season classification in Indonesia (Table 1). Furthermore, the fishing season increases again in the east season (July-August). The fishing season then reaches its peak in September which coincides with the second transition season (East-West).

Table 1. Description of the estimated anchovy fishing season along with the general classification of seasons in Indonesia every month.

Months	Estimation of fishing season	Classification of Indonesian Season
Jan	Fair season	West season
Feb	Poor Season	West season
Mar	Fair season	East-west transition season
Apr	Fishing season	East-west transition season
May	Fishing season	East-west transition season
Jun	Fair season	East season
Jul	Fishing season	East season
Aug	Fishing season	East season
Sep	Peak Season	West-east transition season
Oct	Fishing season	West-east transition season
Nov	Fair season	West-east transition season
Dec	Fair season	West season

Fluctuations in the Fishing Season Index (IMP) per year are shown in Figure 2.

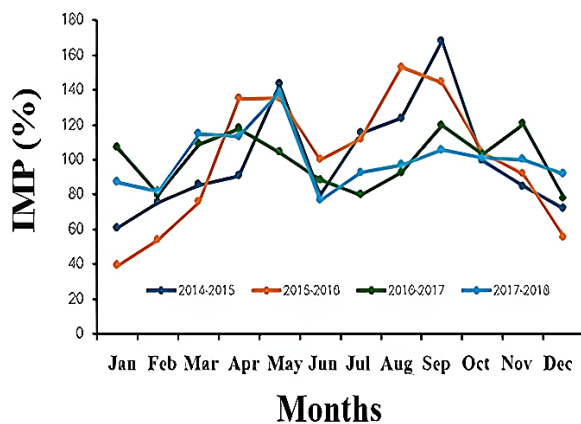


Figure2. Temporal variation of anchovy PMI per year for four periods 2014-2018.

The 2014/2015 fishing period had the highest IMP in general during the 2014-2018 period. This is seen especially in May (first mode) and highest in the second mode (September). The lowest annual PMI value occurred in the 2017/2018 period. One of the basic reasons this phenomenon occurred may be because the formation of the ZPPI weakened during that period. This incident may also be related to the El Nino and La Nina phenomena (climate change effects) on small pelagic fish in 2015/2016 (Baharuddin et al., 2022). Although in Figure 2 it can be seen that the 2015/2016 fishing period already saw a decline in PMI, and the effect only became significant in the following year.

Figure 3 shows that the fishing season is estimated explicitly in April-May and August-September. In Bone Bay, the potential area for anchovy fishing experiences a significant increase in October (Safruddin et al, 2017). This shows that the second transition season (East-West) is the optimum season for anchovy fishing around Fisheries Management Area 713 (WPP 713). In general, it is also found that the anchovy lean season occurs in the western season (December-February). This is because in the west season the wave conditions are quite high so it is technically difficult to carry out fishing properly and there is a risk of damage to fishing gear. This fact is also shown by the results of research on the flying fish season in Barru Waters (Ridwan et al., 2022). Determining the characteristics of fishing season patterns needs to be done so that fish in nature can spawn or reproduce to maintain stock sustainability. Fishing can be optimized in the months that are the fishing season (April-September). By knowing fishing season patterns, fishermen can optimize fishing activities to get maximum catches in a particular season (Rahmawati et al., 2013).

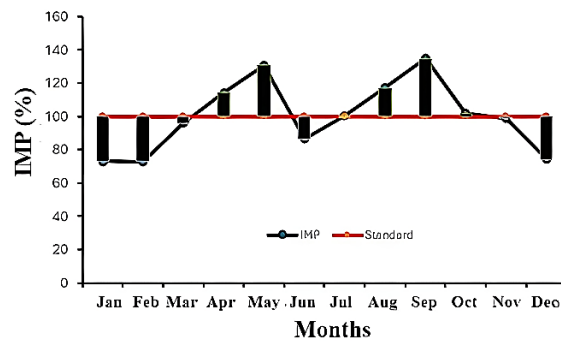


Figure 3. Temporal variation of average anchovy PMI from January to December during the period 2014-2018.

One of the factors of the fishing season is influenced by environmental factors (oceanography) which influence the abundance of fish in a body of water. In September, the peak season for anchovy fishing occurs, it is associated with relatively warm sea surface temperatures

in the range of 29.34-30.66°C. This occurs in the southern waters of the Makassar Strait (Figure 4). At the same time, a chlorophyll-a concentration > 0.3 mg m⁻³ corresponds to the abundance of these anchovies. Current speed conditions tend to be moderate with current patterns circulating between Polman Waters to Takalar Waters (< 0.16 m s⁻¹). Environmental changes

cause seasonal changes in an area and will cause changes in fish distribution patterns in that area. Changes in the aquatic environment such as changes in sea surface temperature, chlorophyll concentration and salinity can affect fish abundance (Rahman et al., 2019; Sadhotomo and Potier, 1995; Zainuddin et al., 2016).

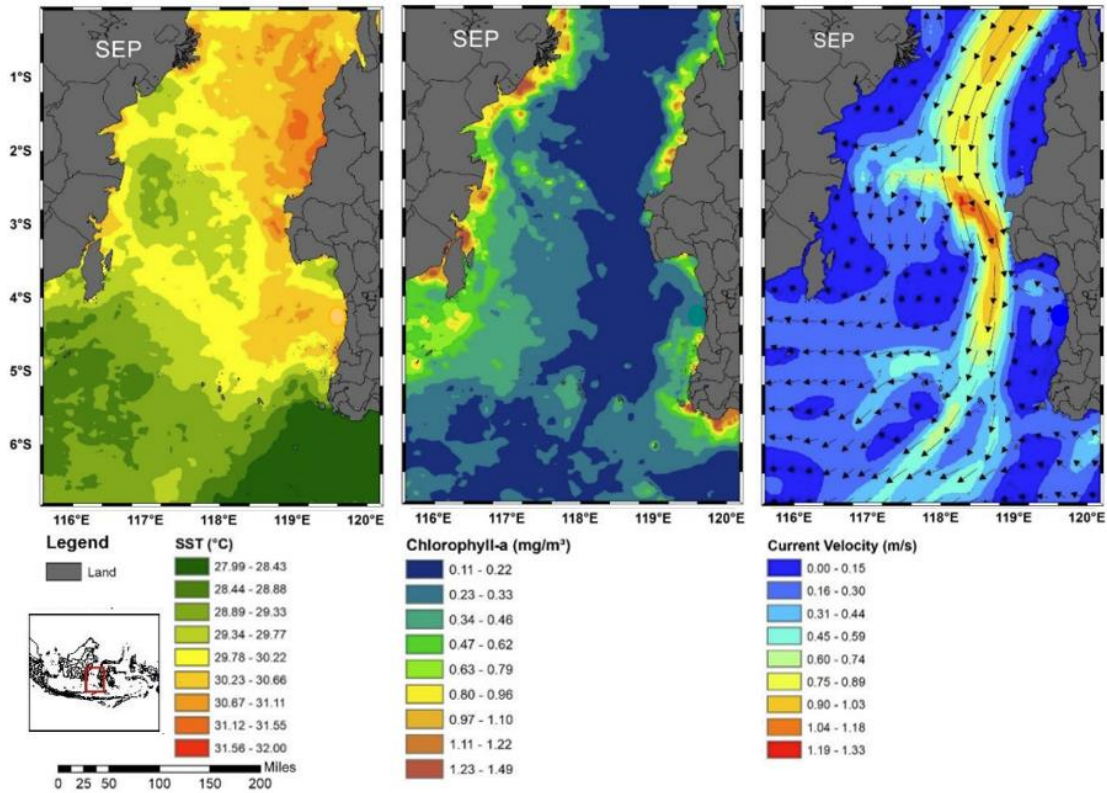


Figure 4. Map of the distribution of sea surface temperature, Chlorophyll-a and current patterns during the peak anchovy fishing season in September 2020 in the waters of the Makassar Strait.

CONCLUSION

Based on the results of fishing season analysis of monthly production data for anchovy fishing at PPI Paotere for the period of 2014 - 2018, it was found that; 1) The anchovy fishing business in the south of the Makassar Strait, especially those landed at PPI Paotere,

is carried out throughout the year and the fishing season is estimated by IMP. 2) The fishing season occurs from April – September and the peak fishing season occurs in September. In October - March the catch is not abundant and the lean season occurs in January - February. 3) The fishing season pattern is thought to be related to the pattern of changes in oceanographic conditions.

REFERENCES

- Baharuddin NAI, Zainuddin M, Najamuddin. 2022. The impact of ENSO-IOD on Decapterus spp. in Pangkajene Kepulauan and Barru Waters, Makassar Strait, Indonesia. *Biodiversitas* 23: 5613-5622.
- Chodriyah U, Hariati T. 2010. Musim Penangkapan Ikan Pelagis Kecil di Laut Jawa. *Jurnal Penelitian Perikanan Indonesia*. 16(3): 217-223.
- Imron, M., K., Kusnandar & Komarudin, D. 2020. *Komposisi Dan Pola Musim Ikan Hasil*

- Tangkapan di Perairan Tegal Jawa Tengah. *ALBACORE Jurnal Penelitian Perikanan Laut*, 4(1), 033–046.
<https://doi.org/10.29244/core.4.1.033-046>.
- Sadhotomo, B and M. Potier. 1995. Exploratory Scheme For The Recruitment And Migration Ofthe Main Pelagic Species: 155-168.
https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers09-06/42771.pdf [Retrieved on 9 September 2023].
- Rahman, M.A., M.L Syamsuddin, M.U.K Agung, & Sunarto. 2019. Pengaruh Musim Terhadap Kondisi Oseanografi Dalam Penentuan Daerah Penangkapan Ikan Cakalang (Katsuwonus pelamis) Di Perairan Selatan Jawa Barat. *Jurnal Perikanan dan Kelautan*, 9(1): 92-102.
- Rahmawati M, Fitri ADP, wijayanto D. 2013. Analisis Hasil Tangkapan Per Upaya Penangkapan dan Pola Musim Penangkapan Ikan Teri (*Stolephorus spp.*) di Perairan Pematang. *Fisheries Resources Utilization Management and Technology*. 2(3): 213-222.
- Rasyid, A. J., Iqbal, A. B., Muh Hatta. (2014). Karakter Oseanografi Perairan Makassar Terkait Zona Potensial Penangkapan ikan Pelagis Kecil Pada musim Timur Makassar *Water Oceanography Character which connected with Fishing Potential Area of Small Pelagic Fish on East Season. Jurnal IPTEKS PSP*, 1(1), 69–80.
- Ridwan, M., Ilyas, Walinono, AR. 2022. Estimating Fishing Seasons for Scads in Barru District: An Approach for Efficiency and Effectiveness Fishing Business of Management. *Jurnal IPTEKS Pemanfaatan Sumberday Perikanan*, 9(1): 23-28.
- Safuruddin, Suciati, A., M. Zainuddin. Estimasi Potensi dan Prediksi Daerah Potensial Penangkapan Ikan Teri (*Stolephorus Spp*) di Teluk Bone. *Jurnal IPTEKS Pemanfaatan Sumberday Perikanan*, 4(8): 134-143.
- Zainuddin, M., Safuruddin, Hidayat, S., dan A. Farhum. 2016. Pola Musim Penangkapan Ikan Cakalang Di Teluk Bone Berdasarkan Data Time Series Pada Tempat Pendaratan Ikan Di Lappa, Sinjai, Sulawesi Selatan. *Jurnal IPTEKS Pemanfaatan Sumberday Perikanan*, 3(5): 434-441.