Determine the fishing season of scad (*Decapterus* sp.) landed at Pusong Fish Landing Base, Lhokseumawe, Indonesia

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ARTICLE INFO

ABSTRACT

The scad (*Decapterus* sp.) is one species commonly caught using purse seine and landed at the Pusong Fish Landing Base, Lhokseumawe, Aceh. The fishermen at this site do not have accurate knowledge about the fishing season of the scad, which leads them to miss out on peak fish catching season and increases the ambiguity about the fish landing data. The goal of this research is to compute the trend of Catch Per Unit Effort (CPUE) for scad fisheries over the last five years (2013-2017) and to examine the fishing season trends of scad landed at Pusong fish landing base. This study took place at the Pusong Fish Landing Base in August 2020. The moving average approach was used to process catch data from 2013 to 2017. Primary and secondary data about scad production and number of fishing trips were used to compile the research findings. The results showed that the CPUE for purse seine catch landed at Pusong Fish Landing Base varies from year to year. The highest CPUE value was recorded in 2015 with 442,534 kg/trip, and the lowest was in 2013 with a value of 27,674 kg/trip. The fishing season index for Scad (*Decapterus* sp.) has a high rating, indicating that this fish species can be caught all year. Based on the fishing season identification criteria, the fishing season index value greater than 100% indicates the peak season. Results from this research indicate that the peak season for scad landed at Pusong Fish Landing Base occurs in July, August, September, October, and November, with their index values of 151%, 146%, 119%, 122%, and 126% respectively. A fishing season index score of less than 100% indicates low season, this was recorded for January, February, March, April, May, June, and December (48%, 97%, 57%, 90%, 62%, 86% and 97%).

Introduction

The Pusong Fish Landing Base is located in Lhokseumawe City in Aceh Province, Indonesia. At this landing base, there are various sizes of fishing vessels that catches various fish species. One of the fishing gears that is most commonly operated by fishermen in this location is the purse seine. The main target for purse seine is pelagic species such as tuna, skipjack, scad, and other pelagic fish species (Anggawangsa *et al.*, 2014). Based on the preliminary study, scad (*Decapterus* sp.) is a fish species that is often caught and landed at the Pusong Fish Landing Base. This fish is a small pelagic fish that is spread throughout Indonesian waters and is an important economic commodity (Hamka and Rais, 2016). This

species is a fish that tends to form schools and belongs to the Carangidae tribe. These fish are usually foundin sizes ranging between 15 to 25 cm (Sangaji *et al.*, 2016).

The total production of scad in Pusong Fish Landing Base varies every year. According to data obtained from the technical implementing unit of Pusong Fish Landing Base, the total production of scad in 2013 was 46,132 kg, 190,400 kg in 2014, 743,015 kg in 2015, 314,410 kg in 2016, and 190,750 kg in 2017. Meanwhile, the number of fishing vessels tended to increase from 2013 to 2017, ranging from 78 units to 198 units. According to Mayalibit *et al.* (2013), the number of fish caught depends on the level of fishing effort and the presence of fish stocks

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in the fishing area. However, an uncontrolled increase in fishing effort will affect the sustainability of fish resources in the waters (leading to overfishing), one of which is indicated by a decrease in the amount of fish production (Kristiana *et al.*, 2021). For this reason, fishing activities must be carried out effectively.

Effective fishing operations must be carried out in order for fish resources to continue to be produced, and one way to do so is to understand the trends in Catch per Unit Effort (CPUE) and the fishing season of scad. The fishing season index can be used to decide when fishing operations should take place in order to reduce the risk of loss. Based on the fishing season index, the trend of the fishing season may be identified, allowing proper time for fishing to be established (Rahmawati *et al.*, 2013). The fishermen at the Pusong Fish Landing Base faces several challenges, one of which is a lack of knowledge regarding the fishing season. As a result, fishermen do not always get optimal catch results, impacting the total production of the catch that was landed at the Pusong fish landing base, and fishermen have experienced both temporal and monetary losses. The fishing operations are carried out with a lack of planning, management, and operation related to the target, which resulted in a loss in terms of economic value (Simbolon *et al.*, 2011). One of the variables supporting the success of fishing effort and fish resource management is the availability of data and information on geographical and temporal fish distributions (Baskoro *et al.*, 2010).

The research about scad fishing season at Pusong Fish Landing Base has never been conducted. However, Sari *et al.* (2017) in their research that was conducted in Banda Aceh claims that the peak season for scad fishing in the Banda Aceh waters occurs in the months of July, August, September, October, November, and December. The rainy season lasts from February to May, and the dry season lasts from June to August. The weather conditions that occur during fishing also plays a role in this seasonal patterns. Therefore, determining the fishing season of scad should be done as an alternative effort to reduce the risk of fishing losses so that the resource's potential can be preserved.

Materials and Methods
Data collection
This study took place in the month of August 2020, at the Pusong Fish Landing Base in Lhokseumawe. This study uses primary data and secondary data. The primary data in this study is a time-series data in the form of monthly summary data on the production of scad (*Decapterus* sp.) fish for five years period (2013-2017) from the Technical Implementation Unit of the Pusong Fish Landing Base. Meanwhile, the secondary data in this study was obtained through an interview process using a questionnaire about fishing trips, fishing seasons, and distance to fishing grounds that was disseminated to fishermen, with a total of 20 respondents.

Data analysis
Analysis of Catch per Unit Effort (CPUE) and fishing season index are the two types of data analysis used in this study. According to Kekenusa and Paendong (2016), the Fishing Season Index can be determined using the moving average method and time series analysis of the catch per unit effort. The advantage of using the moving average method is that it can isolate seasonal fluctuations, allowing to identify the best time to carry out fishing operations (Kurniawan, 2015). The formula used is as follows:

Catch per Unit Effort (CPUE) analysis
The catch per unit fishing effort can be estimated by dividing the number of catches by fishing effort using the equation below (Dajan, 2004):

$$CPUE_i = \frac{ci}{fi} \dots \dots (1)$$

Where: CPUE = catch per unit fishing effort of the year to i (kg/trip); i = 1,2,3,..., n; ci = the catch of the year to i (kg); fi = the fishing effort of the year to i (trip).

Information about the abundance and utilization rate of scad landed at the Pusong Fish Landing Base was determined through CPUE analysis in this study. The results of this analysis are then used to conduct an analysis of the fishing season, but the data is in the form of monthly data.

Fishing season index
The fishing season can be determined using the moving average method and time series analysis techniques, using the formula below (Dajan, 2004):
Develop a moving average CPUEi for 12 months (RG):

$$RGi = \frac{1}{12} \left(\sum_{i=i-6}^{i+5} CPUE \right) \dots \dots (2)$$

Where: RGi= moving average 12-month sequence of the i-th; CPUE : CPUE order to-i; i : 6, 7, 8,....., n-5.

Calculate the value of the moving average CPUE centralized month-to-i (RGPi)

$$RGPi = \frac{1}{2} \left(\sum_{i=i}^{i=1} RGi \right) \dots \dots (3)$$

Where: RGPi : moving average CPUE centralized month-to-i; RGi = moving average 12-month sequence of the i-th.

Calculate the ratio of the average month-to-i (RBi)

$$RBi = \frac{CPUEi}{RGPi} \dots \dots (4)$$

Where:

Rbi = the ratio of the average month-to-i; CPUEi = CPUE month-to-i; i = month-to-6,7,8...., n-5.

Compile the average value in a matrix i x j which should be arranged for each month starting from July 2013 until June 2017, then the calculation is done:

The ratio of the average for the month-to-i (RBBi)

$$RBBi = \frac{1}{n} \left(\sum_{i=1}^{n} RBij \right) \quad..........(5)$$

Where: RBBi = Average Rbij for months-i; Rbij = the ratio of the monthly average for the matrix of size i x j; i = 1,2,......,12; a = 1,2,3,......n

The amount of the ratio of monthly average (JRBB)

$$JRBB = \sum_{i=i}^{12} RBBi \quad.......... (6)$$

Where: JRBB = the amount of the ratio of the average of the month; RBBi = Average Rbij for months-i; i= 1,2,3,......,12

Correction factor (FK)

$$FK = \frac{1200}{JRBB} \quad.......... (7)$$

Where: FK = the value of the correction factor; JRBB = the amount of the ratio of the average of the month

The Fishing season month-to-i (IMPi)

$$IMPi = RBBi \times FK \quad.......... (8)$$

Where: IMPi= the Index value of the fishing season month-to-i; RBBi = the Ratio of the average for the month-to-i; i = 1,2,3,....,12.

Purwasasmita (1993) categorize the criteria for determining fishing season as follows: The fishing season index = 100% = Normal (Moderate season); The fishing season index > 100% = Fishing Season (peak season); The fishing season index < 100% = Not the fishing season (low season).

Results

The trend of catch per unit effort (CPUE) of purse seine for the scad (*Decapterus* sp.)

The analysis results show that scad (*Decapterus* sp.) is one of the most common species of fish landed at the Pusong Fish Landing Base. The following diagrams shows the production of scad (Figure 1(a)) and fishing effort for purse seine fishing gear (Figure 1 (b)) at the Pusong Fish Landing Base over a 5-year period (2013-2017):
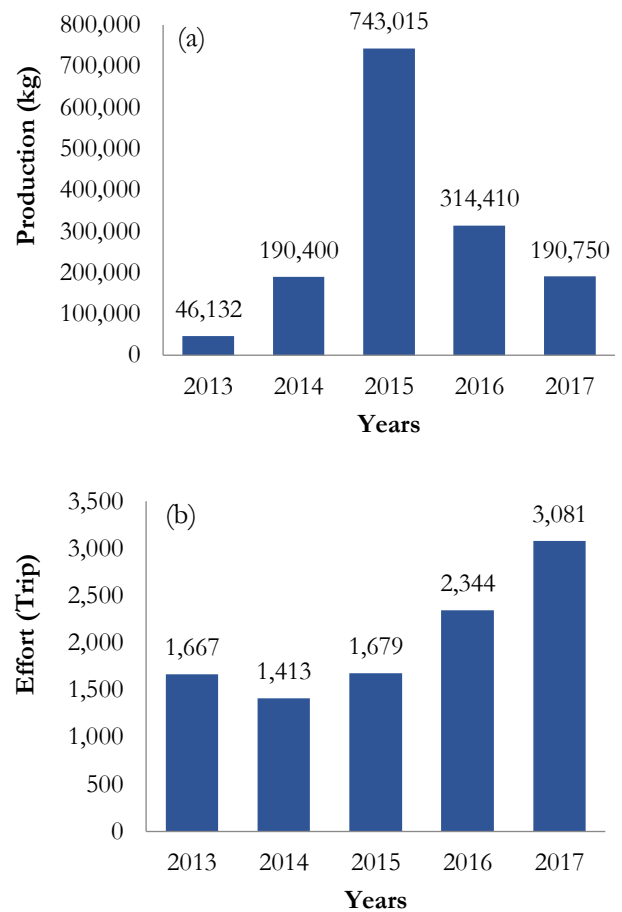

Figure 1. Production of scad (*Decapterus* sp.) (a) and trend of fishing effort for purse seine fishing gear (b) in the Pusong Fish Landing Base between 2013-2017.

Figure 1(a) shows that the trend of scad (*Decapterus* sp.) production that was landed at the Pusong Fish Landing Base for five years (2013-2017) is fluctuated. The highest production was 743,015 kg in 2015, while the lowest production was 46,132 kg in 2013. Meanwhile, fishing efforts for the production of scad at the Pusong Fish Landing Base for the last five years tended to increase. The lowest effort was in 2014, which is 1,413 trips/year, and the highest effort was in 2017, which is 3,081 trips/year.

The catch per unit effort (CPUE) value might give an indication of how plentiful fish resources are in the waterways. CPUE analysis can give an indication on whether or not fish are still present in the waters and whether or not their stockis decreasing. A graph of CPUE for purse seine in the Pusong Fish Landing Base for the last five years (2013-2017) is shown in Figure 2. Where the highest CPUE was 442.534 kg/trip in 2015, and the lowest CPUE value was 27.674 kg/trip in 2013.
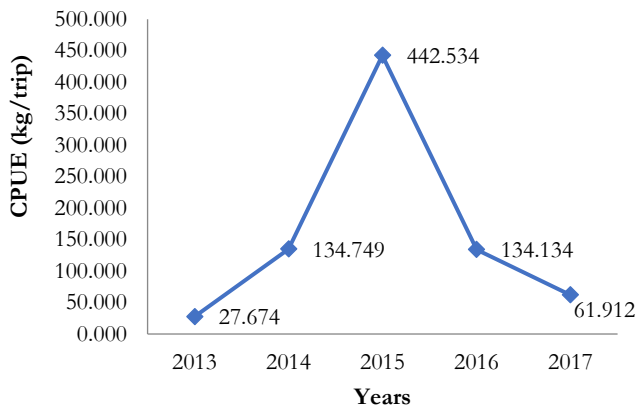
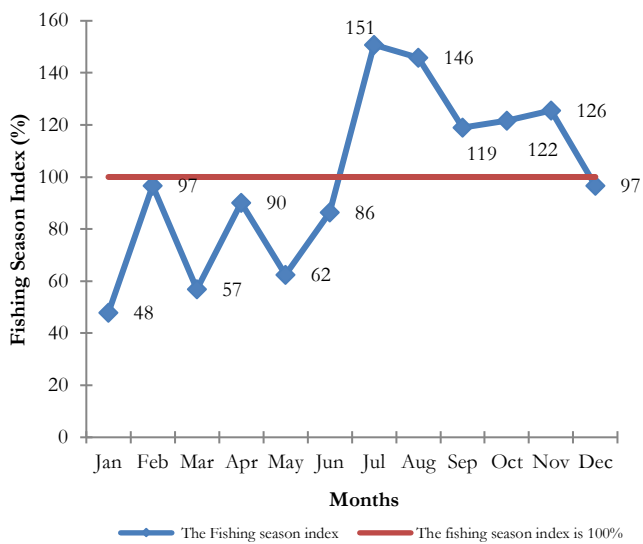Figure 2. Trend of catch per unit effort (CPUE) for purse seine years 2013-2017.

Figure 3. The Fishing Season Index of scad (*Decapterus* sp.) in the Pusong Fish Landing Base.

The fishing season for scad (*Decapterus* sp.)

The calculation of fishing season index for scad (*Decapterus* sp.) shows that the index of fishing season values for scad landed in the Pusong Landing Base ranged between 48 to 151 %, as shown in Figure 3. The highest value of the fishing season index is 151 % in July, while the lowest value is 48 % in January.

Discussion
The trend of catch per unit effort (CPUE) of purse seine

In this study, the effort is used to determine the CPUE is the number of trip operations of the purse seine that landed the catch of scad (*Decapterus* sp.) in the Pusong Fish Landing Base for 5 years (2013-2017). The fishing effort trend of scad in the Pusong Fish Landing Base for the analysed 5 years period

(2013-2017) is increasing. The highest fishing effort was recorded in 2017, which is 3.081 trips per year, while the lowest was recorded in 2014, which is 1.413 trips per year. Between 2013 and 2014, there was a 15% decline in the value of fishing effort. Then, starting in 2015, the value of fishing effort increased annually until it reached its peak in 2017, where there was a 19% increase in 2015, 40% in 2016, and 31% in 2017. The increasing level of fishing effort in recent years, particularly from 2015 to 2017, was because fishermen believed that increasing fishing effort will also increase the number of catch. However, this differs from a statement by Aprilla *et al.* (2013), which states that the number of fishing effort does not guarantee the number of catch. The result of this study shows that the total catch in 2015 was 743,015 kg. While in 2016 and 2017, the total catch decreased by 58% and by 39% respectively. Therefore, the increasing fishing effort during this period does not result in an increase of total catch. The decrease in total catch is caused not only by the increase in fishing effort, but also by several other reasons. Other factors that might contribute to the decrease in productivity of fishing vessels are the changes in weather and fishing season (Nurhayati,2013).

Catch per Unit Effort (CPUE) is an important factor in fishing regulation and monitoring. The role of CPUE calculation in fisheries resources is to provide information about the level of fish utilization and the development stage of the capture fisheries output (Telussa, 2016). According to Zahra *et al.* (2019), the value of CPUE can also be a representation of the amount of fishing effort productivity. The result of this research shows the value of CPUE fluctuated during the analysed 5 years period. The value of CPUE increased between 2013 and 2015, which were 387% in 2014 and 228% in 2015. In 2016 and 2017, the value of CPUE decreased from 70% in 2016 to 54% in 2017. According to data analysis results, the maximum value of CPUE occurred in 2015, which was 442,534 kg/trip, this is supported by the high level of catches (743,015 kg) and the relatively low level of effort (1,679 trip/year) recorded that year. Then in 2013, the CPUE value was at its lowest, with a value of 27,674 kg/trip. The CPUE value was low in 2013 because the recorded catch was low (46,132 kg) while the value of effort was high (1,667 trip/year). According to Sibagariang *et al.* (2011), the relationship between fishing effort and CPUE is that the trend of CPUE value decreases as fishing effort increases. In general, the value of fishing efforts has a linear relationship with the rate of capture or fishing

effort, which is comparable to fishing mortality. The relationship between CPUE and fishing effort is linearly negative, this means that added fishing effort will lower the value of CPUE. Therefore, it is necessary to monitor the addition of fishing effort in fishing activities, especially foractive and large-sized fishing gear such as the purse seine.

The association between fish catch quantity of catch and fishing efforts is measured as trip effect, which fluctuates depending on the catch unit productivity of trip catch effect. If the fishing effort can be minimized, the production and productivity of the catches will increase (Bubun and Mahmud, 2016). The value of CPUE can be used to gauge the efficiency of fishing effort (Utami et al., 2012), where a greater CPUE score indicates a higher level of effort efficiency.

CPUE will decrease as a result of fishing effort that occurred without being matched by an increase in catch. When the value of CPUE decreases, it indicates that the use of fish resources in the waters is at a high level. If the number of fishermen continues to increase, the number of fish caught in the following years may drop. This is owing to the limited resources availability, where the presence of simultaneous efforts by vessels in a fishery that resulted in a catch will result in each ship being incremented by a tiny amount (Nugraha et al., 2012).

The fishing season index of scad (*Decapterus* sp.)

The fishing season index can be used to determine when fishing operations should be carried out. If the index is greater than 100 %, it is referred to as fishing season, however, if the index is less than 100%, it is referred to as non-fishing season (Baskoro et al., 2010). The pattern of fishing season is best illustrated by the high value of fishing season index, which is greater than 100%. This implies that fishing is an excellent activity to do throughout the month with a high index value. The average of fishing season index is 100%, thus if the value of the fishing season is greater than 100%, it can be considered a good time to go fishing (Sinurat et al., 2018).

According to the fishing season index analysed in this study, scad (*Decapterus* sp.) is caught every month, with index values ranging from 48% to 151%. According to the fishing season index analysis results, scad fishing season begins in July, which is the peak fishing season, where the index fishing season value reach 151%. Then it decreased in August (146%) and September (119%), before increasing in October (122%) and decreasing again in November (119%). The months when the fishing season index value is less than 100% takes place from December to June,

thus it is classified as non-fishing season for scad. This is in line with studies undertaken by Sari et al. (2017), who found that the best season to catch scad in Banda Aceh waters occurs from July to December. Similarly, based on data from the Pekalongan Archipelago Fishing Port, Wahju et al. (2011) found that scad fishing season begins in July and ends in December at the Java Sea. While according to Hamka and Rais (2016), the fishing season for scad in the waters of Southeast Sulawesi is in July, August, and September.

The scad fishing season coincides with the end of the easterlies wind season and the occurence of the transitional wind season. At the end of the easterlies wind season in the Strait of Malacca waters, the thermocline layer is lifted and carried away by equatorial currents from the south to the north, spreading water masses from the process of upwelling to the waters towards the West (Azani, 2014). The high index season in the east occurs due to continuous drought in Indonesian waters during these months, which results in high levels of sea water salinity. This condition increases the number of scad in the fishing area's waters. According to Bubun and Mahmud (2016), scad is a fish species that prefers high-salinity waters. When the westerlies wind arrive, Indonesia's water mass had a low salinity level, the eastern waters have a high salinity level (Hamka and Rais, 2016). As a result, it is thought to be the cause of scad fishing season in the east. The weather in the west during this season is marked by heavy rains and high wind speeds, resulting in large sea waves.

Fishermen can still catch pelagic fish during the lean months of the non-fishing season, but only in modest quantity. Attempting to catch fish during non-fishing months can result in losses due to increased operational costs (Ilhamdi et al., 2016). According to findings from conversations with fishermen, scad can be caught all year. This is in agreement with the work of Laitupa et al. (2015), who claimed that catching scad can be done throughout the year in places by moving in accordance with the monthly and seasonal patterns of scad distribution.

Conclusion

The conlusion of this research are:

1. Based on data from 2013 to 2015, the catch per unit effort (CPUE) trend of fishing vessels targeting scad (*Decapterus* sp.) in the Pusong Fish Landing Base has increased up to 2015, and declines in the last two years (2016-2017). The value of CPUE was highest in 2015, which was 442,524 kg/trip, while it was lowest in 2013, which was 27,674 kg/trip.

2. Based on data from 2013 to 2017, the index of fishing season for scad (*Decapterus* sp.) that was landed in the Pusong Fish Landing Base ranged from 48% to 151 %, and the month of July is the best time to catch scad.

References

Aprilla, R.M., Mustaruddin, E.S. Wiyono, N. Zulbainarni. 2013. Analisis efisiensi unit penangkapan pukat cincin di Pelabuhan Perikanan Pantai Lampulo Banda Aceh. Jurnal Teknologi Perikanan dan Kelautan, 4(1): 9-20.

Anggawangsa, R.F., Suwarso, Wudianto. 2014. Catch rate and catch composition of mini purse seine in Bualemo, Banggai District. Indonesian Fisheries Research Journal, 20(1): 23-28.

Azani, R., T.E.Y. Sari, Usman. 2014. Variabilitas spasial dan temporal suhu permukaan laut dan klorofil-a di perairan selat malaka melalui citra satelit aqua modis. Jurnal Online Mahasiswa Fakultas Perikanan dan Ilmu Kelautan Universitas Riau, 1(1): 1-12.

Baskoro, M.S., M. Syahrir R., Darmawan, E. Lubis, E.S. Wiyono. 2010. Pola Musim penangkapan ikan pelagis di Perairan Teluk Apar. Jurnal Ilmu Perikanan Tropis, 13(1): 24-31.

Bubun, R.L., A. Mahmud. 2016. Tingkat pemanfaatan ikan layang (*Decapterus* sp.) berdasarkan hasil tangkapan pukat cincin di Perairan Timur Sulawesi Tenggara. Journal Airaha, 5(1): 96-102.

Dajan, A. 2004. Pengantar Metode Statistik Jilid II. Pustaka LP3ES, Jakarta. 358 p

Hamka, E., M. Rais. 2016. Penentuan musim penangkapan ikan layang (*Decapterus* sp.) di Perairan Timur Sulawesi Tenggara. Jurnal IPTEK PSP, 3(6): 510-517.

Ilhamdi, H., R. Telussa, D. Ernaningsih. 2016. Analisis tingkat pemanfaatan dan musim penangkapan ikan pelagis di Perairan Prigi Jawa Timur. Jurnal Ilmiah Satya Mina Bahari, 1(1): 52-64.

Kekenusa, J.S., M.S. Paendong. 2016. Analisis penentuan musim penangkapan ikan cakalang *(Katsuvonus pelamis* L.) di Perairan Belang Minahasa Tenggara Sulawesi Utara. Jurnal Ilmiah Sains, 16(2): 86-90.

Kristiana, H., J. Malik, N. Anwar. 2021. Estimation of the status of small scale fisheries resources in Semarang. Journal of Tropical Fisheries Management, 5(1): 51-58.

Kurniawan, W. 2015. Musim penangkapan ikan cakalang di Perairan Selatan Jawa Barat dan kaitannya dengan parameter oseanografi. Osenaa, 11(4): 53-60.

Laitupa, F.S., S. Kacoa, M.A. Laitupa, U. Tangke. 2015. Pendugaan daerah potensial penangkapan ikan layang (*Decapterus* sp.) berdasarkan SPL dan klorofil-a di Perairan Pesisir Pulau Ternate. Jurnal Ilmiah Agribisnis dan Perikanan (Agrikan UMMU-Ternate), 8(2): 28-35.

Mayalibit, D.N.K. Kurnia, R. Yonvitner. 2013. Analisis bioekonomi untuk pengelolaan sumberdaya ikan selar kuning (*Selaroides leptolepis*, uvier dan Valenciennes) yang didaratkan di PPN Karangantu. Jurnal Bonorowo Wetland, 4(1): 49-57.

Nugraha, E., B. Koswara, Yuniarti. 2012. Potensi lestari dan tingkat pemanfaatan ikan kurisi (*Nemiptorus japonicus*) di Perairan Teluk Banten. Jurnal Perikanan dan Kelautan, 3(1): 91-98.

Nurhayati, A. 2013. Analisis potensi lestari perikanan tangkapan di kawasan Pangadaran. Jurnal Akuatika, 4(2): 195-209.

Purwasasmita, R. 1993. Musim penangkapan ikan cakalang Katsuwonus pelamis dengan kapal-kapal huhate dan pengaruhnya terhadap peningkatan produksi di perairan sekitar Sorong. Jurnal Penelitian Perikanan Laut 79: 1-13.

Rahmawati, M., A.D.P Fitri, D. Wijayanto. 2013. Analisis hasil tangkapan per upaya penangkapan dan pola musim penangkapan ikan teri (*Stolephorus* spp.) di Perairan Pemalang. Journal of Fisheries Resources Utilization Management and Technology, 2(3): 213-222.

Rosalina, D., W. Adi, D. Martasari. 2010. Analisis hasil tangkapan lestari dan pola musim penangkapan cumi-cumi di Pelabuhan Perikanan Nusantara Sungailat-Bangka. Maspari Journal, 2(2011): 26-38.

Sangaji, M.B, U. Tangke, D. Namsa. 2016. Potensi dan tingkat pemanfaatan ikan layang (*Decapterus* sp.) di perairan pulau Ternate. Jurnal Ilmiah Agribisnis dan Perikanan, 9(2): 1-10.

Sari, R.N., E. Miswar, C. Marwan. 2017. Studi hasil tangkapan ikan layang (*Decapterus* sp.) dengan alat tangkap pukat cincin (*Purse Seine*) yang didaratkan di Pelabuhan Perikanan Samudera (PPS) Lampulo. Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah, 2(3): 423-428.

Sibagariang, O.P., Fauziyah, F. Agustriani. 2011. Analisis potensi lestari sumberdaya perikanan tuna longline di Kabupaten Cilacap, Jawa Tengah. Maspari Journal, 3(2011); 24-29.

Simbolon, D., B. Wiryawan, P.I. Wahyuningrum, H. Wahyudi. 2011. Tingkat pemanfaatan dan pola musim penangkapan ikan lemuru di perairan Selat Bali. Buletin PSP, 19(3): 293-307.

Sinurat, J.W., E.Y. Sari, Usman. 2018. Kajian musim penangkapan ikan kembung (*Rastrelliger* spp.) di Perairan Sibolga Utara. Jurnal Online Mahasiswa Fakultas Perikanan dan Ilmu Kelautan Universitas Riau, 5(1): 1-10

Telussa, R.F. 2016. Kajian stok ikan pelagis kecil dengan alat tangkap mini purse seine di Perairan Lempasing, Lampung. Jurnal Ilmiah Satya Mina Bahari, 1(1): 32-42.

[UPT PPI Pusong] Unit Pelaksanaan Teknis Pangkalan Pendaratan Ikan Pusong Dinas Kelautan Perikanan dan Pertanian, Kota Lhokseumawe. 2013. Hasil Tangkapan dan Jenis Tangkapan PPI Pusong, Kota Lhokseumawe.

[UPT PPI Pusong] Unit Pelaksana Teknis Pangkalan Pendaratan Ikan Pusong Dinas Kelautan Perikanan dan Pertanian, Kota Lhokseumawe. 2014. Hasil Tangkapan dan Jenis Tangkapan PPI Pusong, Kota Lhokseumawe.

[UPT PPI Pusong] Unit Pelaksana Teknis PangkalanPendaratan Ikan Pusong Dinas Kelautan Perikanan dan Pertanian, Kota Lhokseumawe. 2015. Hasil Tangkapan dan Jenis Tangkapan PPI Pusong, Kota Lhokseumawe.

[UPT PPI Pusong] Unit Pelaksana Teknis Pangkalan Pendaratan Ikan Pusong Dinas Kelautan Perikanan dan Pertanian, Kota Lhokseumawe. 2016. Laporan UPT PP Pusong, Kota Lhokseumawe.

[UPT PPI Pusong] Unit Pelaksanaan Teknis Pangkalan Pendaratan Ikan Pusong Dinas Kelautan Perikanan dan Pertanian Kota Lhokseumawe. 2017. Laporan UPT PP Pusong, Kota Lhokseumawe.

Utami, D.P., I. Gumilar, Sriati. 2012. Analisis bioekonomi penangkapan ikan layur (*Trichiurus* sp.) di Perairan Parigi Kabupaten Ciamis. Jurnal Perikanan dan Kelautan, 3(3): 137-144.

Wahju, R.I., Zulkarnain, K.P.S. Mara. 2011. Estimasi musim penangkapan layang (*Decapterus* spp.) yang didaratkan di PPN Pekalongan, Jawa Tengah. Buletin PSP, 19(1): 105-113.

Zahra, A.N.A., Susiana, D. Kurniawan. 2019. Potensi lestari dan tingkat pemanfaatan ikan selar (*Atule mare*) yang didaratkan di Desa Kelong, Kabupaten Bintan, Indonesia. Jurnal Akuakultur Pesisir dan Pulau-Pulau Kecil, 3(2): 57-63.