



**Real-time recruitment monitoring for Pacific bluefin tuna
using CPUE for troll vessels:**

Update up to 2019 fishing year

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Summary

Japan has conducted a real-time monitoring of the CPUE from troll fisheries for strengthening the recruitment monitoring to comprehend the trend of most recent recruitment of Pacific bluefin tuna in a timely manner. The operation and catch information are recorded by data logger equipped on fishermen's boats participating the survey. These data are sent to the National Research Institute of Far Seas Fisheries (NRIFSF) on a real-time basis. The catch data per day by each boat were used as nominal CPUE and those were standardized for two regions, East China Sea and Pacific side, as recruitment abundance, respectively. This paper shows updated results up to 2018 fishing year in East China Sea and up to 2019 fishing year in Pacific side. The result in East China Sea showed that the level of recruitment in 2018 fishing year was less than that in 2017 but were higher than historical averages. The result in Pacific showed the levels of recruitment in 2019 fishing year was higher than that in 2018 fishing year and point estimation was the highest level throughout period of this survey. These results were published on the Japan Fisheries Agency's website in a timely manner.

Introduction

The current stock assessment of Pacific Bluefin Tuna (PBF) uses standardized CPUE of Japanese troll fisheries, which operate in the East China Sea (off the west coast of western Kyusyu), as an index of recruitment (ISC 2016, ISC 2018). This CPUE is based on the sales slips and as it uses annual data, the index in most recent year is not available until October of the following year. Additionally, there is no information about zero-catch trips in the sales slip. Under these situations, ISC recommended strengthening the monitoring of recruitment to comprehend the trend of recruitment in a timely manner (ISC 2013).

Japan has initiated a real-time monitoring of the operations of the troll fisheries in 2011 and has collected catch data per day from fishermen's boats participating in the survey. CPUE were calculated as catch in number per day and were standardized. The standardized CPUE could represent the level of recruitment of PBF in the most recent year. The result has been published on the Japan Fisheries Agency's web-site. The information in the recent year were published for East China Sea in May 2019 and for Pacific side in November 2019, respectively.

Materials and Methods

The troll fisheries in Japan, which target age-0 PBF individuals, were operated mainly in coastal water of western Japan. Some of these fisheries harvest PBF for farming pen soon after the hatching, when PBF reaches around 20-30 cm in fork length. Depending on fishing grounds and period, the spawning ground where the targeted PBF by troll fishery was spawned can be distinguished. It is known that

spawning in Nansei-islands area occurs in May to July while in the Sea of Japan in July to August. Age-0 PBF hatching around Nansei-islands are caught in East China sea and in the Pacific side during summer. On the other hand, age-0 PBF hatching in Sea of Japan are caught in off the coast of Oki islands. These two fisheries can be assumed to represent the trend in recruitment from the main two spawning grounds. Additionally, in winter season, troll fishermen target bigger size age-0 PBF, around 30-50 cm, for fresh market. This kind of fishery operates mainly in western side of Japan, especially in East China Sea. This fishery in East China Sea can be regarded as perspective of whole recruitment index other than that estimated by sales slips.

National Research Institute of Far Seas Fisheries (NRIFSF), Japan, introduced recruitment monitoring system, which can collect operations and catch data in a timely manner from these three troll fisheries in Pacific side in July to August, in the Sea of Japan in September to November and in East China Sea in November to following February since 2011 (Fig. 1). A previous document for this monitoring survey (Tsukahara and Chiba, 2019) described results until recruitment level in the Sea of Japan in 2018 fishing year. This document presents two latest results reported after last working group, recruitment levels in East China Sea in 2018 and in Pacific side in 2019.

The data logger and transmitter are equipped on fishermen's boats participating in this survey. The fishermen input the number of caught PBF into data logger during the fishing operation. The catch information together with geographical position data are sent to the NRIFSF via cellular network in real-time. The received data are gathered as catch data per day and are analyzed for standardization in NRIFSF. The standardizations were conducted by zero inflated negative binomial GLM model. The best models were determined by the Bayesian information criterion (BIC). The candidate explanatory variables used for standardization were bellow;

- **Year:** 9 fishing years for Pacific side and 8 fishing year for East China Sea
- **Season:** 4 half-months in July to August for Pacific side, 4 months in November to February for East China Sea.
- **Block:** Rough distinction of operation site, 2 blocks only for Pacific side (Western coastal water of Kyusyu island and Southern coastal water of west Japan)
- **Area:** Fine distinction of operation site, 6 areas for Pacific side: Around Tsushima Island, Around Goto Islands, Bungo Channel, Tosa Bay, Kii Channel and Kumano-nada, and 2 areas for East China Sea: Tsushima and Goto island.
- **Prefecture:** 5 Prefectures for Pacific Side where fishermen belong (Nagasaki, Miyazaki, Kochi, Wakayama and Mie).

Results and Discussion

Figure 2 shows the both standardized CPUEs. The index in East China Sea at 2018 fishing year was higher than the historical averages while it was lower than that in 2017. However, the confidence intervals in recent years were wider than the previous ones, especially in 2017 fishing year. This was caused by artificially suspended catch due to catch limitation and/or low demand from fish farms. In 2017 fishing year, the Japan Fishery Agency requested the self-regulation for small fish on January 23th 2018, and operations in 2017 fishing year were ended on that day.

An index in Pacific side at 2019 fishing year was the highest level through the period of this survey. The number of catch and efforts in Pacific side increased until 2015 because of increasing cooperating fishermen, but those were low and decreasing since 2016, while the number of cooperating fishermen is stable (Fig. 3). This is because of low demand rather than catch limitation. In recent years, the demand for farming pen caught by troll is sharply dropping all over Japan due to increasing supply for pens from another fishery. As a result, some of cooperating fishermen participating in monitoring programme have not operated for farming pens recently.

The recruitment index updated up to 2018 fishing year (Nishikawa et al., 2019) showed recruitment levels in 2017 and 2018 was less than historical average from 1980 and considerably lower than that in 2016, which is inconsistent with the real-time monitoring CPUEs presented here. The recruitment index in the assessment uses different data source; it is based on information from sales slips. All of the indices are apparently affected by artificial restraint, therefore the standardized CPUEs using fishing data need to be interpreted carefully.

Conclusion

The recruitment levels of PBF were estimated using the standardized CPUE of troll fisheries which target 0-age PBF from two spawning areas respectively. The values of point estimation in East China Sea at 2018 fishing year and in Pacific Side at 2019 fishing year were both higher than respective historical average. On the other hand, the limited amount of data due to some management factors, such as catch limit, lead to the increase of uncertainties in standardization, thus recruitment levels should be monitored continuously with multiple information, such as sales slips and catch at age data.

References

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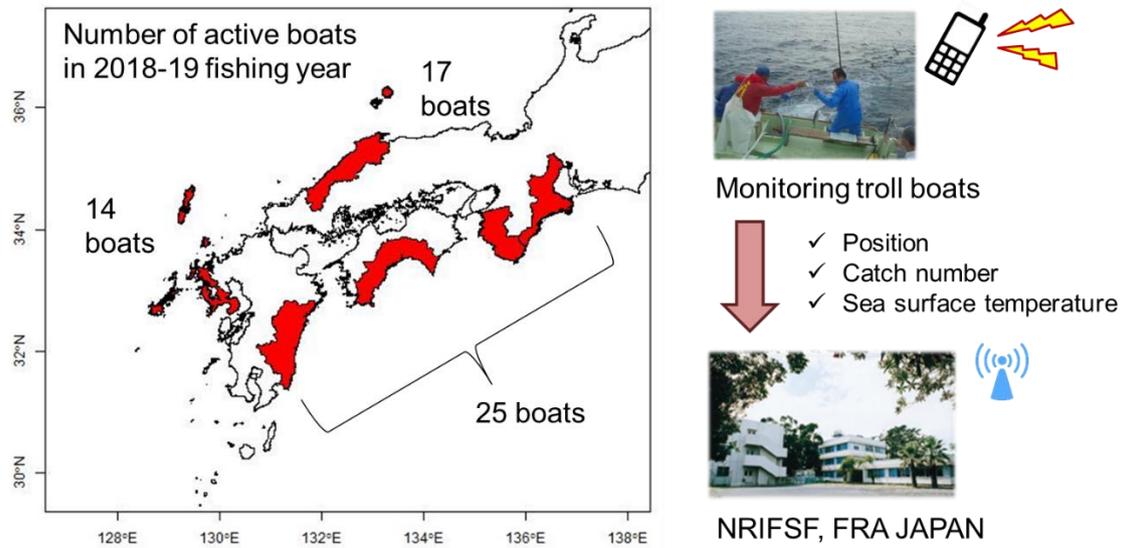


Fig. 1 Concept of Japan's real-time recruitment monitoring in 2018-2019 fishing year.

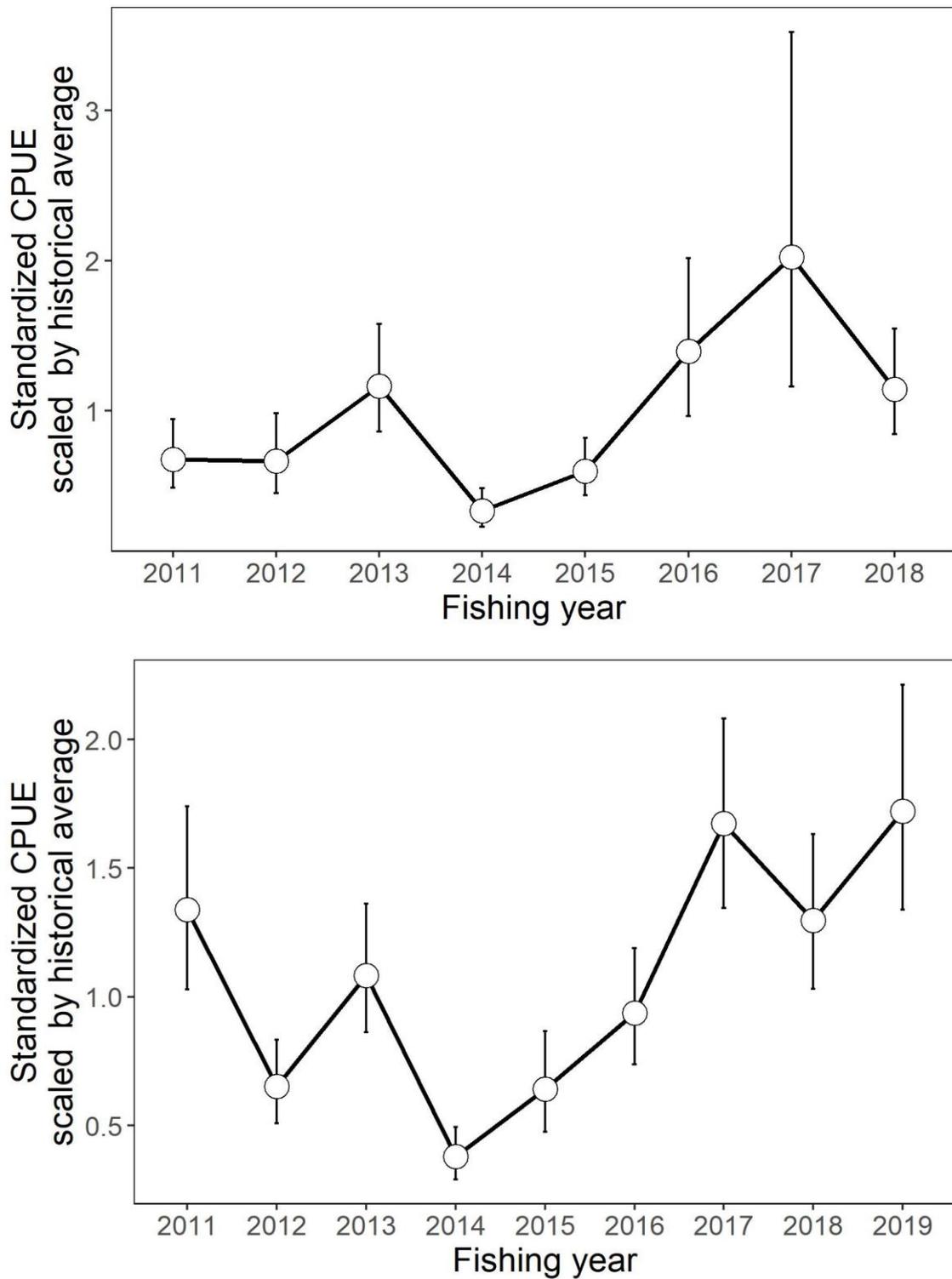


Fig. 2 The standardized CPUE in East China Sea (Upper) and Pacific side (Bottom).

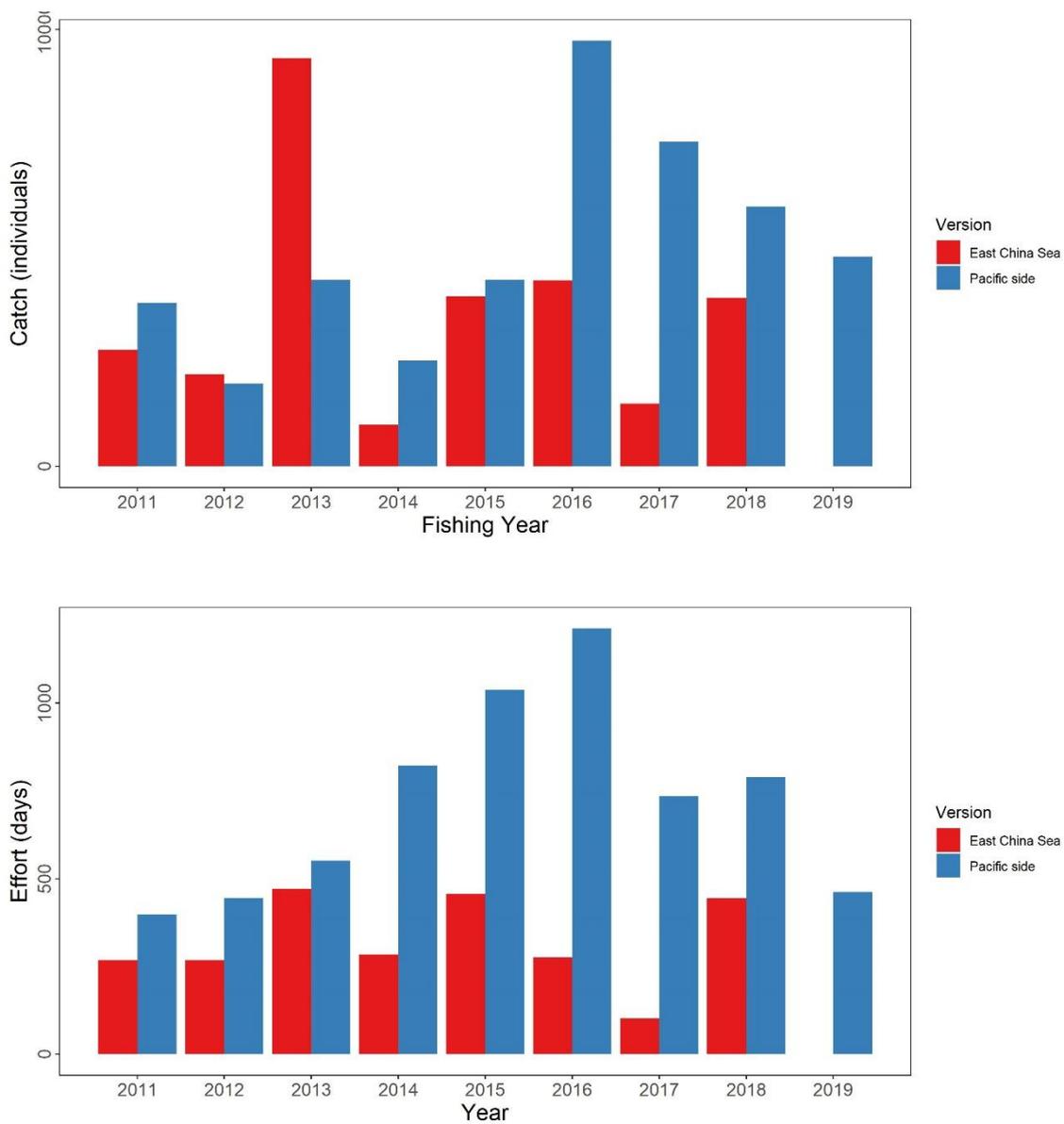


Fig. 3 Annual change of the number of catch (Upper) and operation days (Lower) for vessels participating the survey.