THE ANNUAL CHANGES OF CPT OF TROLLING LINES FISHERY IN PALABUHANRATU WEST JAVA, INDONESIA

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ABSTRACT

Trolling line is one of the fishing gears that is categorized as line-fishing with rods. Troll line fishery in Palabuhanratu heavily depends on the installation of a deep-sea fish aggregating device (FADs). The deployment of FADs as a destined troll liner's fishing ground in southern Palabuhanratu, which is geographically located at coordinates between 7° to 9° S and 104° to 106° E in the Indian Ocean. The FADs’ coordinates locations have been set in a portable handheld global position system (GPS) by fishers. This study provides new information on troll liner catch-per-trip (CPT) based on fishers’ monthly data, ranging from 2005 to 2018. The results showed that the highest catches occurred between September and October every year with the maximum catch rate was 1567.20 kg/trip in February 2006 while the lowest one was 174.10 kg/trip in August 2010. The average troll liner catches from 2005 to 2018 was 740.33 kg/trip. Based on monthly catch data from 2005 to 2018, the highest CPT occurred in 2016.

Keywords: Catch-per-trip; Palabuhanratu; Trends; Trolling Lines

INTRODUCTION

The total catches landed in the southern-off Indian Ocean of West Java fluctuated across the years (Nurhayati & Purnomo, 2017). Palabuhanratu landing site is located at the Indonesian Fishery Management Area (FMA) 573, which extends outward in the Indian Ocean from the southern-off Java to Nusa Tenggara (Hartini et al., 2013). Skipjack tuna (Katsuwonus pelamis) is the dominant species caught by trolling lines, then followed by yellowfin tuna (Thunnus albacares), and other pelagic species, such as little eastern tuna (Euthynnus affinis) and swordfish (Xiphias gladius) (Food and Agriculture Organisation of the United Nations, 2001; Puspito, 2009).

Most of the fishing gears used by fishers in Palabuhanratu are trolling lines, handline, and kite fishing (Inizianti, 2010). Trolling lines fishery strongly depends on the availability of baits during the fishing operation, as research by Khan et al. (2018) found that in eastern Indonesia, line fishing relies on the availability of baits (Khan et al., 2020). Types of bait mostly used by the fishers are both natural and artificial baits during the fishing operations (Food and Agriculture Organisation of the United Nations, 2001; Wijaya, 2012; Yahya & Rahmat, 2017). Moreover, trolling lines in this area also use fish aggregating devices (FADs) for fishing operations.

Usually, the catch-per-trip (CPT) to be considered as an estimation of the fish that have been taken from wild stock. The catch-per-unit-effort is mostly useful if the relationship between catch and effort is linear through the origin (strict proportionality) (Garrod, 1964; Gulland, 1964; Lima et al., 2000; Ricker, 1975). Catch-per-trip (CPT) are the results of assumptions that can be taken in different combinations: (i) fish vulnerability to fishing gears; (ii) the distribution of stock space that determines the distribution of fishing efforts (Palooheimo & Dickie, 1964). Various vessel characteristics and fishers affect the quantity of fish taken by the boats per trip, and therefore, in the end, it will affect the accuracy of the trip as a fishing effort unit. These include the size of the vessels, storage capacity, crew skills, and the availability of technology (Food and Agriculture Organisation of the United Nations, 1980; Oxenford, 1999). This research aims to determine the dynamics of catch and effort from 2005 to 2018 as a baseline to describe the annual trend catch-per-trip (CPT) of trolling lines as a piece of underlying scientific evidence for fishing evaluation and management of trolling lines fishery in Palabuhanratu.
MATERIALS AND METHODS

Research Site

The research was conducted from March to October 2019 at Palabuhanratu, West Java, Indonesia. Fishing operation time normally occurs from dawn (05:00 am) until dusk (06:00 pm), but sometimes until late evening when they are looking for other targeted species, such as squids. The fishing ground is where the FAD’s deployed, with coordinates between 7° to 9° S and 104° to 106° E. The FAD’s sites have been stored by the fishers using handheld GPS. Every trolling line has their FAD sites and is only allowed for fishing at their own FADs’ sites with fishing depth ranging from 20 to 60 m deep.

Data Analysis

Catch-per-trip data on this paper is defined as the volume of landings (kg) divided by number of trips of trolling lines. More detail is as the following formula (Noija et al., 2014):

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\text{Catch per trip (CPT)} = \frac{\text{catch (kg)}}{\text{trip}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cd-
Catches of trolling lines show fluctuations (Figure 1). The minimum catch ranged from 1,791 kg in October to 20,310 kg in April during 2005 - 2018, with the average catch ranging from 27,143 kg in December to 68,438 kg in July. The maximum value ranges from 50,440 kg in January to 163,126 kg in June. In general, the distribution of catch data is not symmetrical, which shows that the median value is not in the middle of the box, and the top whisker is higher than the bottom whisker. The graph also indicates there is no extreme value within the 2005 – 2018 catch data.

Trip data for trolling lines showed fluctuations in trends (Figure 2.). Minimum trip data ranged from four trips in October to 20 trips in April. The average monthly for the 2005 -2018 trip data ranged from 37.7 trips in January to 118.9 trips in June. The maximum monthly trip ranged from 79 trips in December (2018) to 333 trips in June (2011). In general, the distribution of catch data is not symmetrical, as the median is not in the middle of the box, and the top whisker is longer than the bottom whisker. Based on the picture also shows that there is no extreme value in the capture data trip.
Monthly Catch-Per-Trip (CPT) 2005-2018

The average annual CPT of trolling lines fishery from 2005 to 2018 at around 740.33 kg/trip. The maximum was 1567.19 kg/trip in February 2006, while the lowest rate of 174.10 kg/trip occurred in August 2010. The trend analysis of CPT from 2005 to 2018 shows there are two peaks indicate the status of trolling lines fishery (Figure 3).

The CPT value of trolling lines ranges between 461.03 and 1,318.04 kg per trip. The value of CPT for trolling lines in 2005 - 2006 increased 11% then in 2006 - 2010 with an average decrease of 20.4%. In 2010 - 2012, the value of CPT increased an average of 30.5%, then in 2012 - 2014 the value of CPT decreased an average of 17.5%. In 2014 - 2016, the value of CPT increased with an average of 62% and decreased again in 2017 of 38%. In 2017 - 2018, the value of CPT increased 16% (Figure 4).

Figure 3. The summated monthly catch-per-trip data were showing the range of variability within each month over the years 2005-2018. The band inside each bar represents the median, and the middlebox represents the interquartile range, while the lines outside the box ("whiskers") describe the lower and upper quartiles.

Figure 4. The average annual catch-per-trip (CPT) 2005-2018.
Discussion

Catch-per-trip (CPT) data for trolling lines show fluctuations based on monthly data during 14 years (Figure 3). The monthly data collection for 14 years aims to find out the fishing season for trolling lines fishing during that time period (2005 - 2018). Based on the monthly CPUE graph in 2005 - 2018, the value of CPUE has fluctuated every year. In June, it was the lowest CPUE with a value of 567 kg/trip while in September it was the highest CPUE with a value of 806 kg/trip. Overall, in September - October (east season), CPUE values were quite high, ranging from 780 - 806 kg/trip. In general, the distribution of catch data is not symmetrical. This is shown because the median value is not in the middle of the box and the top whisker is longer than the bottom whisker. Based on the picture also shows there are no extreme values in CPT data.

The trolling catch rate used in the form of catch data and monthly trips in 2005 - 2018 is then presented in graphical form (Figure 4). In 2012 - 2018, the graph shows an increase in the catches rates trend. The increasing trend in the rate of trolling can be used as an indication that trolling fishing in that year is at a developing stage. Trend that shows the stages of development should be carried out management of fish resources through trolling lines fishing gear. Management is carried out so that sustainable fish resources are created with no over-exploitation and the catch rate will continue to increase. Management that can be done through trolling fishing gear are reduction of fishing gear, ship departure arrangements, and regulations for catching fish that are not yet mature gonads or fish that have not spawned in their lives.

Over exploitation is also indicated by the further fishing ground than ones before 2010 that causes it to take more time to get to the fishing ground. Fishing grounds that are further away caused the spread of FADs is also getting farther. The fishing ground factor and the distribution of FADs are related to the fishing trip duration, which was previously 4-7 days became 7-15 days at the sea; therefore, the frequency of fishermen to go fishing in one month also decreases. The structure of the fishing fleet from the beginning until now has not changed even though the trolling line fishermen in the Palabuhanratu Bay only rely on GPS to catch fish.

Based on the graphs obtained, the rate of trolling lines fishing has fluctuated for each month and year. Factors that can influence the value of CPT are total catch and trips. The CPT value increases along with the decreased trips even though the production of fish is constant, and vice versa. Moreover, when the production of fish increases and the trips decrease, the value of CPT will increase. In contrast, when the abundance of fish decreases, the value of CPT will decrease even though the total trips are constant.

The graphic pattern in Figure 4 shows the fluctuation in the catch rate. The CPT trends could be explained by the fact that CPT spatial variations were caused by many conditions, such as water current, water transparency, and fishing pressure (Kantoussan, 2007). The CTC value could be influenced by professional fishing techniques and the ability of fishing gear to catch fish (Coulibaly et al., 2018; Lae, 1982). Low CPT can be caused by the fish in the water column to look for food or to spawn and gather in the waters making fish not vulnerable to fishing activities so that the CPT has decreased (Kantoussan, 2007; Tah et al., 2010). The CPT may also be affected by the differences in catchability among different fishing vessels, gears, and methods, which might confound the indexes of total catch (Richards et al., 1990). In the context of gear power (effective net area), simple linear regression could detect no effect on the CPT. Consequently, although there was a tendency for more experienced fishermen to use greater gear power, this is unlikely to be the cause of the higher CPT achieved by the more experienced fishermen (Boyce et al., 1989).

The value of the catch rates had decreased by 5%, indicating that the level of trolling lines fishing exploitation has decreased in 2005 – 2012. The decrease of the catch trends could indicate that the trolling lines fishery is in a fully exploited status and if it is left unchecked will experience over exploitation or overfishing. This event is in accordance with KEP.45 / MEN / 2011 that large pelagic fish found in Fishery Management Area (FMA) 573, which includes Palabuhanratu Bay, are in fully exploited status. The status is due to the high trip by trolling lines so that the resources of large pelagic fish are decreasing in the region. The graph shows that in 2012 - 2018 the catch rate trend had increased by 7%, which can be used as an indication that trolling lines fishing in that period was at a developing stage. The trend that shows the stages of development must be carried out management of fish resources through trolling fishing gear.

CONCLUSIONS

The value of CPT for 14 years (2005 - 2018) in the Port of Palabuhanratu showed fluctuated trendlines, in one period decreased while in the other period.
increased. The increase and decrease in CPT value are influenced by trips and total catch.

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