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CATCH OF TUNA FISH ON TROLLING FISHING IN INDIAN OCEAN WATERS, SOUTHERN COAST OF EAST JAVA RELATED TO SEA SURFACE TEMPERATURE VARIABILITY

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ABSTRACT

The existence of tuna fish is influenced by environmental factors, such as sea surface temperature and concentration of chlorophyll-a. Information of fishing season is essential in order to support the success of fishing activities. The Indian Ocean has potential resource of tuna fish, particularly bigeye and yellowfin. Most common way to catch tuna is by trolling. This study aimed 1) to describe fluctuation of tuna catch by trolling, 2) to map variability of sea surface temperature, and 3) to determine connection between tuna catch and sea surface temperature. The research was conducted in Indian Ocean Southern Coast of East Java. The data analyses were carried out through 1) analysis of fishing season index, 2) analysis to determine spatial and temporal distribution of sea surface temperature image 3) analysis of correlation between tuna catch and sea surface temperature. The result shows a pattern of tuna catch, which increasing in east season and decreasing in west season. Tuna catch reaches its peak in June. The sea surface temperature in southern coast of East Java during 2008-2012 has a tendency to spreading with value of 43% variant. The connection between tuna catch and sea surface temperature shows a pattern of increasing catch when the sea surface temperature decreasing.

Key words: catch of tuna, Indian Ocean, sea surface temperature, southern coast of East Java

INTRODUCTION

Indian Ocean is potential water for its tuna. The most common tuna found in the waters are albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), southern bluefin tuna (*Thunnus maccoyii*) and skipjack tuna (*Katsuwonus pelamis*). The existence of tuna is strongly influenced by the environmental factors such as temperature, salinity, mass of water, front, up welling, termoklin, and water flow condition. The tuna is also used to undertake long distance migration.

The pattern of fish life cannot be separated from oceanographic parameters, such as temperature, salinity, water flow, and the content of chlorophyll-a. Each type of fish has its own habitat with different range of temperature to support its optimum life. The temperature variability of sea surface will influence the fish spreading in one particular area and could indicate a potential of fishing area.

Based on the above explanation, it is important to conduct a study to know the variability of oceanographic parameters, particularly waters temperature, in connection with fishing area. This research aimed 1) to obtain data of tuna production in 5 years, especially for yellow fin and big eye; 2) to obtain data of the variability of sea surface temperature during 5 years in south of East Java; 3) to determine connection between production of yellow fin tuna and sea surface temperature.

MATERIALS AND METHOD

Materials

The materials used were data of tuna production, image of chlorophyll-a concentration and sea surface temperature. The data of tuna production was obtained from the coastal fishing

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ports Pondokdadap and Tamperan, East Java. The data is a serial time of 5 years during 2008-2012. The data of image of chlorophyll-a concentration was downloaded from the ocean color site (www.oceancolor.gsfc.nasa/). It is a data coverage taken monthly from Aqua MODIS composite satellite from 2008 to 2012.

Data analysis

The data analysis conducted were 1) spatial and temporal analysis to find out the spreading of sea surface temperature in south of East Java and 2) correlation analysis between yellowfin tuna and sea surface temperature. The spatial and temporal analysis is used to find out variation of chlorophyll-a concentration based on time and space. This analysis is also used to look at the phenomenon of increasing and decreasing of chlorophyll-a concentration and to analyze the factors which affecting these phenomenon. Graphic fluctuation of chlorophyll-a concentration and sea surface temperature can also be used to interpret fluctuation of chlorophyll-a and sea surface temperature based on the pattern of the season. Meanwhile, the cross correlation analysis is conducted to see the time lag which happening between the increasing production of yellow fin tuna and the increasing concentration of chlorophyll-a and sea surface temperature.

RESULTS AND DISCUSSION

Variability of sea surface temperature

Varian is one of the technique used to explain the homogeneity of the group of data. Result from the calculation of variant value on sea surface temperature (SST) resulted with a combined variant value of 43%. This indicates that the data of SST in south waters in East Java is spreading. Figure 1 indicates a clear fluctuation of the spreading of SST during 5 years where the increasing of SST is mostly happened in west season (December-April) and the decreasing of SST is usually happened in east season (May-November). Sea surface temperature is low during east season which commonly happens in south waters of East Java which is far away from the coast. During east season, temperature of mass of water in the Indian Ocean is low.

The spreading pattern of SST in south waters of East Java is influenced by a seasonal pattern resulted from the movement of monsoons (Wyrtki, 1962). Figure 2 indicates that the SST value during west season is higher compared to east season. In general, the increasing of SST in west season starts in November with average temperature of 29.2ºC. The highest of SST occurs in March with temperature of 30.2ºC. The SST value will remain high until April, which is the end of west season with average

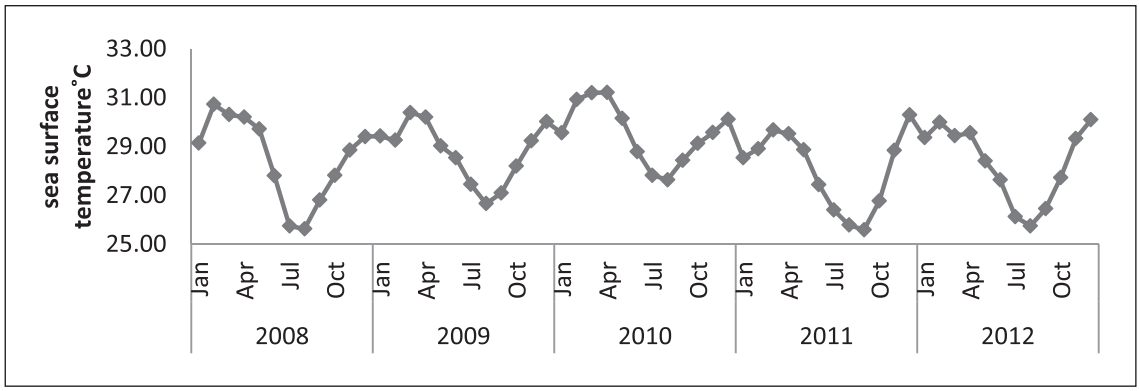

Fig. 1. The monthly average of sea surface temperature in the Southern part of East Java.

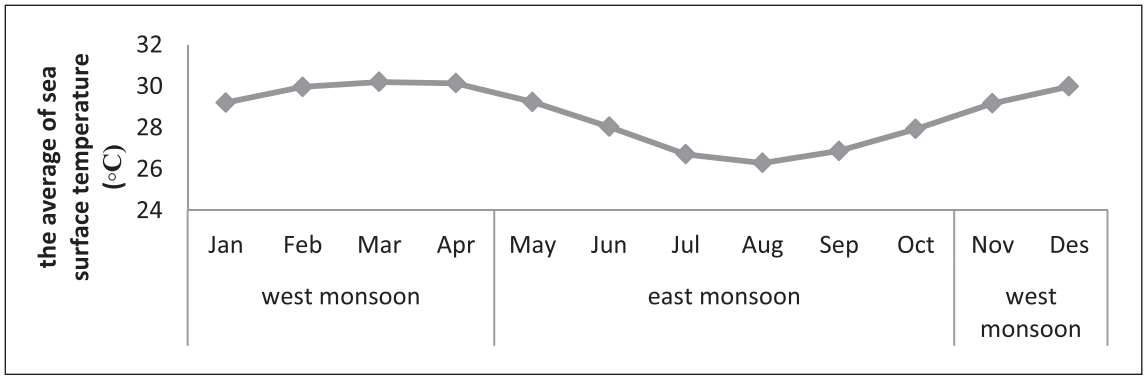

Fig. 2. The average of sea surface temperature on East and West season in the Southern part of East Java.

temperature of 29.25ºC. During east season, the SST value will drop to 26.29ºC in August. Until September, the SST value will remain low in 26.8ºC. The increased intensity of southeast monsoon wind speed will result in increased of upwelling intensity. The increased of upwelling intensity from June to August will increase the flow of cold water from the bottom to the surface layer. In parallel there will be the decrease in SST from June to August (Farita, 2006).

The temperature difference happened due to the influence of mass of water from the Indian Ocean. During west season, northwest monsoon has been created which carrying Current Java Coast along the southern coast of Java. The Current Java Coast is a narrow current which is moving along the southern coast of Java from west to east which opposite with the South Equatorial Current. According to (Sprintall *et al.*, 2000), the Current Java Coast in the surface will carry warmer temperature (more than 27.5ºC) with low salinity. The mass of warm water carried by the Current Java Coast in the south waters of Java-Sumbawa came from southwest of Sumatra and also Java sea which entering through Sunda strait. Unlike waters condition during west season, the east season tends to be lower. The lower of the SST during east season is related with the upwelling phenomenon which happening in that water. The general condition of the waters of the Indian Ocean is influenced by the movement of the monsoon. During the southeast monsoon (April-October), wind southeast of Australia produce upwelling and bring colder water masses and nutrients to the surface. This condition is the opposite from northwest monsoon (October to April) (Susanto *et al.*, 2006).

Production of Tuna

Figure 3 indicates the production of tuna in south waters of East Java for 5 years (2008-2012). The production of tuna in the research area has formed a pattern, that is the production is high during east season and low during west season. In a year, the peak is usually happen in June and the lowest is in January or February. The production of tuna during east season is also presumed to have connection with the upwelling phenomenon in the south waters of East Java which starting from early April up to end of October with the highest average of chlorophyll-a concentration in July and the lowest average sea surface temperature in August.

Connection between sea surface temperature and production of yellow fin tuna

Figure 4 indicates connection between sea surface temperature and production of tuna. The production of tuna tends to increase when the temperature of sea surface dropped. This is due to the increasing of chlorophyll-a concentration during east season. The abundant of chlorophyll-a concentration is a sign that the upwelling phenomenon is about to happen, marked by the sea surface temperature which is much cooler compared to its surrounding area. The dropped temperature in the upwelling condition could reach about 2ºC. Other factor, which causes the average sea surface temperature during east season lower compared to

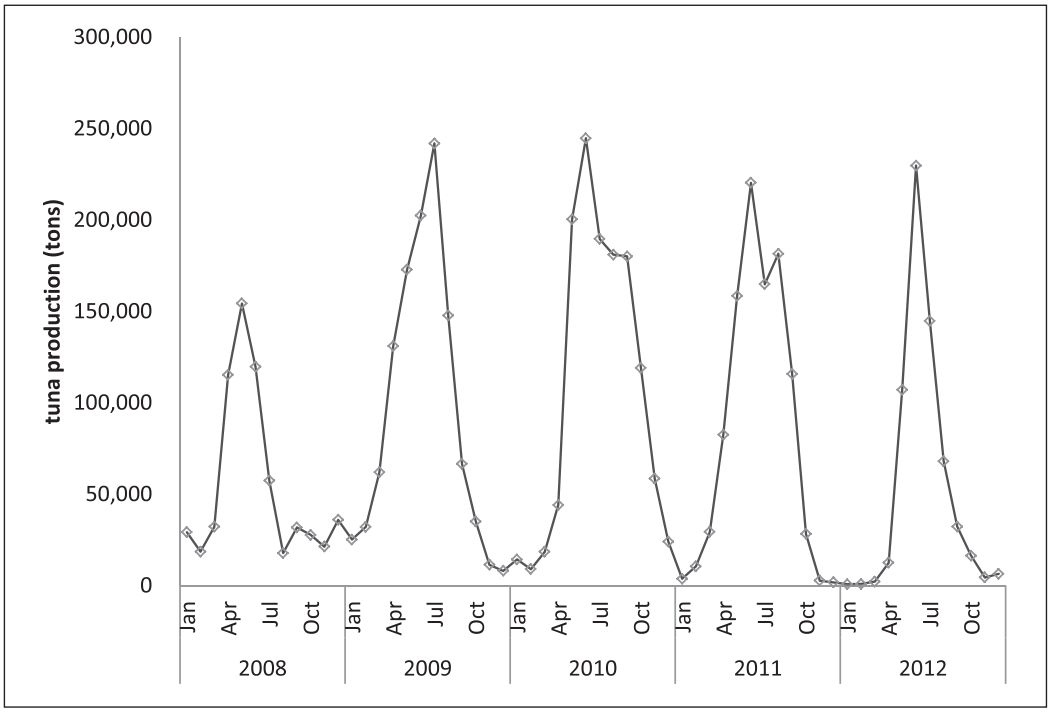

Fig. 3. Tuna production in Southern part Java year 2008-2012

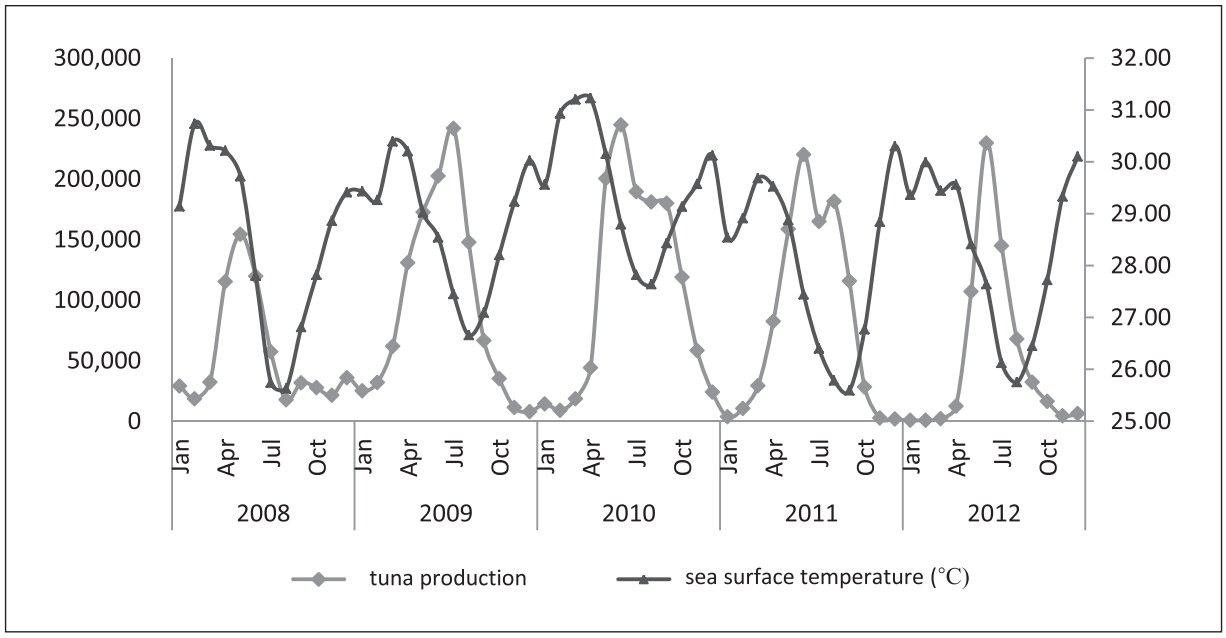

Fig. 4. Fluctuations of sea surface temperature and the production of yellowfin tuna in Southern part of Java year 2008-2012.

west season, is the entering of cold mass of water from northwest Australia. Meanwhile, the warm temperature during west season is presumed to happen due to the entering of warm and light mass of water from equatorial Indian Ocean carried by Kelvin waves and current of coastal Java which flowing to the east of Indian Ocean. The warmer sea surface temperature might be caused by *Indian Ocean Dipole* phenomena (Saji *et al.*, 1999; Manyilizu *et al.*, 2014).

CONCLUSIONS

Production of tuna in south of East Java formed a pattern, that is to increase during east season and to decrease during west season. Peaked production is generally in June. Sea surface temperature during 5 years in south of East Java tends to spread with variant value of 43%. The connection pattern between the production of tuna and sea surface temperature is a tendency of increasing production when the sea surface temperature dropped.

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