Impact of a El-Nino Southern Oscillation (ENSO) to Fluctuation of Skipjack Catch Production in Southern East Java

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Abstract. There are challenges in utilizing marine resources in Indonesia and one of them is environmental changes caused by ENSO phenomenon. Skipjack catch production in southern Malang has been fluctuated since this phenomenon occurred. Lack of information about ENSO phenomenon among fisherman has led to under-utilized fish production which resulting in less Skipjack caught during ENSO. The purpose of this study was to analyze the impact of ENSO phenomenon to catch production of Skipjack. The method used in this study was by gathering secondary data of catch production of skipjack and seawater surface temperature from satellite image of level 3 AQUA-MODIS with 4 km resolution during ENSO which occurred between 2014-2016. The result of this study showed that seawater surface temperature on southern Malang was 24.825-32.055°C. Southern Oscillation Index (SOI) showed strong El-Nino occurred between May-October 2015, La-Nina occurred between June-September 2016. Analysis data showed that there was less significant influence of ENSO and seawater surface temperature which led to other variables may contribute into ENSO. During El-Nino 2015 there was sharp increasing of skipjack catch production in southern Malang and the major cause was colder seawater surface temperature, this indicating that the seawater was rich of nutrients. Supporting by optimum water condition during El-Nino that location was rich of food resources which suits some of big pelagic fishes, particularly skipjack.

1. Introduction
Based on [1,2], ENSO phenomenon has been lately occurred in Indonesian seawater. The impact has affected fisheries sector in many ways because this phenomenon resulted in fish catch fluctuation, particularly for skipjack catch production. Lack of information about ENSO phenomenon among fishermen has led to non-optimum utilizing fish catch when the phenomenon occurred.

Oceanography parameters such as seawater surface temperature should help detecting fish location in seawater, including skipjack. Skipjack live in seawater with certain temperature condition [3].

Optimizing fish catch production during ENSO occurred, there should be analysis data of variation of seawater surface temperature to obtain data about fishing ground, specially for skipjack in southern east java. SST data was obtained by remote sensing.

2. Method
2.1. Research Location and Time
This study was held in southern Malang seawater, east Java. Data taken by satellite during El-Nino and La-Nina condition between 2014 – 2016.

2.2. Data Collection
Monthly Skipjack catch production obtained from Ministry of Fisheries and Aquaculture between 2014-2016. Skipjack catch production is catch landed in PPP Pondok Dadap Malang Regency East Java.

2.3. Data Analysis
AQUA MODIS Image satellite data was used for this study namely seawater surface temperature which obtained by downloading via website (https://oceancolour.gsfc.nasa.gov) with 4 km resolution. Image data then analyzed with software SNAP and ArcGIS version 10.1. Data presented as diagram. Scattered SST visualized as a map.

3. Result and Discussion
3.1. Sea Surface Temperature
Water temperature could affect fish growth, activity, and mobilization including fish distribution, abundance, fertility and spawning; also hatching and survival of fish larvae. Water temperature changes led to changing of density of fish population [4,5,6].
Based on observation in monsoon and during El-Nino and La-Nina, SST average in southern Malang during El-Nino was 25.56°C. SST average in southern Malang during La-Nina was 29.60°C.

**Figure 2.** SST southern Malang in south-west monsoon during El-Nino at 2015

**Figure 3.** SST southern Malang in south-west monsoon during La-Nina at 2016

During El-Nino, SST showed declining of temperature until reached 24.83°C. When El-Nino occurred, there was extrem increasing of temperature that affected the cold seawater mass going onto the surface which led to SST became colder. Meanwhile, SST reached 30.18°C during La-Nina. The water temperature changing can change fish population density in a waters, pelagic fishes will move away from higher temperature water and search for lower temperature water [7].

**Figure 4.** SST during El-Nino in south west monsoon at 2015

**Figure 5.** SST during La-Nina in south west monsoon at 2015
3.2. Skipjack catch production

Fish catch in some waters will be depended on the nutrient richness. Therefore while ENSO occurring will give higher impact to skipjack catch in Indonesia waters. When ENSO occurred SST in Indian ocean was colder and caused the waters became rich of nutrients. So that skipjack which were in Pacific oceans moved forward to Indian ocean resulting in a lot of skipjack gathered around Indian ocean [8].

Based on observation, there was temperature changing when ENSO phenomenon occurred. When El-Nino occurred SST in indonesia waters was colder compared to when La-Nina occurred.

**Figure 6.** SST in indonesian waters when El-Nino phenomenon occurred in 2015

**Figure 7.** SST in indonesian waters when La-Nina phenomenon occurred in 2016.
Figure 8. Skipjack catch production in southern Malang when El-Nino and La-Nina occurred.

Figure 9. Skipjack catch production in Ambon when El-Nino and La-Nina occurred.

When El-Nino occurred in June 2015 had caused skipjack catch production in southern Malang reach 527.750 kg and when La-Nina occurred in June 2015, there was declining in fish catch so the catch production only reached 111.848 kg. The catch declining also occurred in July and August. Meanwhile the catch production in Ambon was different than in southern Malang. When El-Nino occurred in June 2015 skipjack catch production in Ambon only reached 9.500 kg while when La-Nina occurred in June 2015 skipjack catch production increased to 51.955 kg. The increasing also occurred in July and August. When El-Nino in 2015 occurred, the significant increase of Skipjack tuna catches occurred in South Malang Waters was mainly caused by Sea Surface Temperature (SST) was cooler, it indicates that the waters was fertile which was rich of nutrients. Being supported by this optimum waters condition in El-Nino, this location was considered as the great woof so that it is beneficial for some of big pelagic fishes, especially Skipjack tuna.

4. Conclusion
ENSO phenomenon has significant impact in fluctuation of skipjack catch production in southern Malang. Skipjack catch production increased when El-Nino occurred and declined when La-Nina occurred. However in some waters in Indonesia the fluctuation differed when ENSO occurred.

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