Catch Methods to Estimate The Production of Bigeye Tuna (*Thunnus obesus*) From Benoa Port, Bali, Indonesia

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ABSTRACT

Bigeye tuna (*Thunnus obesus*) is one of the most important commercial species in Indian Ocean including Indonesia. The catch of bigeye tuna has been monitored since 2002 from Benoa Port, Bali, Indonesia. The objectives of this study is to investigate the method that is used to estimate the production of bigeye tuna from Benoa Port using enumeration data. The data were obtained from enumeration activity from January 2012 to December 2016. The estimation of the total production was calculated from sampled data multiplied by the proportion of total vessels and sampled vessels. There were 3,805 vessels landed during the study and 60.05% of them were sampled. There were 183,561 bigeye tunas were measured (kg) and 30,060 were measured (cmFL). The average length and weight of bigeye tuna were tend to be stagnant from year to year with 124,78 cmFL and 42,94 kg of weight. Generally, the estimation of landed bigeye tunas is tend to be stable. The maximum catch was in 2015 which is 1,926.252 tons.

Keywords*:* Bigeye tuna; production; enumeration; Indian Ocean.

INTRODUCTION

Bigeye tuna (*Thunnus obesus* Lowe, 1839) is one of the main export commodities in Indonesia. It was spread across tropical and sub-tropical waters of the Indian Ocean, Pasific Ocean and Atlantic Ocean. Bigeye tuna, in industrial scale, was commonly caught using longline. Longline is passive but effective gear for catching tuna because of its construction and the ability to reach the swimming layer.

Bigeye tuna is a highly migratory species. It was a diurnal fish which the feeding periodicity is in the noon to afternoon (Barata et al 2012). Further, this fish were commonly caught at 193.97 – 470.12m depth with temperature 8,35-15,52^{o}C. Bigeye tuna in eastern Indian Ocean consisted of two sub populations (Suman et al 2015; Nugraha 2011). The first sub population was found in south of Java and Nusa Tenggara, while the second one was from west Sumatera.

The population of bigeye tuna in Indian Ocean is still good. Along with the increasing market demand, the exploitation of large eye tuna is higher, especially in the Indian Ocean. If it's not balanced with the good management, the sustainability of the resources could be threatened.

Benoa port is one tuna landing centers in Indonesia. Almost all of the tuna which were landed in this port were from longline. Most of the bigeye tunas from the longline were the mature one and at least had spawned once (Jatmiko *et al* 2014, Wujdi *et al* 2016).

MATERIALS AND METHODS

Bigeye tuna data were collected daily by enumerator from January 2012 to December 2016 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 (±1 cm), weighing the weight (± 1 kg) with a regular balance. The bigeye 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 (trip)

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

CPUE = Ci / Ei, where:

CPUE = catch per unit effort (tons/trip)

Ci = catch (tons)

Ei = effort (trip)

RESULTS AND DISCUSSION

Total of 3,805 vessels were landed from January 2012 to December 2016 and 2,285 vessels were covered (60.05%). This number was higher than the minimum percentage recommended vessels covered with 30% (IOTC, 2002). Generally, the percentage of observed

vessels increase slightly from 2012 to 2016 (Figure 1). The estimation of landed bigeye tuna varies each month but tend to be stable. There is no sharp different for the yearly average production of bigeye tuna. The average CPUE also fluctuated monthly with the average around 3.5 tons/trip. The highest CPUE was 8.3 tons/trip while the lowest CPUE just around 1.3 tons/trip (Figure 2). This is higher than the average CPUE of yellowfin tuna (Jatmiko *et al*., 2016).

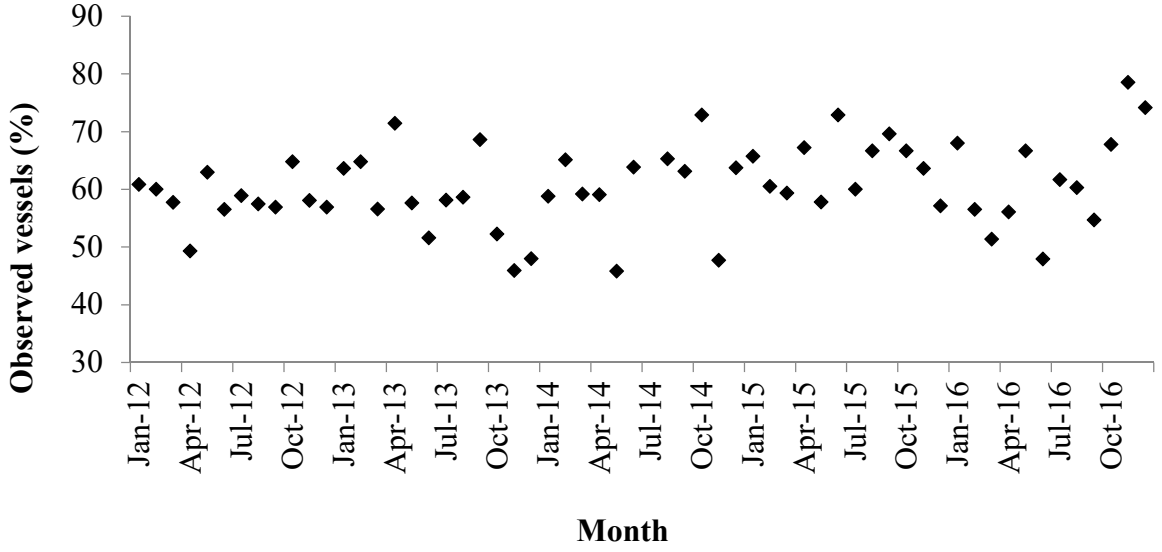

Figure 1. Monthly observed vessels in Benoa Port from 2011 to December 2016

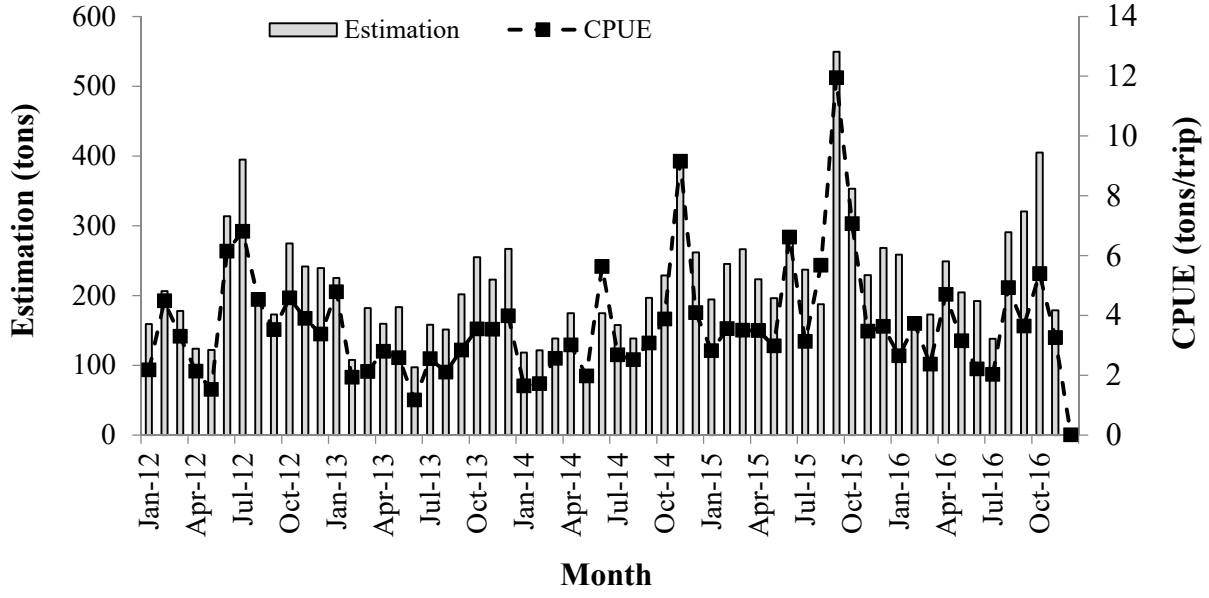

Figure 2. Monthly estimation (tons) and CPUE (tons/trip) of bigeye tuna in Benoa Port from 2011 to 2016.

The average length and weight of bigeye tuna were tend to be stagnant from year to year with 124,78 cm of fork length (Figure 3) and 42,94 kg of weight (Figure 4). The lowest of average length was occurred in July 2012 and July 2014 with less than 110 cm (Figure 3). The average length of bigeye tuna landed in Benoa Port was higher than its length first of maturity (L_m). The Lm of bigeye tuna in Indian Ocean, from previous studies were 88.08 cm (Nootmorn 2004) and 102.4 cm (Farley et al., 2003). Further, from the other oceans, the Lm of bigeye tuna in Pacific Ocean was 99.7 (Sun *et al.*, (2006) and 107,8 cm (Zhu *et al* 2010).

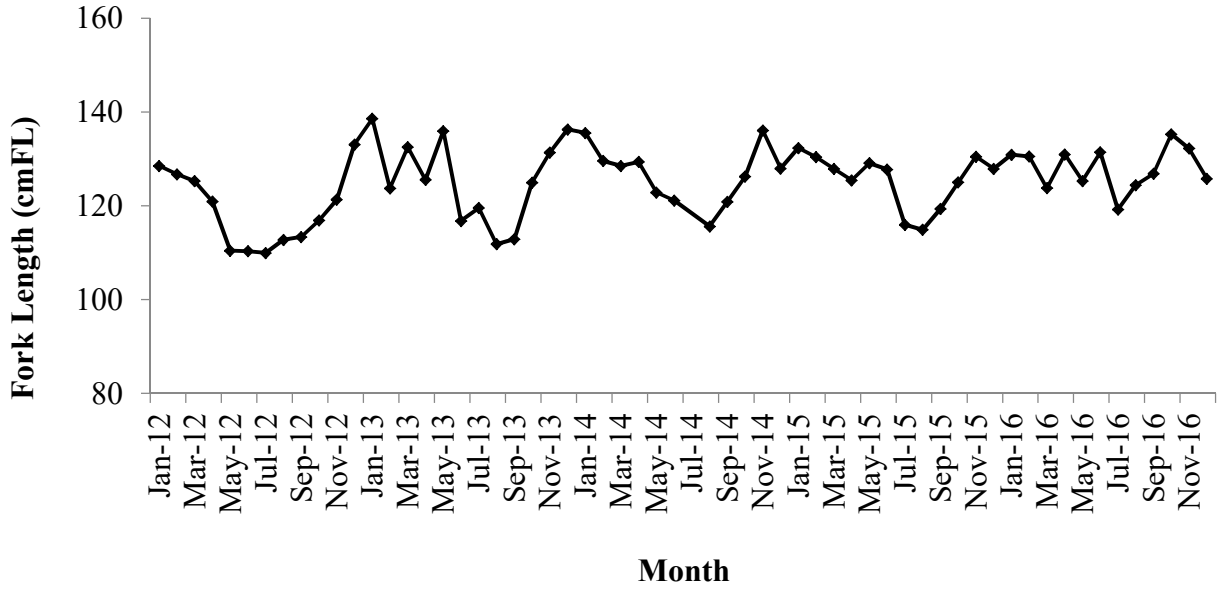

Figure 3. Monthly average length (cm) of bigeye tuna in Benoa Port from 2010 to 2015.

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 5). 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. Nevertheless, the coverage of length data increased over time.

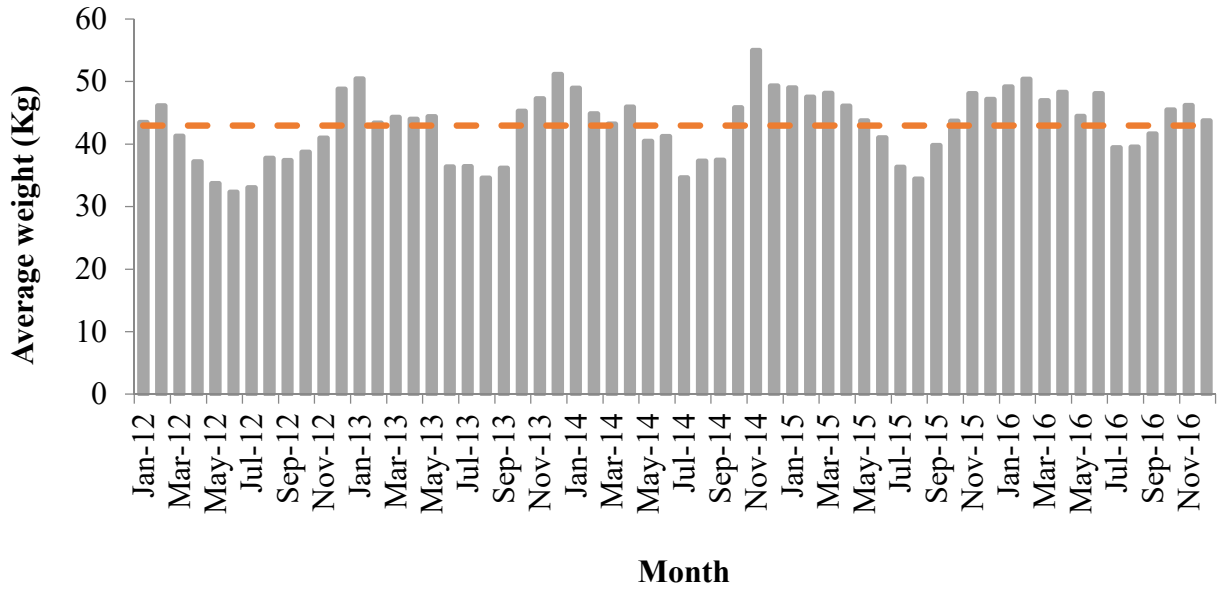

Figure 4. Monthly average weight (Kg) of bigeye tuna in Benoa Port from 2010 to 2016

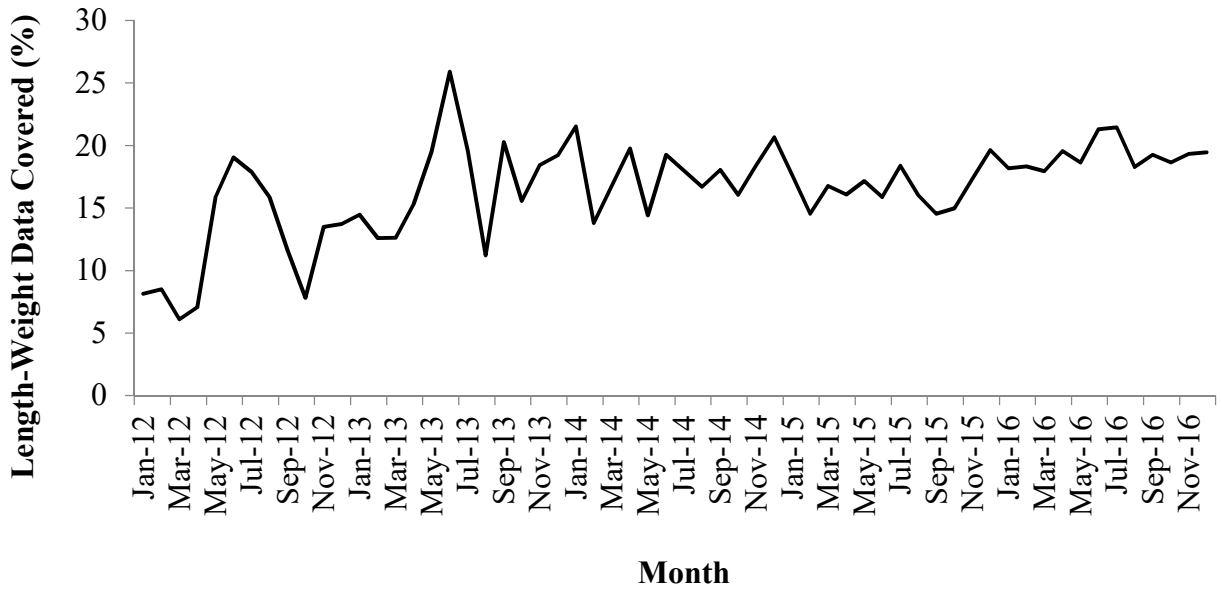

Figure 5. Length weight data covered (%) of bigeye tuna in Benoa Port from 2011 to 2016.

CONCLUSION

The catch of bigeye tuna in Benoa Port tends to remain unchanged in the last five years. The enumeration activity in Benoa Port is still developed and makes an 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.

ACKNOWLEDGEMENT

This study is funded by research project at Research Institute for Tuna Fisheries. The authors wish to thank all enumerators for their contribution in data collection.

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