

Enumeration methods used to investigate the production of yellowfin tuna (*Thunnus albacares*) in Indian Ocean; Case study of tuna monitoring in Benoa Port, Bali, Indonesia

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## ABSTRACT

*Yellowfin tuna (*Thunnus albacares*) is one of the important catch for the fishing industry in Indonesia. The objectives of this study is to investigate the production of yellowfin tuna in Indian Ocean. Data were collected from enumeration data in Benoa Port, Indonesia from January 2010 to December 2015. The methods used in this study was enumeration methods where we collected data from sampled vessels. The estimation values were calculated from sampled data multiplied by covered percentage vessels. Total of 5,105 vessels were landed during that periods and 2,711 vessels were covered (54.74%). More than 200,000 yellowfin tuna were measured its weight (kg) and around 36,000 were measured its fork length (cm). Generally, the estimation of landed yellowfin tuna decreased during that periods. The number was sharply declined from nearly 1,000 tons in June 2010 to only less than 100 tons in December 2015. It means that the decreasing level was around 10 times in 5 years. However, the average CPUE fluctuated monthly with the average around 3 tons/trip. Moreover, the average length and weight of yellowfin tuna were tend to be stagnant from year to year with 131 cm of fork length and 42 kg of weight. The findings from this study provide fundamental information for management of yellowfin tuna stock and population.*

**KEYWORDS:** *yellowfin tuna; production; enumeration; Indian Ocean.*

## INTRODUCTION

Tuna is one of important export commodity in Indonesia with total production reaches 1.297 tons from 2004 to 2011. Yellowfin tuna is the highest percentage with 69% from total tuna production, followed by bigeye tuna (24%), albacore (6%) and southern bluefin tuna (1%) (DGCF, 2012). Yellowfin tuna (*Thunnus albacares*) is highly migratory species with distribution in trophic and temperate water. This species can be found in Atlantic, Indian and Pacific Ocean (Collette & Nauen, 1983). In Indonesia, the distribution of this species spreading from west and

south Sumatera; south of Java, Bali and Nusa Tenggara; Banda and Sulawesi Sea; and west of Papuan waters (Uktolseja *et al.*, 1991).

From 2005-2012, the production of yellowfin tuna was dominant with 72% from total production of big tuna group which reach 1.3 million tons. One of the important tuna landing site in Indonesia is located in Benoa port, Bali with more than 70% of total tuna production in Indonesia (DGCF, 2014). The objective of this study is to investigating the production of yellowfin tuna (*Thunnus albacares*) in Indian Ocean using enumeration methods in Benoa Port, Bali.

## MATERIALS AND METHODS

Yellowfin tuna data were collected daily by enumerator from January 2010 to December 2015 in Benoa Port, Bali. Every day, enumerator took information about all landed vessels. Then decide to determine sampled vessels to collect the production of sampled vessels and the individual length and weight information. The fork length (FL) of fish was measured ( $\pm 1$  cm), weighing the weight ( $\pm 1$  kg) with a regular balance. The yellowfin tuna from Benoa Port was caught by longline fishing.

Data analysis used to estimate the fish production and the catch per unit effort. Estimation was calculated using IOTC formula (2002):

$CM = LM * AVM$ , where:

CM = catch estimation (tons)

LM = number of landed vessels (trip)

AVM = catch from sampled vessels (tons) / number of sampled vessels (tri)

While catch per unit efforts was calculated using CPUE formula (Gunarso & Wiyono, 1994):

CPUE =  $C_i / E_i$ , where:

CPUE = catch per unit effort (tons/trip)

$C_i$  = catch (tons)

$E_i$  = effort (trip)

## RESULTS AND DISCUSSION

Total of 5,105 vessels were landed from January 2010 to December 2015 and 2,711 vessels were covered (54.74%). This number was higher than the minimum percentage recommended vessels covered with 30% (IOTC, 2002). Generally, the percentage of observed vessels increase significantly from 2010 to 2015. The number is increased a half from around 40% in 2010 to around 40% in 2015 (Figure 1). The estimation of landed yellowfin tuna decreased during that periods. The number was sharply declined from nearly 1,000 tons in June 2010 to only less than 100 tons in December 2015. It means that the decreasing level was around 10 times in 5 years. However, the average CPUE fluctuated monthly with the average around 3 tons/trip. The highest CPUE was around 6 tons/trip while the lowest CPUE just around 1 ton/trip (Figure 2).

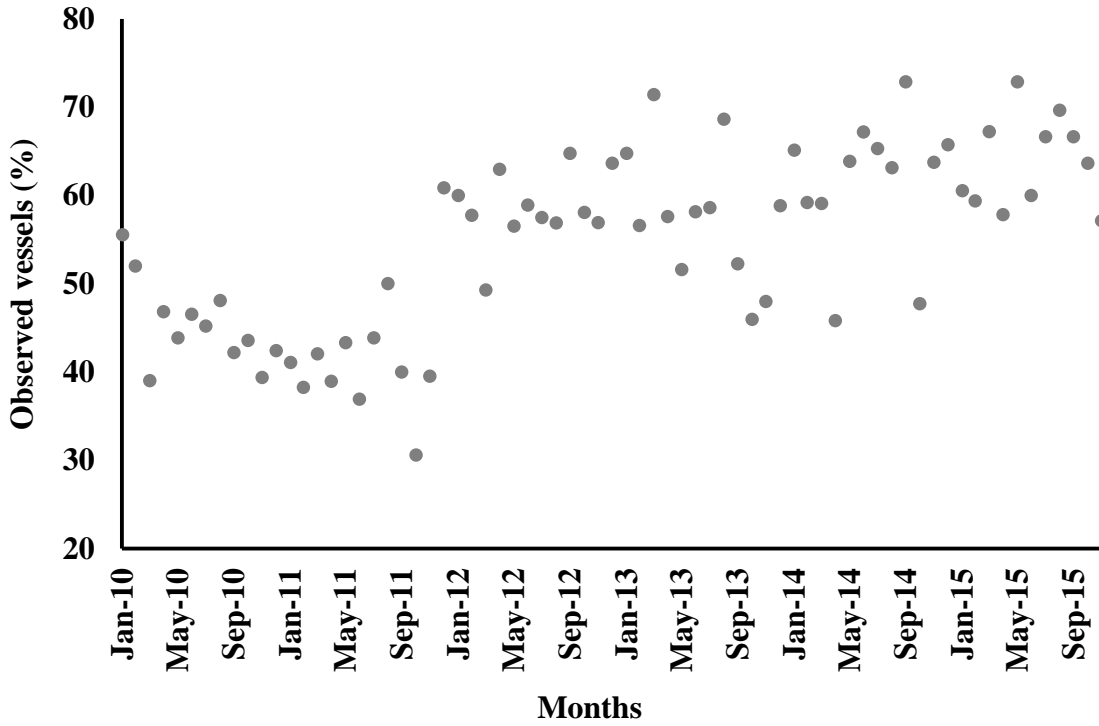


Figure 1. Monthly observed vessels in Benoa Port from January 2010 to December 2015.

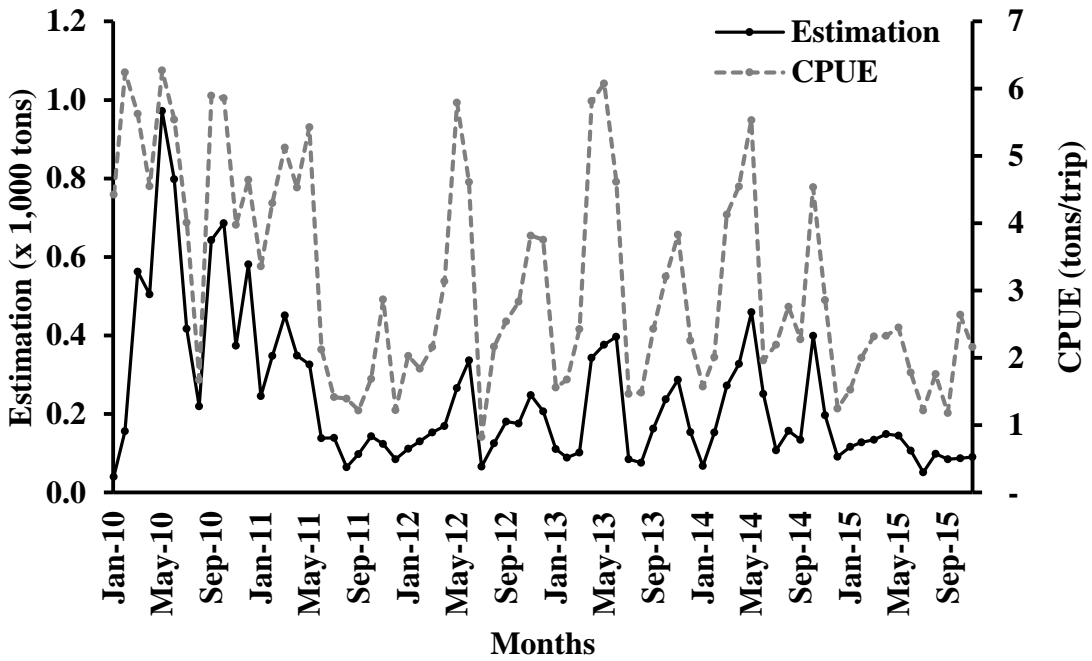


Figure 2. Monthly estimation (x 1,000 tons) and CPUE (tons/trip) of yellowfin tuna (*Thunnus albacares*) in Benoa Port from January 2010 to December 2015.

The average length and weight of yellowfin tuna were tend to be stagnant from year to year with 131 cm of fork length and 42 kg of weight. The lowest of average length was occurred in September 2012 with less than 110 cm but the number was increased to average level in May 2013 then tend to stagnant until December 2015 (Figure 3). The average length of yellowfin tuna landed in Benoa Port was higher than the length maturity ( $L_m$ ) of this species with 102 cm (Zudaire *et al.*, 2013). It means that the yellowfin tuna landed in Benoa Port was indicate to have been spawned before being caught. Similar trend also occurred for the weight, the lowest of average weight also occurred in September 2012 with less than 30 kg and increased again to average level in May 2013 then tend to stagnant until December 2015 (Figure 4).

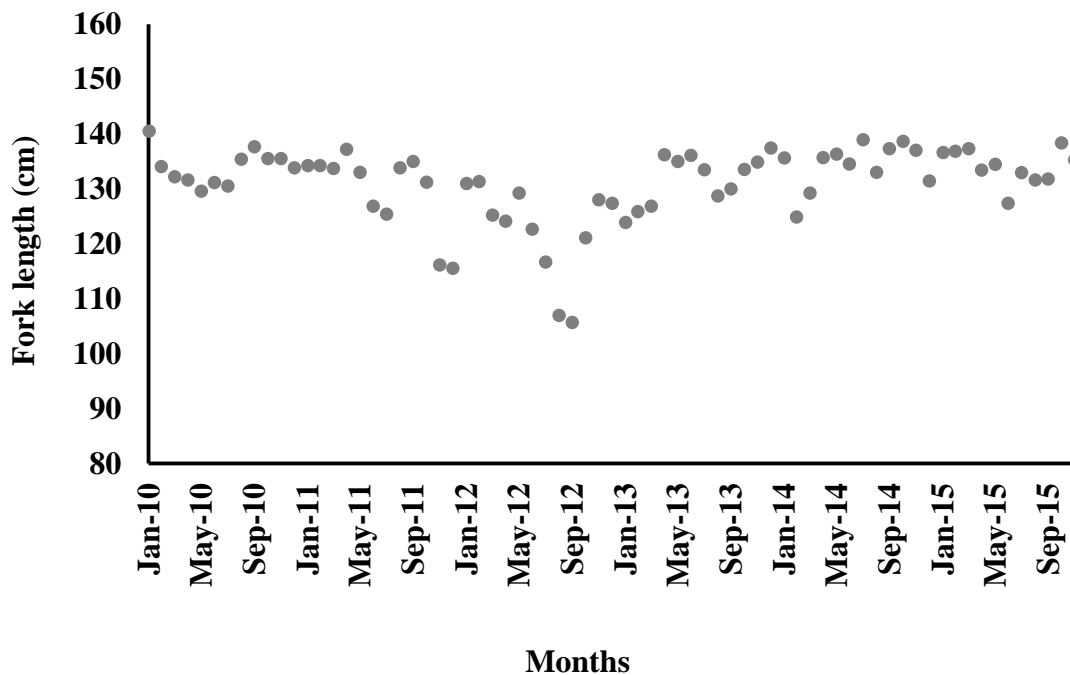


Figure 3. Monthly average length (cm) of yellowfin tuna (*Thunnus albacares*) in Benoa Port from January 2010 to December 2015.

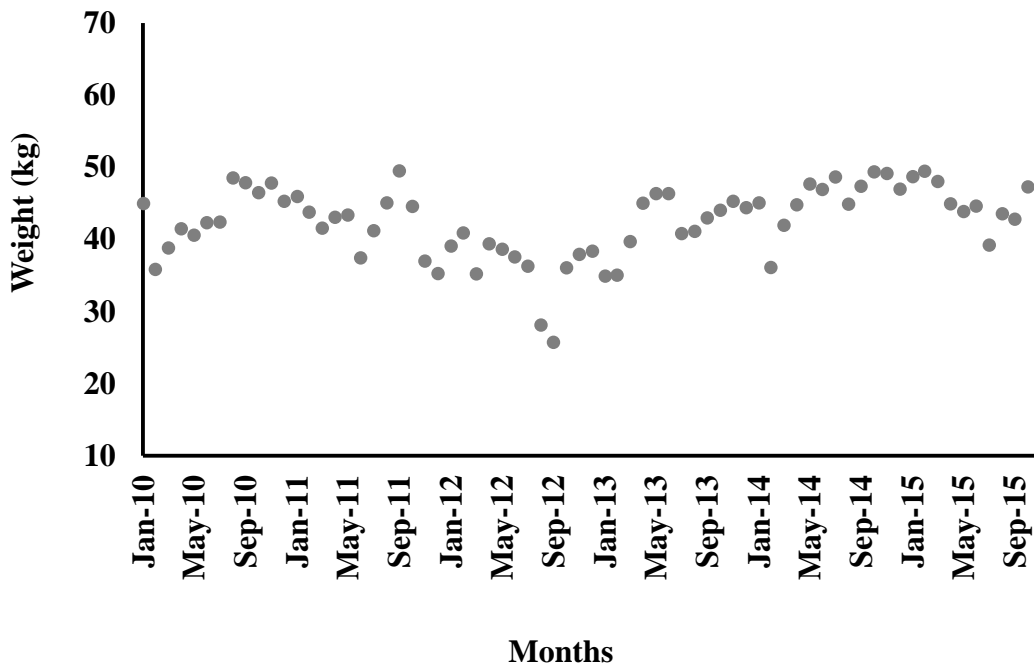


Figure 4. Monthly average weight (kg) of yellowfin tuna (*Thunnus albacares*) in Benoa Port from January 2010 to December 2015.

Another thing that need to be improved for enumeration activities in Benoa Port is to increase the information about fish length. Length and weight information is very useful tools for supporting sustainable management strategies (King, 2007). The coverage of length data was only less than 30% (Figure 4). There were several reasons why the length coverage was very low. First is the limited number of personnel (enumerators) to cover length data. The second is the activity in processing plant that run very fast that make difficulties to measure length of the fish.

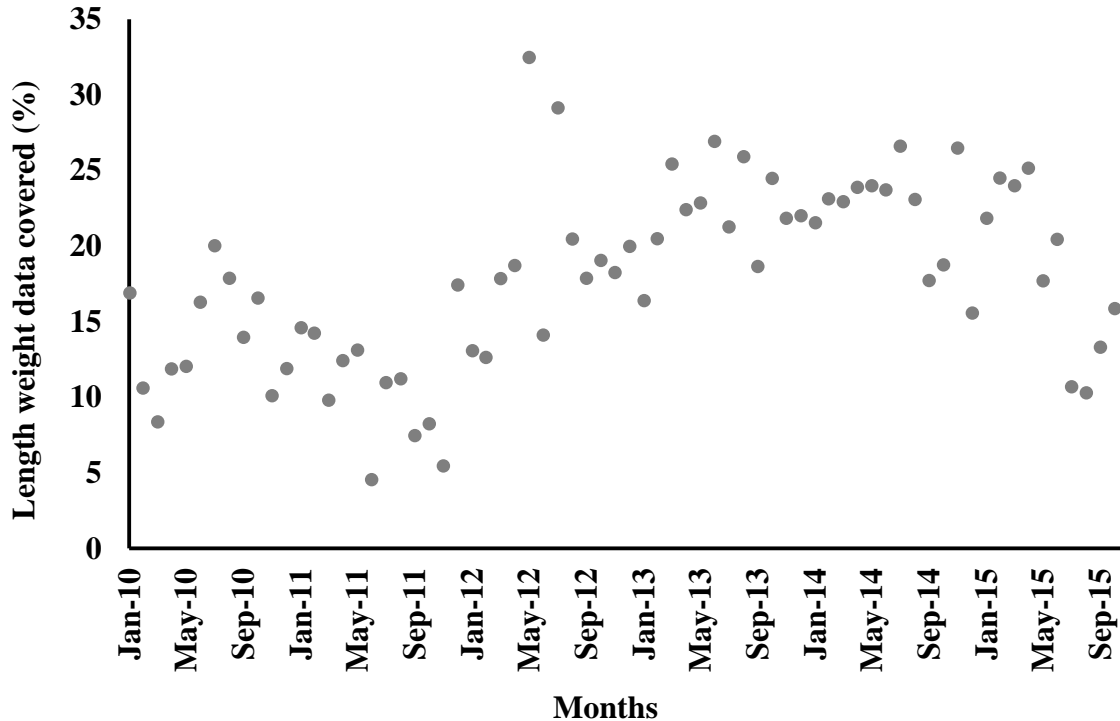


Figure 5. Length weight data covered (%) of yellowfin tuna (*Thunnus albacares*) in Benoa Port from January 2010 to December 2015.

## CONCLUSION

The enumeration activity in Benoa Port is still develop and make a upright progress to collect fisheries data. It needs improvement to gain robust data through implementation of good method developing the human resources, both the number and skills.

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