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Catch of Skipjack Tuna (*Euthynnus* sp.) in National Fisheries Port Pengambengan, Bali, Indonesia

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ABSTRACT

The Bali Strait has very high pelagic fish resources, ranging from small pelagic fish to large pelagics, one of which is a type of tuna. Skipjack tuna (*Euthynnus* sp.) is one of the dominant and high economic value fish resources. The composition of fish catch landed in National Fisheries Port (PPN) Pengambengan in 2014 is dominated by small pelagic fish. The composition of the largest fish catches consists of lemuru, skipjack, mackerel and scad. This study aims to look at the production of skipjack tuna and season distribution for 5 years. This information can be used as an effort to manage fisheries in PPN Pengambengan continuously. This research was carried out in the waters of the Bali Strait with fishing base PPN Pengambengan. The catch of skipjack tuna in Bali is fluctuated every month during 2013 until 2017. The average catch is high in 2014, and the lowest catch was in 2016. This was allegedly due to the catches of previous years namely in 2014 – 2015 skipjack tuna fish resources were overexploited. The catch of skipjack tuna based on the season has the highest value in September - November (transition II (intern-monsoon)) and the lowest is in December-February (northwest season).

***Keywords*:** Bali strait, catch per unit effort, monsoon, tuna, *Euthynnus*, yellowfin tuna, *Thunnus albacares*, bigeye tuna, *Thunnus obesus*

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1. INTRODUCTION

Skipjack tuna (SKJ) is an economically valuable species worldwide subjected to intensive international trade for canning (Grande et al., 2014). It is the most important species among tunas and tuna-like species, comprising 58.1% of the world's total volume landed in 2010, supporting a growing global production in the last decades of above 3 million t/year.

It is a cosmopolitan and migratory species, widely distributed throughout the world's tropical and subtropical oceans between 55° – 60°N and 45° – 50°S, but is mostly abundant in the equatorial region throughout the year. Industrial fleets from different countries around the world exploit this fishery resource (Grande et al., 2016). In the southwest Atlantic, SKJ catches represent between 10 and 17.0% of global production. Despite SKJ being considered a resilient species due to the high productivity and life history parameters (e.g., rapid growth and fecundity), it is classified as moderately vulnerable (Cheung et al., 2005, 2009). Recent assessments indicate that the southwestern Atlantic stock is close to reaching full exploitation status, with a maximum yield of about 30,000 t/year.

In south China, the SKJ fishery production reached 18,000 t/year in the last decade. The pole-and-line fleet has been operating regularly on the resource since the 1980s in the south-southwestern China coast (23°S – 34°S) supplying the tuna canning industry (Andrade and Campos, 2002). However, since the mid-1990s, their catches have declined to below 15,000 t/year. Reproduction, growth and mortality are life-history attributes that determine the dynamics and resilience of populations under fishing pressure. Population productivity is pivotal in sustainable fisheries management, indicating the sustainable level of fishing mortality that can be exerted and the population's ability to recover from a state of overfishing. We investigated SKJ population parameters in the Bali Strait water, evaluating the production. Our results provide updated information on the SKJ population attributes in the Bali Strait water is located in the east of Java Island and west of Bali Island that may be used for production assessments and management of the stock.

Bali Strait water is located in the east of Java Island and west of Bali Island. Bali Strait water has an area of about 2,500 km^2 with a depth in the middle of the strait about 300 meters deep and deeper in the southern part of the strait, which is around 1300 meters (Wujdi et al. 2012). Bali Strait has very high pelagic fish resources, ranging from small pelagic fish to large pelagics, one of which is a type of tuna.

One economically valuable fish resources is a kind of tuna (Cunningham, 2009). Yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*) are the second and third most important large tuna commodity by catch weight, after skipjack tuna (Gerasmio, 2012). Skipjack (*Euthynnus* sp.) is one of the dominant and high economic value fish resources. The results of this fishery became the target of fishermen and one of Indonesia's main export commodities. In 2011, the value of tuna production reached Rp. 3.3 M, in 2015 the production of tuna fish increased by 5.65% from the previous year (Mujib *et al.* 2013).

The composition of fish caught landed in National Fisheries Port Pengambengan in 2014 is dominated by small pelagic fish. The composition of fish catches consist of oil sardine, tuna, mackerel and scad. The spread of fishing grounds varies throughout the year, especially along the west coast of Bali. Thus, this study aims to look at the production of tuna and season distribution for 5 years. This information can be used as a fishery management in a sustainable manner National Fisheries Port Pengambeng

2. MATERIALS AND METHODS

This research was conducted in two stages. The first stage is the stage of data collection in the waters of the Strait of Bali with the National Fisheries Port Pengambengan Bali. Research is conducted from March to April 2018 and data processing is carried out from May to June 2018. The material used in the research is image data on sea surface temperature and tuna production for the past 5 years (2013-2017). Medote used in this research is a case study method in the waters of the Bali Strait.

Data on tuna fishing production is obtained from the National Fisheries Port Bali. Most of the tuna fish in Pengambengan are captured by a two-ship purse seine fleet that carries out one day fishing work patterns. The object of this research is purse seine two boat system. All fishing vessels that are in Pengambengan are called populations. The subpopulation will be determined by the fleet population, and the subpopulations taken are the two fleet seine fleets that are actively operating. Each subpopulation is taken 10% of the total subpopulation (Fonteneau, 2014).

The selection of respondents was done by purposive sampling. Purposive sampling is a sampling method used by researchers if researchers have certain considerations in taking samples (Robinson, 2014). The respondents chosen were boat masters and crew members who were informed of the composition of the number and type of catch and the length of the dominant fish caught. Data catches of tuna from the National Fisheries Port Pengambengan processed into graphic form and then performed a descriptive analysis.

The catch is presented according to the catch per unit effort value (CPUE) and is presented in the graph. The CPUE value is obtained from the comparison of catches and the number of trips (Prakarsa et al., 2014):

$$CPUE = \frac{Catch\ (kg)}{Effort\ (trip)}$$

3. RESULT

Indonesia as a country that has large marine area reserves the large potential of marine resources. One of parameters to identify marine resources is sea surface temperature (SST). From 2007 to 2016, in Indonesia SST is ranging between 27.91 to 30.46 °C (Kusuma et al., 2017). This research was conducted in March 2018 in the Bali Strait waters, the sea surface temperature in March ranged from 28,34 to 31,8 °C (Figure 1) with an average temperature of 30.1 ºC. This result is in accordance with the results of research by Ridha et al. (2013) where the sea surface temperature in the Bali strait waters in the Northwest monsoonranges from 28-31 0C. March is included in the transition I (intern-monsoon) (March-May), according to Syafik et al. (2013) Transition I (intern-monsoon) has a warm sea surface temperature that is suspected due to the influence of the west wind.

Figure 2 shows SST in the waters of the Bali Strait over the past 5 years (2013-2017), SST in the Northwest monsoon (December, January, February) looks higher when compared to SST in the Southeast monsoon (June-August). SST increases in October or SST rises in Transition II season (September-November), and SST decreases when entering the Southeast monsoon (June-August) precisely decreases in June.

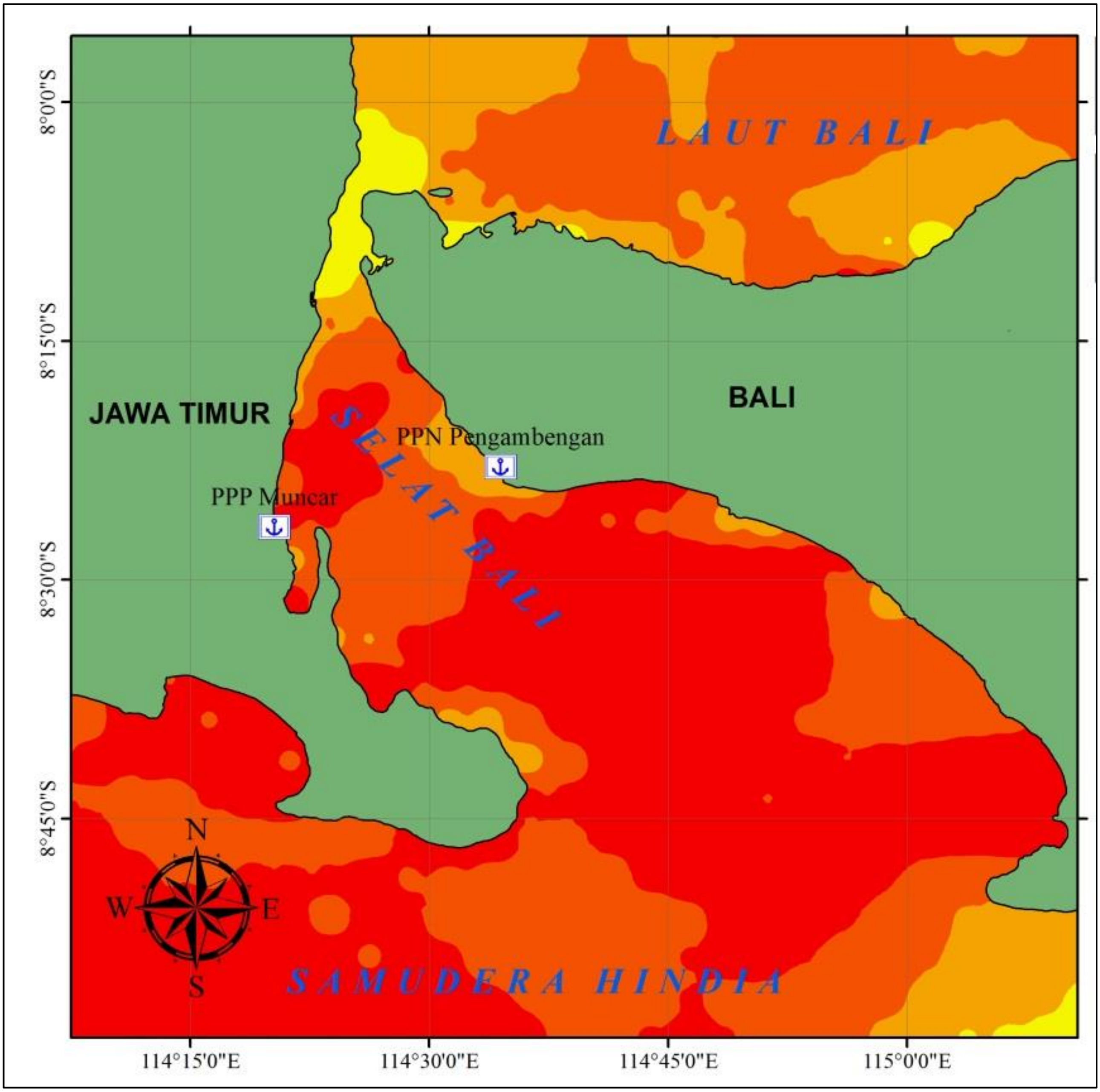

Figure 1. Map of SST Distribution in Bali Strait Waters in March 2018

Bali Strait waters have a relatively high SST value in the northwest monsoonand are relatively low in the southeast monsoon (Nababan et al., 2016). This is caused by the influence of the Indian Ocean water mass, in the northwest monsoonon the Indian Ocean the northwest monsoon blows that brings the Flow of the Java Coast (Sulistya et al., 2007). This is also in accordance with the research of Hernomo et al. (2015) that the value of SST in May was higher than the value of sea surface temperature in September of the previous year which was the end of the east season.

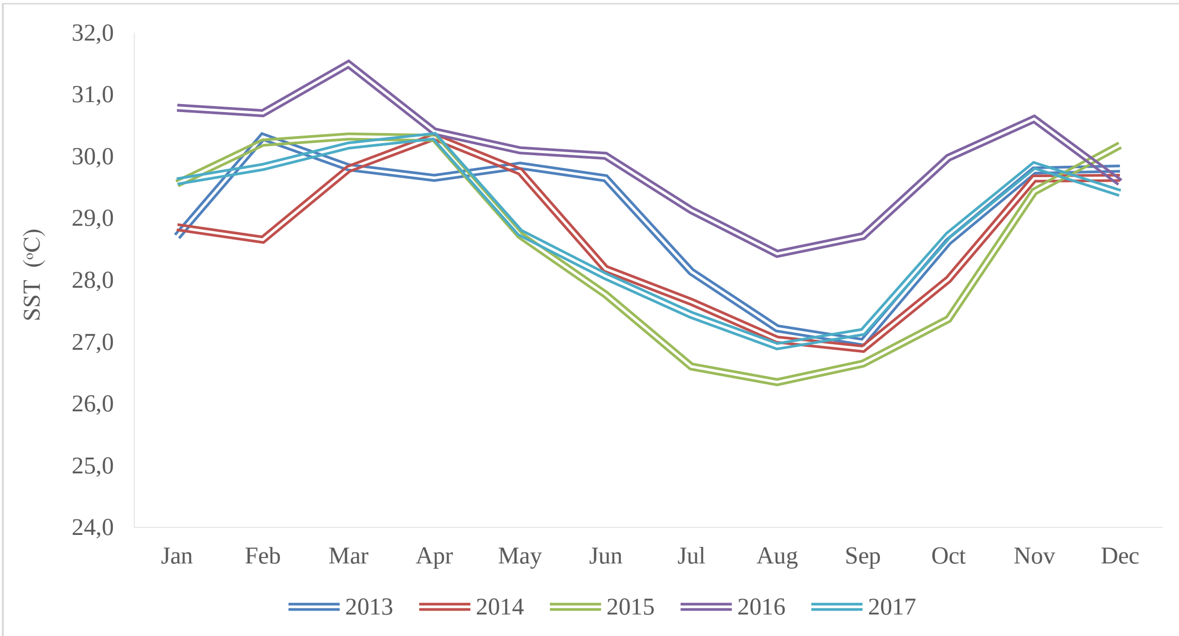

Figure 2. SST Distribution for 2013-2017 in Bali Strait Waters

3. 1. Skipjack Tuna Catches in National Fisheries Port Pengambengan

The potential of Indonesian marine fisheries is 10.5 million tons/year (Apriliani et al., 2019). One of them is National Fisheries Port Pengambengan which contributes to the potential capture fisheries in Indonesia. The tuna catches fluctuate every month during 2013 until 2017. The highest catch is in September with a catch of 567.8 tons and the lowest catch occurs in January with a catch of 1 ton, in 2014 the highest catch is in May with a catch of 757,998 tons and the lowest catch was in February at 4 tons. In 2015 the highest catch occurred in October, which was 146.07 tons, the lowest catch in that year occurred in January and February which did not get tuna at all. In 2016 the highest catch occurred in September (41,994 tons) and did not get tuna at all in July and December, and in 2017 the highest catch occurred in September (596,661 tons) and the lowest in February (0,006 tons) (Figure 3).

The average catches for five years (2013 - 2017) occurred in 2014, and the lowest catches of skipjack tuna occurred in 2016. This was allegedly due to the catches of previous years, namely in 2014 - 2015 tuna fish resources were exploited excessive. Exècessive exploitation of fish in the peak years of production there is a trend to be followed by a very sharp decline in production in the next year (Caddy & Seijo, 2005).

The average catch of skipjack tuna when viewed by season, the highest catch occurs in the transition II (intern-monsoon) (September-November) with an average catch of tuna of 155,84 tons, followed by the transition I (intern-monsoon) (March - May) with an average catch of tuna of 147,74 tons, in the southeast monsoon(June - August) with an average catch of 94.79 tons, and the lowest catch occurs in the northwest monsoon(December - February) with an average catches of 8,19 tons (Figure 3). According to Prayoga et al. (2017) the high catch in the second season is thought to be due to favorable weather conditions for making skipjack una fishing so that the fishermen can make optimal catches. The low catches in the northwest monsoon (December - February) are suspected in the northwest monsoonwhen the weather is in poor condition with high rainfall, causing fishermen to not be able to catch fish optimally.

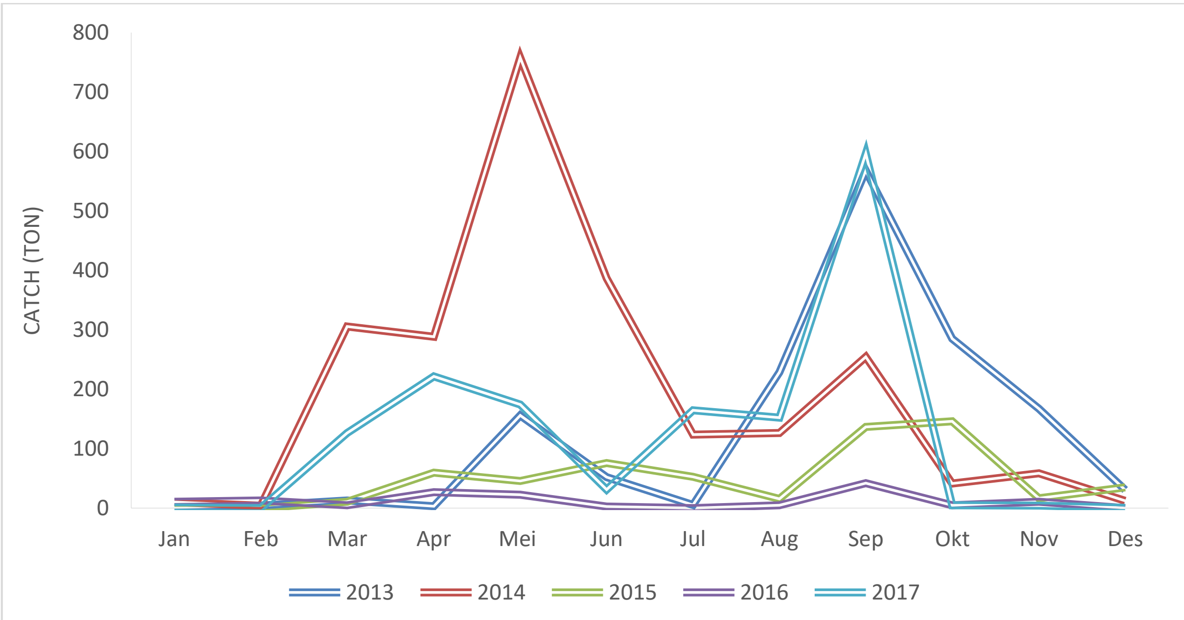

Figure 3. Skipjack Tuna Catch in 2013-2017

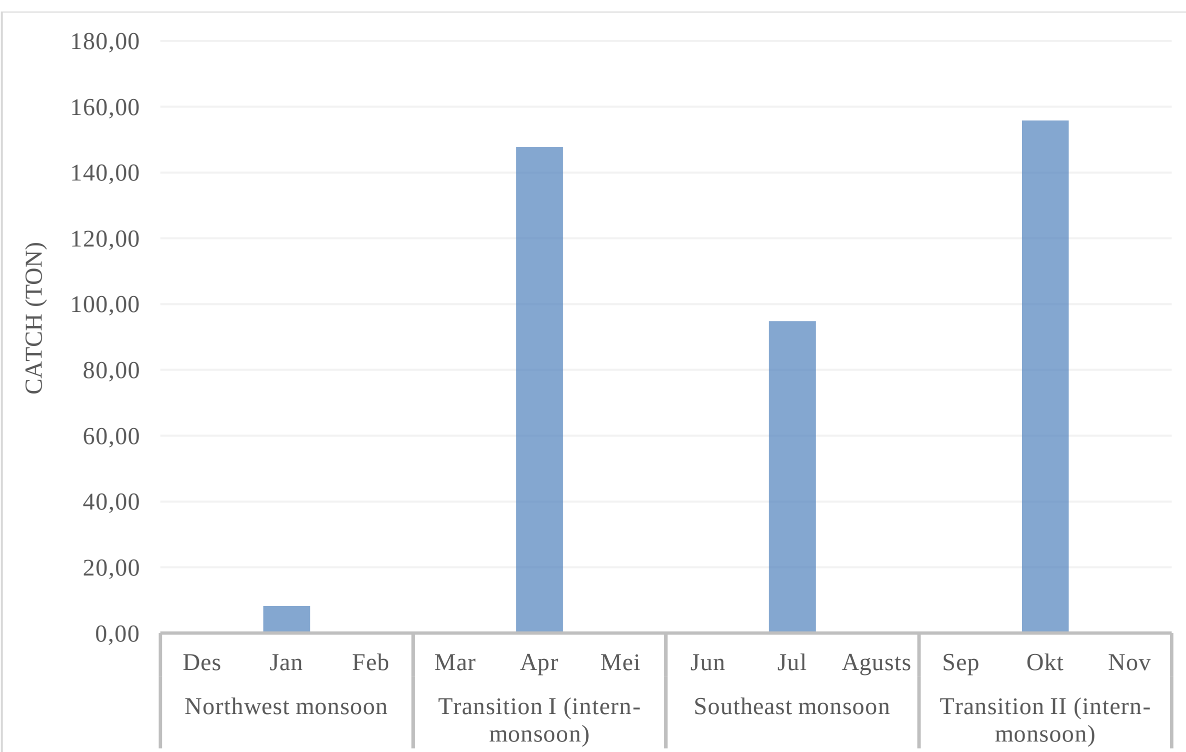

Figure 3. Average of Skipjack Tuna Catch Season in 2013-2017 Based on the Strait of Bali

One way to find out somewhere that is ongoing (over fishing) is to look for the value of the catch per unit effort (CPUE). CPUE is a unit of fish population per type of fishing gear divided by capture effort. This method is used to help determine populations in situations that are impractical to get a definite amount of individual fish in an area (Prakarsa et al., 2014). According to Hinton & Maunder (2004) CPUE is one of the important information in the study of fish stocks and can be assumed to be proportional to the abundance of fish resources in every effort. The greater the CPUE, the productivity of fish resources increases. Adding, the CPUEdit decreases the fish resource increases. The CPUE trend obtained from one can review one indicator about a fishery stock. The rising CPUE trend is a picture of exploitation Fish resources can be given still at the development stage.

The flat CPUE trend is part of the exploitation of fish resources. The CPUE trend that is decreasing is an indication of the level of exploitation of fish resources aimed at over-exploitation called over-fishing (Caddy & Seijo, 2005).

The fluctuations in the CPUE value of tuna which were landed in Pengambengan in 2013-2017 are presented in Figure 4. The average CPUE value of tuna in 2013 amounted to 0,58 tons per trip, in 2014 had an average CPUE of 0,89 tons per trip, in 2015 amounted to 0,32 tons per trip, in 2016 amounted to 0,17 tons per trip, and the CPUE value of 2017 was 0,98. The highest CPUE value occurred in May 2014 which reached 2.35 tons per trip. The lowest CPUE value occurred in January 2015, February 2015, July 2016, and December 2016, which values up to 0 tons per trip or did not get tuna catches at all (Figure 4).

The CPUE value calculated over the past five years shows the production efficiency of fishermen purse seine trips. The average CPUE value in 2013-2014 experienced an increase in efficiency, but decreased in 2015-2016 and increased again in 2017. The decline in the value of CPUE occurred due to oceanographic conditions or excess capacity effort (Caddy & Seijo, 2005), these allegations must be reviewed further by conducting more in-depth research on CPUE.

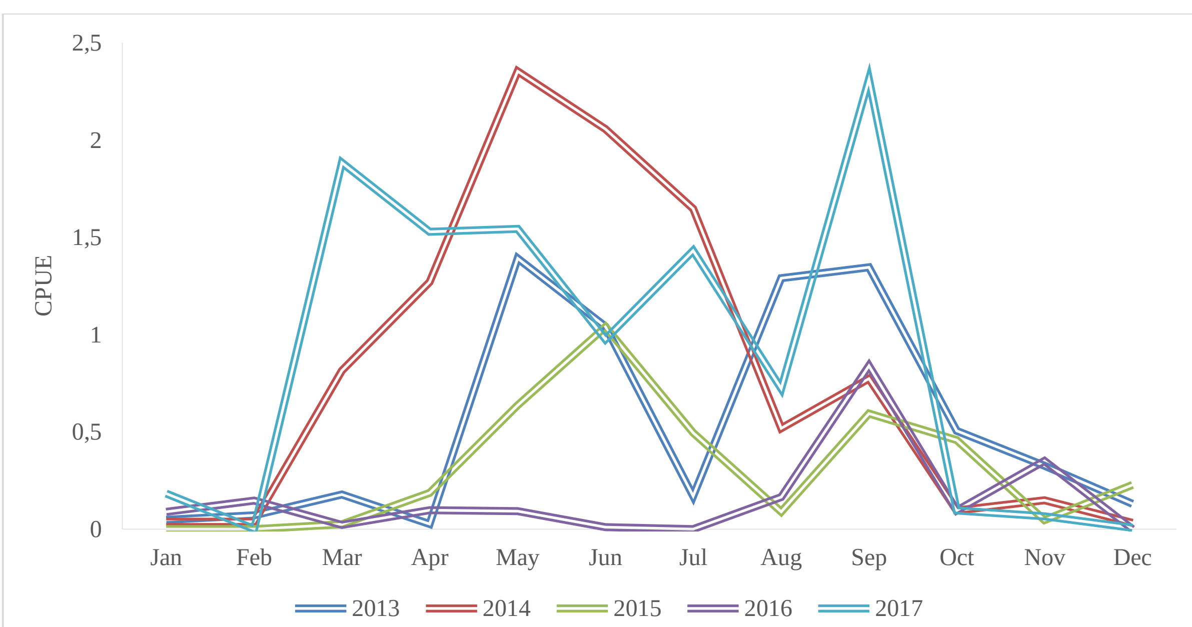

Figure 4. CPUE Skipjack Tuna in 2013-2017 in Pengambengan

3. 2. Catch Size

Rahman et al. (2016) states that the fecundity that occurs in fish species is often associated with fish body length compared to the weight of the fish. This is because the shrinkage fish length is relatively small compared to the weight shrinkage which is related to the water content that is still present in the body of the fish when it is only transported from the water. When fish arrive on land, the water content in the fish's body decreases.

The length of the catch is used to determine whether or not it is appropriate for the fish to be caught. Total catch shows a category not suitable for capture (100%) by referring to the length of the skipjack tuna that is suitable for capture which has a length above 36.54-37.01 cm fork length in west season, 36.89-37.71 cm fork length in west-east season, 40.96-42.13 cm fork length in east season, and 40.20-51.30 cm fork length in east-west season (Tadjuddah et al., 2017). These three things occur because of differences in geographical location between the size of skipjack tuna caught in the Bali strait by reference to the size of the catchable skipjack tuna that is used for assessment so that it might cause differences in the size of the fish first gonad mature.

According to Oliveira (2015) different geographical conditions and locations can cause differences in the size of fish first maturing the gonads for the same fish species. Differences in the size of fish are also influenced by external and internal factors. Internal factors are factors that are difficult to control such as sex, age, parasites and disease. While external factors that usually affecting the size are temperature and food (Apriliani et al., 2018).

3. CONCLUSIONS

Based on the results of research that can be concluded that:

1) Tuna catches fluctuate every month during 2013 to 2017. The average catch is high in 2014, and the lowest catch of tuna is in 2016. This is presumably because of the catches of previous years namely years 2014 - 2015 tuna fish resources are overexploited.
2) The catch of tuna based on the season has the highest value in September - November (transition II (intern-monsoon)) and the lowest is in December-February (northwest season).

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