Remote sensing for assessing the potential anchovy fishing ground in the Pesisir Selatan Regency, West Sumatra, Indonesia

[1,2]Made Ariana, [1]I Nyoman Suyasa, [3]Domu Simbolon

[1] Department of Fishery Resourses Utilization, Jakarta Fisheries University, Indonesia; [2] Marine and Fisheries Polytechnic of Pariaman, Fisheries Department, West Sumatra, Indonesia; [3] Fishery Resources Utilization Department, Faculty of Fisheries and Marine Science, IPB University, Darmaga-Bogor, Indonesia. Corresponding author: M. Ariana, imadear.1203@gmail.com

Abstract. The purpose of this study was to determine the spatial and temporal distribution of the potential fishing zones (PFZ). The study used catch per unit effort (CPUE) data and remote sensing data on salinity, chlorophyll-a and sea surface temperature (SST), in order to predict potential zones of anchovy fishing. The CPUE based analysis showed that the maximum capture yield was obtained during the 2nd transition season. Oceanographic parameters in Pesisir Selatan Regency showed the distribution of salinity between 32.27 and 33.54‰, a chlorophyll-a content between 0.16 and 0.77 mg m^{-3}, and a SST distribution range from 30.28 to 30.68°C, which are suitable values for anchovy habitats. Based on salinity and chlorophyll-a data, PFZs were rather situated on the coast and did not necessarily coincide with the fishing spots identified by the fishermen based on SST. The PFZs predicted, based on composite data, were spread out along the Pesisir Selatan Regency, with a seasonal peak in September and October.

Key Words: salinity, temperature, chlorophyll-a, CPUE, PFZ.

Introduction. Generally, fishermen determine the area of anchovy fishing based on conventional methods using the five senses, such as: seeing flocks of birds that swooped near the surface of the water, discoloration of the water, chunks of wood or other floating objects, the presence of water ripples on the surface and others (Demena et al 2017), or based on the experience of previous trips. Identifying the fishing grounds with these ineffective methods are more time, money and energy consuming (Amri 2002; Gamawan et al 2018), therefore effective and efficient methods were proposed by the researchers, namely by using remote sensing for the potential anchovy fishing ground assessment. Recently, satellite remote sensing became important for environmental monitoring (Chassot et al 2011), being also used to manage fisheries to a sustainable level (Klemas 2013).

Satellite remote sensing data can be used to analyze sea surface temperature (SST), sea surface chlorophyll (SSC) and sea surface salinity (SSS), with relatively high spatial and temporal resolution (Polovina & Howell 2005). The application of remote sensing from satellites to the field of fisheries is increasing worldwide (Laurs 1986; Lehodey et al 1997; Zagaglia et al 2004; Druon 2010; Perez et al 2013; Kamei et al 2014). Oceanographic phenomena are often used to analyze preferred habitats and to determine potential fishing grounds (Lennert-Cody et al 2008; Osawa & Julimantoro 2010) including anchovies in the waters of the Pesisir Selatan Regency, West Sumatra Province. The purpose of this study was to determine the spatial and temporal distribution of the potential fishing zones (PFZ), using catch per unit effort (CPUE) data and remote sensing data on: salinity, chlorophyll-a and sea surface temperature (SST), in order to predict potential zones of anchovy fishing.

Material and Method

Description of the study sites. This study was conducted at Pesisir Selatan Regency waters, West Sumatra, located between 0° 30' 00" - 2° 20' 00" S and 99° 30' 00" - 101° 00' 00" E. This location is situated inside the Fisheries management area (FMA) number 572 of the Indian Ocean, where the catch of local fishermen is dominated by small pelagic fish (Figure 1).

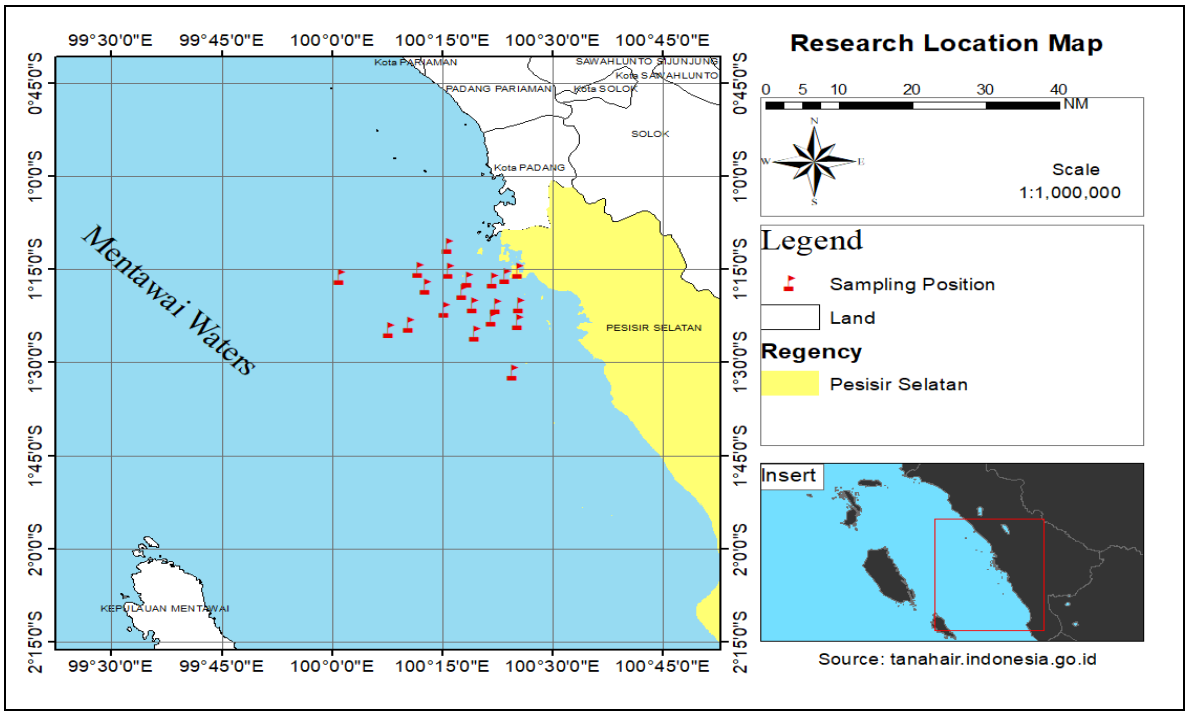

Figure 1. Research location.

Data collection. The data in this research consist of: 1) time series data, i.e. the fishing anchovy landed by fisherman for five years; 2) satellite image data (salinity, chlorophyll-a and sea surface temperature), on a monthly basis, for 5 years (2014 to 2018), and 3) direct observation data (in-situ) for satellite image data validation. Monthly satellite images data (salinity, chlorophyll-a and sea surface temperature), at the research location, with a 4 km resolution and in the NetCDF format, are obtained by downloading data available on the internet. Chlorophyll-a and sea water temperature data were obtained through the site http://oceancolor.gsfc.nasa.gov, while salinity data were obtained from https://podaac-w10n.jpl.nasa.gov/allData/smap/L3/. The method used for direct observation data collection was an "on the spot" direct survey method to obtain data on sea surface salinity (SSS), chlorophyll-a, sea surface temperature (SST) and catch (including fishing GPS positioning) at 20 fishing locations.

Data analysis

Catch per unit effort (CPUE). The catch per unit effort calculation aimed to determine the value of catch rate of a unit of fishing efforts, based on the ratio of the total catch against the total effort (Kumaat et al 2013). The corresponding mathematical expression is:

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

Sea surface salinity (SSS). The category of potential fishing zone was divided into two types based on the SSS distribution. If the waters had the salinity between 27.7 to

33‰, the fishing area was categorized as "potential fishing zones". The waters with salinity outside 27.7 to 33‰ were categorized as fishing areas "with less potential".

Chlorophyll-a. The category of potential fishing zone was divided into two types based on the chlorophyll content. If the waters had a chlorophyll-a content higher than 0.2 mg m^{-3}, then the fishing area was categorized as potential. If the waters with chlorophyll-a content was smaller or equal to 0.2 mg m^{-3}, then the fishing area was categorized as "less potential fishing zone". The classification was based on the consideration that chlorophyll-a concentrations above 0.2 mg m^{-3} show the presence of phytoplankton in the water, maintaining the sustainability of fisheries development.

Sea surface temperature (SST). The category of potential fishing zone was divided into two, based on the SST. If the waters where the SST ranged between 28.0 and 29.5°C, those waters were categorized as "potential fishing zones", if the waters had an SST outside the range of 28.0 to 29.5°C then those waters were categorized as "with less potential".

Results and Discussion. The catch of anchovy in Pesisir Selatan Regency waters, which is landed in the fishing port of Carocok, fluctuated. However, the catch tended to increase on the dry-wet transition season or transition II (September-November). This was allegedly due to increased rainfall stimulating the chlorophyll-a and implicitly the abundance of the phytoplankton, which is anchovy's main food. The increase of chlorophyll-a is caused by large amount of freshwater from river flows to coastal area. This is in line with the statement of Sachoemar (2006) that waters near the coastal area are rich in nutrients or nutrients carried by river bodies. Such conditions stimulate the growth of an increasingly fertile phytoplankton. Figure 2 shows the average catch of anchovy per month landed at the Carocok Fishing Port in the Pesisir Selatan Regency.

The catch of anchovy from January to April tended to be constant in the range of 13,483-17,107 kg. In May, the catch increased significantly by 28,269 kg. From June to October the catch of anchovies tended to increase, then it decreased in November. The description above shows that the anchovy fishing season in Pesisir Selatan Regency is generally not constant throughout the year, but the anchovies continue to be caught every month throughout the year, which suggests a shifting pattern of the fishing season from year to year in each month.

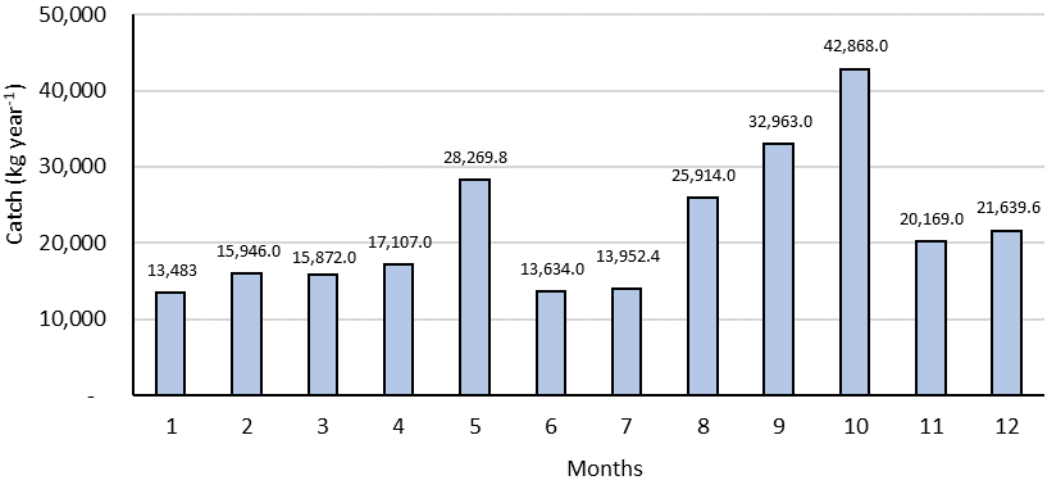

Figure 2. The average catch of anchovy in the waters of Pesisir Selatan regency, 2014-2018.

Correlations. Correlation is a degree relation or degree of association between two variables, this analysis is conducted to determine how close the relationship between two variables. Correlation on these variables can be seen in Table 1 after calculated by SPSS

software as follows. The r_{table} values at the levels of 99% and 95% were 0.2108 and 0.2500, respectively.

Table 1

Correlation values of SSS, chlorophyll-a density, SST and fishing results

		Catch	*SSS*	*CLO*	*SST*
Catch	Pearson correlation	1	-.025	.511**	-.491**
	Sig. (2-tailed)		.851	.000	.000
	N	60	60	60	60
SSS	Pearson correlation	-.025	1	.030	-.325*
	Sig. (2-tailed)	.851		.821	.011
	N	60	60	60	60
CLO	Pearson correlation	.511**	.030	1	-.437**
	Sig. (2-tailed)	.000	.821		.000
	N	60	60	60	60
SST	Pearson correlation	-.491**	-.325*	-.437**	1
	Sig. (2-tailed)	.000	.011	.000	
	N	60	60	60	60

*correlation is significant at the 0.05 level (2-tailed);**correlation is significant at the 0.01 level (2-tailed); SSS- sea surface salinity; CLO-chlorophyll-a; SST- sea surface temperature.

Analysis of the influence of oceanographic parameters on the fishing results.

a. The results of cross-correlation between anchovy catches and SSS in the waters of the Pesisir Selatan Regency had a negative correlation value (Table 1), which means that an increase in salinity causes a decrease in anchovy yield. The correlation value between catches and salinity is -0.25. This means that there is a weak relationship with a negative trend (Pearson correlation value 0.20-0.399).
b. The results of cross-correlation between chlorophyll-a and anchovy catch in the waters of the Pesisir Selatan Regency had a positive correlation value (Table 1). This value indicates that the increase in anchovy catch is due to an increase in chlorophyll-a. The correlation value between the catch with chlorophyll-a is 0.511. The meaning of this value is that there is a fairly strong relationship with a positive trend (Pearson correlation value of 0.40-0.599). Abdullah et al (2018) suggested that there is a fairly strong relationship between the chlorophyll-a variable and sea surface temperature at the catch location and moment. The relationship of chlorophyll-a value with catches is directly proportional or positive, the higher the value of chlorophyll-a, the more consistent the catch (Pamungkas et al 2014).
c. The result of the cross-correlation between sea surface temperature and anchovy catch in the waters of the Pesisir Selatan Regency had a negative correlation value (Table 1), meaning that an increase in temperature causes a decrease in catches. The correlation value between the catch value and the temperature is -0.491. The meaning of this value is that there is a fairly strong relationship with a negative trend (Pearson correlation value of 0.40–0.599). Akhlak et al (2015) stated that sea surface temperature affects catches by 63.4%. Fluctuations in sea surface temperature do not have a negative impact on fishing activities. Pamungkas et al (2014) stated that temperature is more dominantly affecting the level of fish production due to the fact that generally each species of fish will choose the appropriate temperature to carry out activities such as eating, spawning and other activities.
d. Data analysis result showed that there is an association of spatial and temporal data of salinity, chlorophyll-a, and sea surface temperature with the catch of anchovy in the waters of the Pesisir Selatan Regency. Table 2 shows the results of the calculation of the effect of all parameters of the catch.

The results of the analysis on the summary model present a correlation coefficient of 0.611. This coefficient shows that the parameters of temperature, salinity and chlorophyll-a have a strong influence on the presence and abundance of anchovies in the

waters of the Pesisir Selatan Regency. However, the coefficient of determination (R2) is only 0.373, which means that the contribution of the three parameters together in influencing the catch of anchovy is only 37.3%, with a significance level of 95%. Anchovy is generally massively captured during the dark moon, indicating that light fishing is not merely influenced by light but also by technical factors such as: the ability of fishermen, the type and technology of fishing gear and weather conditions for fishing. According to Surini (2013), on bad weather or bright moon, the fishing operation is ineffective. Furthermore, the success of fishing operations is not only influenced by oceanographic factors but is also influenced by the technical factors of fishing operations (Syahdan et al 2007). Sulaiman et al (2015) stated that the composition of the type of catch during the study using mercury lamps consisted of black anchovies (*Stolephorus insularis*) in proportion of 59%, and white anchovies (*Stolephorus indicus*) in proportion of 10%.

Gustaman et al (2012) and Alwi et al (2014) stated that the use of lights on embedded lift net fishing affects the anchovy catches rate 56.6%. On the other hand, Natiqoh et al (2017) stated that fish are attracted by light partly due to the hunger. Catches in the sea are not only influenced by the salinity, sea surface temperature and chlorophyll concentration in the waters but can also be influenced by: upwelling, tidal, wave, current, front, water depth, migration, predators, fishing mortality, natural mortality and recruits (Simbolon 2019).

Table 2

Model summary of all parameters calculated

Model summary				
Model	*R*	R^2	*Adjusted* R^2	*Std. error of the estimate**
1	0.611[a]	0.373	0.340	12,897.7

[a]-predictor: constant, SST, SSS, Clo-a; the standard error of the anchovy catch predicting regression model is less than the standard deviation value (15,873.7 kg).

Potential anchovy fishing zone spatial prediction in the waters of Pesisir Selatan Regency. Constructing predictive maps of the potential fishing zone for anchovy included salinity, chlorophyll-a and sea surface temperature parameters. Data was collected via satellite imagery, then processed, classified and used as a zoning indicator, prior to map making. The processing of satellite image data was done by compiling all data into monthly average data for the period 2014-2018, using the "extract multi value to point" function of the "spatial analyst tool", from the data processing menu of the software ArcGIS 10.5. Data has been compiled/combined, then each parameter was averaged according to the categories and re-processed using data extracts and interpolation data.

Potential fishing zones of ancovy in the transition season I and dry season. The fishing ground of anchovy in the transitional season I (March-May) consisted of the coastal waters of the Pesissir Selatan Regency. The potential capture zone seemed to be higher in the coastal area. Farther offshore, the capture zones can be classified as "with less potential", presumably because the anchovy habitat tends to be situated close to the coast or in the bay area. The analysis showed that in the transition season I, the best potential anchovy fishing zones (PFZ) in the waters of the Pesisir Selatan District were found in April (Figure 3).

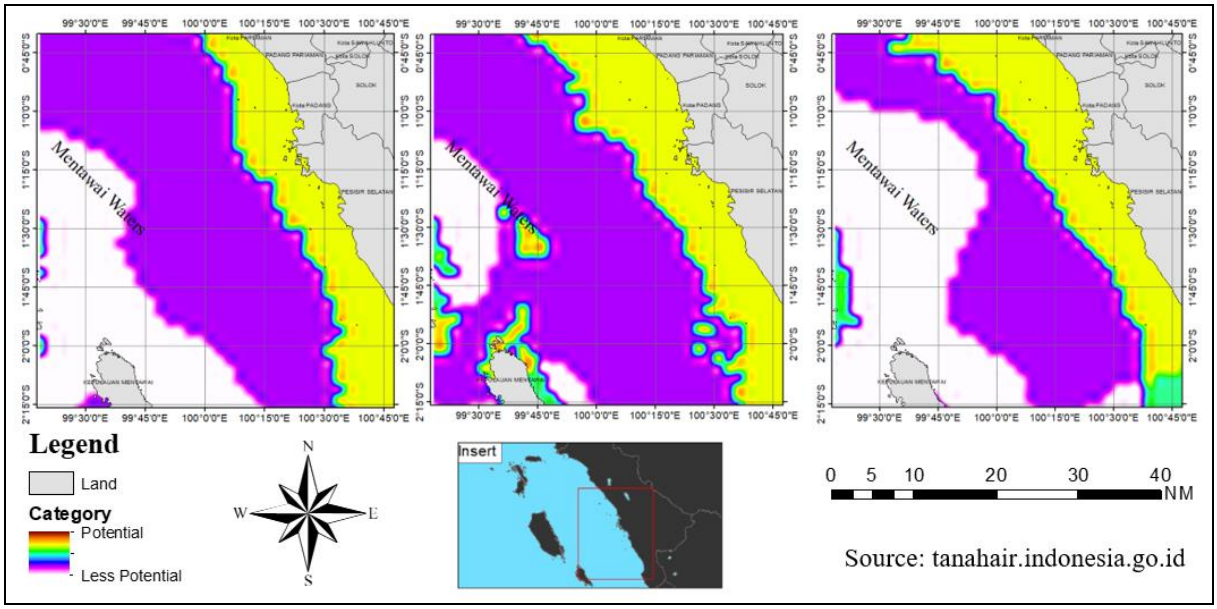

Figure 3. Map of alleged PFZ anchovy in South Pesisir Regency waters transitional season period I.

The waters of the Pesisir Selatan Regency in the dry season (June-August) cannot be categorized as PFZ or included as a "zone with less potential". PFZs in the east monsoon are only distributed in coastal areas, in relatively narrow zones (Figure 4). For the fishing in the waters of the Pesisir Selatan Regency, the dry season can be considered a lean season, as suggested by the catch data. Based on this data, fishermen should reduce their catching effort or otherwise the recommended fishing zone is in the waters close to the coast. Nutrients flowing from the mainland to the coastal waters favor the phytoplankton resources abundance, as indicated by the chlorophyll-a presence, and implicitly the anchovy abundance.

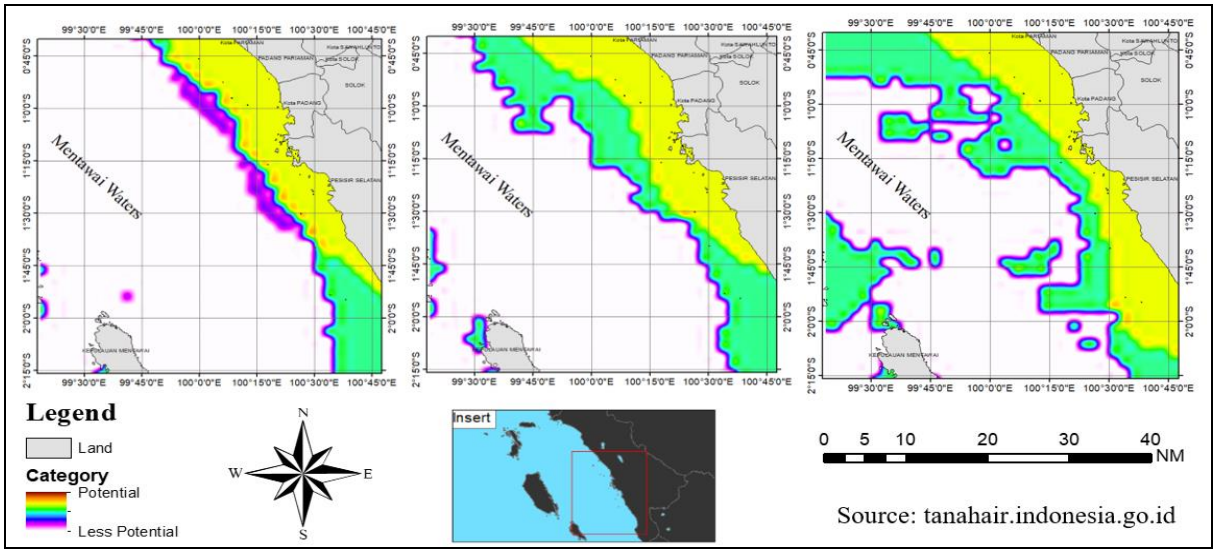

Figure 4. Map of alleged PFZ anchovy in the waters of the Pesisir Selatan Regency in the east season.

PFZ of anchovy in transition season II and in the wet season. During the transitional season II (September-November), there were many potential zones for anchovy fishing. September and October had the highest catching potential during this season. This fact is consistent with the research conducted by Safruddin et al (2017), who affirmed that anchovies tend to occupy space at relatively warm temperatures, usually in September, October, and November. Furthermore, Fauziyah et al (2016)

stated that larger size anchovies can be captured more easily in September, when the location of the anchovies PFZs from Muara Sungsang is in the border area of Padang City waters and exactly in the middle of the Pesisir Selatan Regency (Figure 5). Abundant rainfalls and strong southeast winds during the transition season II make boats controlling and fishing gear operating quite difficult, which is. This is of a real concern for fishermen, influencing the catch efficiency, which depends on both the biophysical conditions of the PFZ and on the fishing techniques.

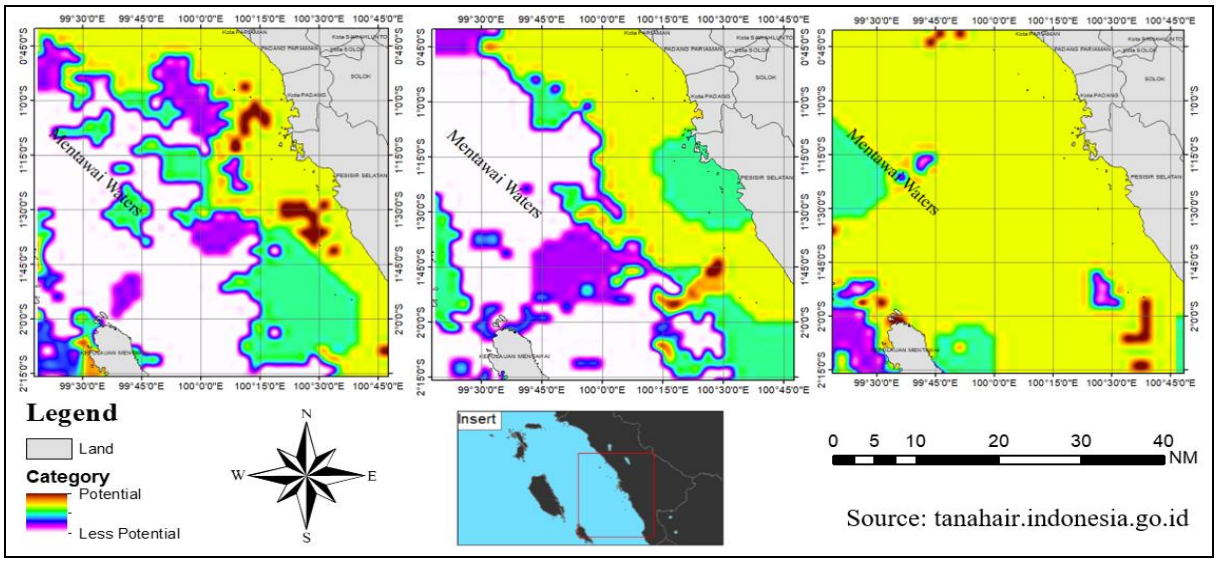

Figure 5. Map of alleged anchovy PFZ in the waters the Pesisir Selatan regency in the transitional season period II.

Potential fishing zones in the wet season (December-February) in the waters of the Pesisir Selatan Regency were only concentrated around the coast (Figure 6). In January, several points were identified as PFZ. PFZ's spatial distribution in December is almost the same as in the transition season II, especially in November. Furthermore, in February, the anchovy PFZ in the waters of the Pesisir Selatan Regency was not too broad, the same as in January. In this season, it is recommended to concentrate fishing efforts close to the southern part of the Pesisir Selatan Regency into the waters of Bengkulu or Mentawai District, at a considerable distance.

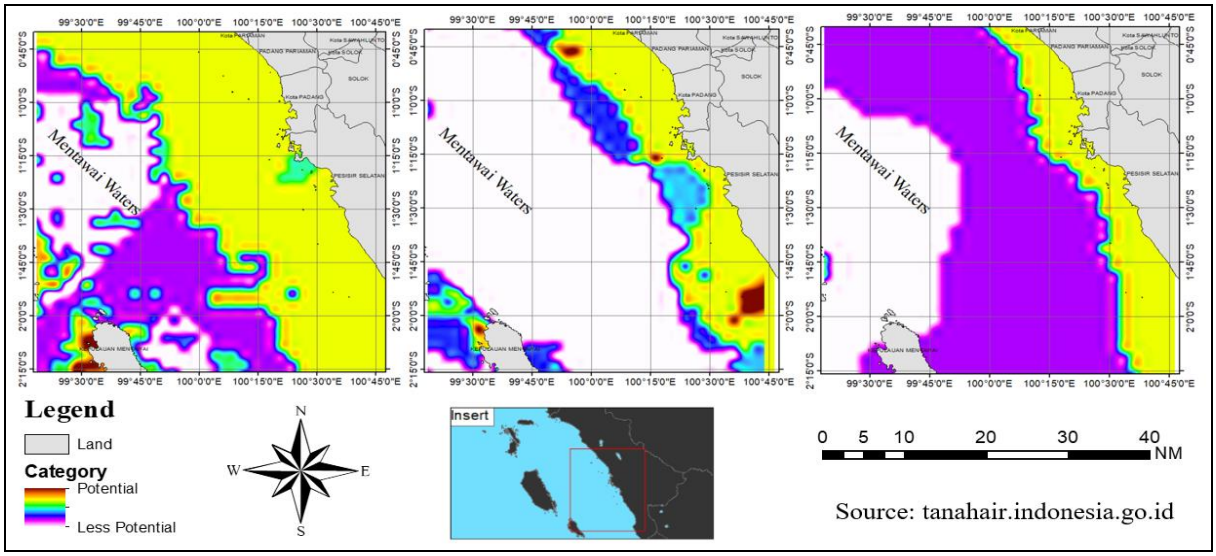

Figure 6. Map of alleged anchovy PFZ in the waters of the Pesisir Selatan regency in the west season period.

Potential zones for anchovy fishing in the waters of the Pesisir Selatan Regency occur in the transition season II (September-October), due to the water masses mixing and upwelling. Water mass circulation due to the heavy rainfalls accompanied by strong winds on the water surface, in September and October, and also to the upwelling events will bring nutrients to the water surface and will disperse them, increasing the water fertility in the area.

In general, in spite of monthly fluctuations which could be observed during the transition season II, the zones with potential for anchovy fishing in Pesisir Selatan Regency are situated in coastal waters. Such a dynamics of the PFZ is also reported in the extensive research of Luasunaung (2011), where the area of anchovy fishing in the waters of Dodinga Bay, although significantly varying on a monthly basis, it is relatively invariant during two main periods: from March to May, and in October and November. A similar conclusion about the monthly variability of the potential anchovy fishing zones (PFZ) was delivered by the research of Safruddin et al (2017): between September and November, the PFZ grew from a relatively small area to reach a peak in October, before declining. The formation of anchovy PFZ in coastal areas might be related to the food abundance in these zones.

Conclusions. The CPUE based analysis showed that the maximum yield of capture was obtained during the second transition season. Oceanographic parameters in Pesisir Selatan Regency showed a distribution of salinity between 32.27 and 33.54‰, a chlorophyll-a content between 0.16 and 0.77 mg m^{-3}, and a SST distribution range from 30.28 to 30.68°C, which are suitable values for anchovy habitats. Based on the salinity and chlorophyll-a data, PFZs are rather situated on the coast and do not necessarily coincide with the fishing spots identified by the fishermen based on SST. The PFZs predicted based on composite data are spread out along The Pesisir Selatan regency, with a seasonal a peak in September and October.

References

Abdullah Z., Yusrizal, Syamsuddin S., 2018 Analysis of sea surface temperature and chlorophyll-a to determine fish potential in the purse seine fishing ground using level 3 aqua modis satellite image data. Journal of Marine Affairs and Fisheries 1:38–45.

Akhlak M. A., Supriharyono, Hartoko A., 2015 The relationship between sea surface temperature, chlorophyll and capture of purse seine vessels landed at Bajomulyo Juwana Fishing Port, Pati. Journal of Fisheries Resourches Utilization Management and Technology 4:128–135.

Alwi D., Kaparang F., Patty W., 2014 Study on the use of different light intensities on fish catch of raft net lifts in Dodinga Bay, West Halmahera Regency. Aquatic Science and Management 2(2):38–43.

Amri K., 2002 Relationship of oceanographic conditions (sea surface temperature, chlorophyll-a and currents) with small pelagic fish catches in Sunda Strait waters. MSc Thesis, Bogor Agricultural Institute, 126 p.

Chassot E., Bonhommeau S., Reygondeau G., Nieto K., Polovina J., Huret M., Dulvy N. K., Demarcq H., 2011 Satellite remote sensing for an ecosystem approach to fisheries management. ICES Journal of Marine Science 68:651–666.

Demena Y. E., Miswar E., Musman M., 2017 Determination of potential areas for catching skipjack fish (*Katsuwonus pelamis*) using satellite imagery in Jayapura's South Jayapura City waters. Unsyiah Maritime and Fisheries Student Scientific Journal 2:194-199.

Druon J. N., 2010 Habitat mapping of the Atlantic bluefin tuna derived from satellite data: Its potential as a tool for the sustainable management of pelagic fisheries. Marine Policy 34:293–297.

Fauziyah, Hadi, Saleh K., Supriyadi F., 2016 Size distribution of anchovy captured in fix lift net at Muara Sungsang, South Sumatra. Marine Fisheries 7(2):161–169.

Gamawan R. P., Suryanti S., Wibawa T. A., 2018 Mapping of anchovy (*Stolephorus* sp.)

fishing ground based on ocean color satellite data in Batang Regency Waters. Fisheries Science: Indonesian Journal of Fisheries Science and Technology 13(2): 133.
Gustaman G., Isnaini, Fauziyah, 2012 Effectiveness of the difference in color of the lights to the capture fix lift net in the waters of Sungsang, South Sumatra. Maspari Journal 04:92–102.
Kamei G., Felix J. F., Shenoy L., Shukla S. P., Devi H. M., 2014 Application of remote sensing in fisheries: Role of potential fishing zone advisories. In: Geospatial technologies and climate change. Sundaresan J., Santosh K. M., Déri A., Roggema R., Singh R. (eds), pp. 175–186, Amsterdam-Netherlands: Springer International Publishing.
Klemas V., 2013 Fisheries applications of remote sensing: an overview. Fisheries Research 148:124–136.
Kumaat J., Bow J., Wiryawan B., Wisudo S. H., Monintja D. R., 2013 Sustainable potential of fisheries capture in Sitaro Island Regency. Marine Fisheries 4(1):41–50.
Laurs R. M., 1986 Applications of satellite remote sensing to fisheries. Society of Airborne and Satellite, Physical and Fishery Oceanography 8:139–150.
Lehodey P., Bertignac M., Hampton J., Lewis A., Picaut J., 1997 El Nino Southern oscillation and tuna in the western Pacific. Nature 389:715–718.
Lennert-Cody C. E., Roberts J. J., Stephenson R. J., 2008 Effects of gear characteristics on the presence of big eye tuna (*Thunnus obesus*) in the catches of the purse-seine fishery of the eastern Pacific Ocean. ICES Journal of Marine Science 65:970–978.
Luasunaung A., 2011 Analysis of anchovy (*Stolephorus* sp.) catching season in Ddodinga Bay, West Halmahera Regency. Tropical Fisheries and Maritime Affairs 7:6–11.
Natiqoh N., Ulfah, Utami E., Kurniawan, 2017 Comparison of catch of anchovy (*Stolephorus* sp.) in the fix lift net using a light on the surface of water in Rebo Waters of Bangka Regency. Journal of Aquatic Resources 11:36–43.
Osawa T., Julimantoro S., 2010 Study of fishery ground around Indonesia Archipelago using remote sensing data. In: Adaptation and mitigation strategies for climate change. Sumi A., Fukushi K., Hiramatsu A. (eds), pp. 57–69, Springer, Tokyo, Japan.
Pamungkas D., Djumanto, Khakim N., 2014 The relationship between sea surface temperature and chlorophyll-a with the catch of pelagic fish in the coastal fishing port of Sadeng Yogyakarta using MODIS satellite imagery. Journal of Agricultural Sciences 1:1–11.
Perez J. C., Alvarez M. A., Heikkonen J., Guillen J., Barbas T., 2013 The efficiency of using remote sensing for fisheries enforcement: Application to the Mediterranean bluefin tuna fishery. Fisheries Research 147:24-31.
Polovina J. J., Howell E. A., 2005 Ecosystem indicators derived from satellite remotely sensed oceanographic data for the North Pacific. ICES Journal of Marine Science 62:319–327.
Sachoemar S. I., 2006 Utilization of ADEOS satellite data for monitoring aquatic fertility and identification of fishing ground. Indonesian Journal of Science and Technology 3:119-123.
Safruddin, Suciati A., Zainuddin M., 2017 Potential estimation and prediction of potential catching area of anchovy (*Stolephorus* spp.) in Bone Bay. PSP Science and Technology Journal 4(8):134–143.
Simbolon D., 2019 Fishing areas: planning, degradation and management. IPB Press, Bogor, Indonesia, 246 p.
Sulaiman M., Baskoro M. S., Taurusman A. A., Wisudo S. H., Yusfiandayani R., 2015 The difference between floating lift net using mercury lamps with led lights. Indonesian Fisheries Research Journal 21:123-130.
Surini, 2013 Sea surface temperature variability relation to small pelagic fishing ground in Lampung Bay Waters. MSc Thesis, Bogor Agricultural Institute, Bogor, Indonesia, 35 p.
Syahdan M., Sondita M. F. A., Atmadipoera A., Simbolon D., 2007 The relationship between sea surface temperature and chlorophyll-a against catching results of

Skipjack tuna (*Katsuwonus pelamis*, Linne) in eastern waters of southeast Sulawesi. PSP Buletin Journal 16(2):246-240.
Zagaglia C. R., Lorenzzetti J. A., Stech J. L., 2004 Remote sensing data and longline catches of yellowfin tuna (*Thunnus alalunga*) in the Equatorial Atlantic. Remote Sensing of Environment 93:267–281.
*** NASA's OceanColor Web, http://oceancolor.gsfc.nasa.gov.
*** Physical Oceanograpgy Distributed Active Archive Center, https://podaac-w10n.jpl.nasa.gov/allData/smap/L3/.

Received: 25 April 2020. Accepted: 24 August 2020. Published online: 30 August 2020.
Authors:
Made Ariana, Jakarta Fisheries University, Department of Aquatic Resources Management, Pasar Minggu-Jakarta Selatan, Jl. AUP No. 1, 12520 Jakarta, Indonesia, e-mail: imadear.1203@gmail.com
I Nyoman Suyasa, Jakarta Fisheries University, Department of Aquatic Resources Management, Pasar Minggu-Jakarta Selatan, Jl. AUP No. 1, 12520 Jakarta, Indonesia, e-mail: soeyasa_stp@hotmail.com
Domu Simbolon, Bogor Agricultural University, Faculty of Fisheries and Marine Science, Department of Fishery Resourses Utilization, Campus IPB Darmaga Bogor, 16680 Bogor, Indonesia. e-mail: domu@apps.ipb.ac.id

How to cite this article:
Ariana M., Suyasa I. N., Simbolon D., 2020 Remote sensing for assessing the potential anchovy fishing ground in the Pesisir Selatan Regency, West Sumatra, Indonesia. AACL Bioflux 13(4):2273-2282.