



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

**Yohei Tsukahara, Osamu Sakai,
Kazuhiro Oshima and Shuya Nakatsuka**

National Research Institute of Far Seas Fisheries,
Japan Fisheries Research and Education Agency
5-7-1, Orido, Shimizu-ku, Shizuoka 424-8633, JAPAN

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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, Pacific side and Sea of Japan, respectively. The both results of standardization show the levels of recruitment in 2017 were above those in 2016. These results were published on the Japan Fisheries Agency's web-site.

Introduction

The current stock assessment of Pacific Bluefin Tuna(PBF) uses standardized CPUE of Japanese troll fisheries, which operate in the East China Sea (coastal waters of western Kyusyu), as an index of recruitment (ISC 2016). This CPUE was based on the sales slips. As it uses annual data, the data in most recent year is not available until October of following year of recruitment. Additionally, there is no information about zero-catch trips in the sales slip. Under these situation, ISC recommended the 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 the survey. These CPUE data were standardized. These standardized CPUE could represent the level of recruitment of PBF in most recent year. The result has been published on the Japan Fisheries Agency's web-site. The information in most recent year (2017) was published for Pacific side and Sea of Japan in October and December 2017, respectively.

Materials and Methods

The troll fisheries in Japan, which target age-0 PBF individuals, were operated in coastal water of western Japan. These fisheries could be classified into two operations, Pacific side and Sea of Japan, due to two spawning grounds of PBF, Nansei-islands in May to July and Sea of Japan in July to August. National Research Institute of Far Seas Fisheries (NRIFSF), Japan, introduced recruitment monitoring system, which could collect operation and catch data in a timely manner on these two troll fisheries at Pacific side in July to August and at Sea of Japan in September to November. (Fig. 1)

The data logger and transmitter are equipped on fishermen's boats participating the 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 negative binomial GLM model, but zero inflated model was applied to the standardization of Pacific side due to high ratio of zero catch trips in raw data. The best models were determined by the Bayesian information criterion (BIC). The candidate explanatory variables used for standardization are bellow;

- **Year:** 7 calendar years for Pacific side, 5 calendar years for Sea of Japan
- **Season:** 4 half-months in July to August for Pacific side, 3 months in September to November for Sea of Japan.
- **Block:** Rough distinction of operation site, 2 blocks for only 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 Sea of Japan: Douzen-area and Dougo-area.
- **Prefecture:** 5 Prefectures where fishermen belong (Nagasaki, Miyazaki, Kochi, Wakayama and Mie).

Results

Figure 2 shows the both of standardized CPUEs. In 2017 the indices are higher than the levels in each observation period. Especially in the Sea of Japan, the value of point estimation was much higher level than what we observed. However, the confidence interval in 2017 was quite wide. This uncertainty was caused by artificially restrained catch due to catch limitation and/or low demand from fish farms. The recruitment index to be used in current stock assessment (Fukuda 2018) shows recruitment level in 2016 was higher than historical average in assessment period. In fact, the number of operation days has decreased in spite of relatively the high number of catch (Fig. 3). These results from real-time monitoring indicate that most recent year's (2017) recruitment level could be higher than that of 2016.

Conclusion

The recruitment levels were estimated using the standardized CPUE of troll fisheries which target 0-age PBF from two PBF spawning area respectively. As a result, the values of point estimation were both higher than last year and observation periods. On the other hand, the limited number of data by 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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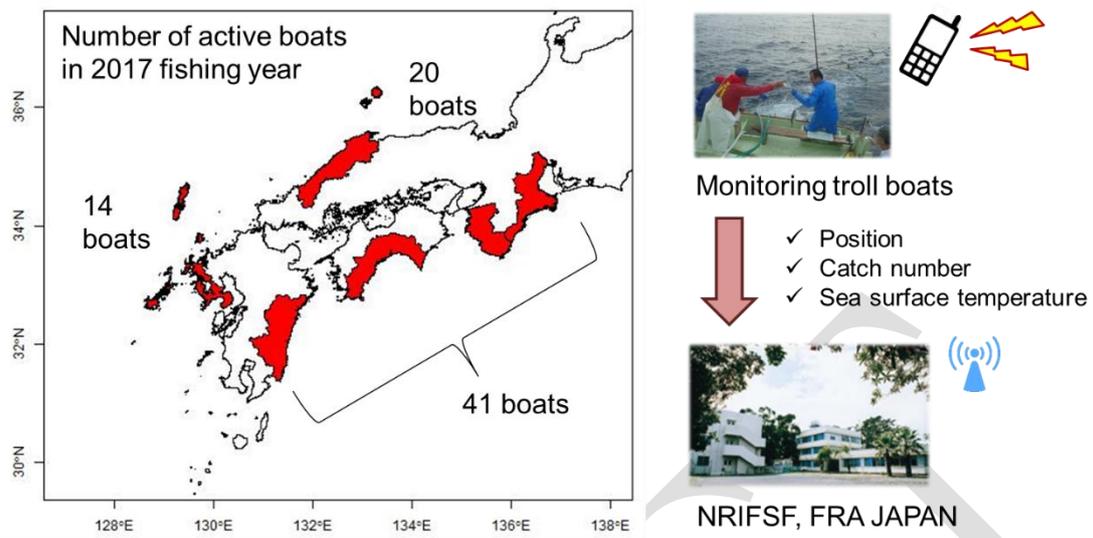


Fig. 1 Concept of Japan's real-time recruitment monitoring in 2017.

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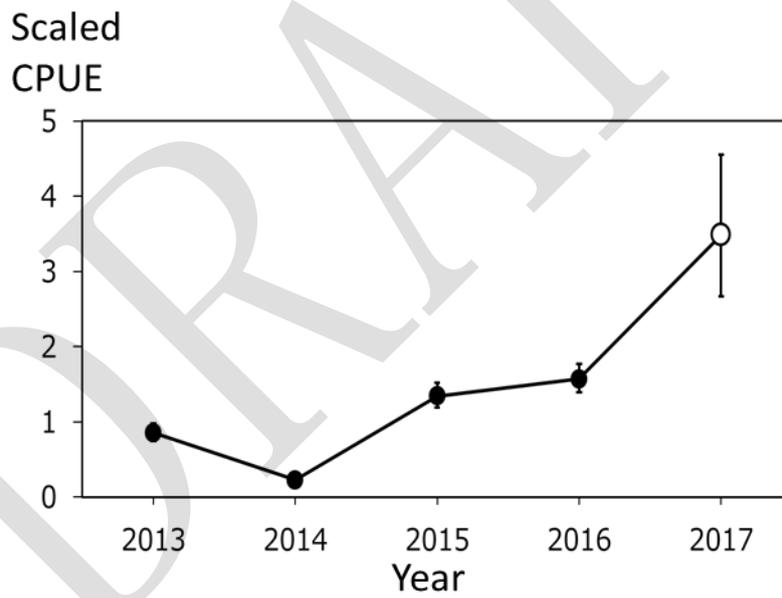
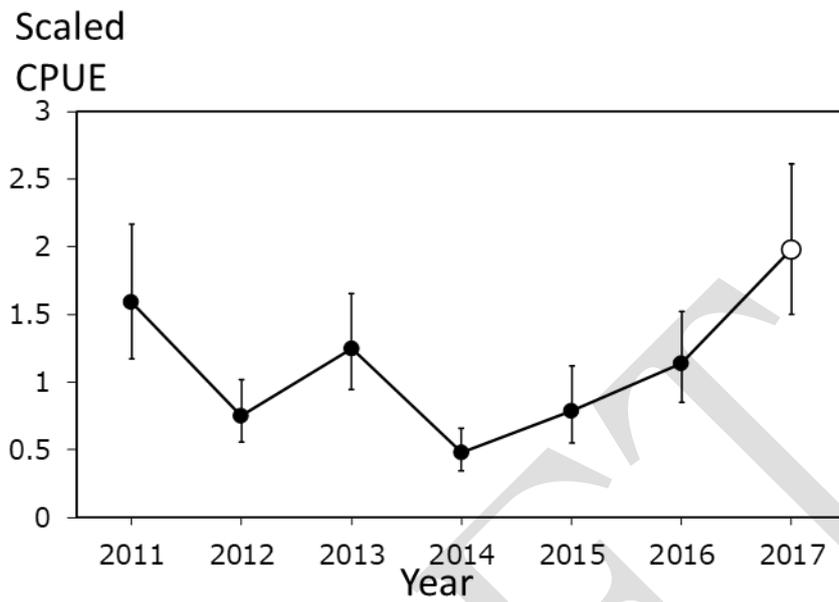


Fig. 2 The standardized CPUE in Pacific side (Upper) and Sea of Japan (Bottom).

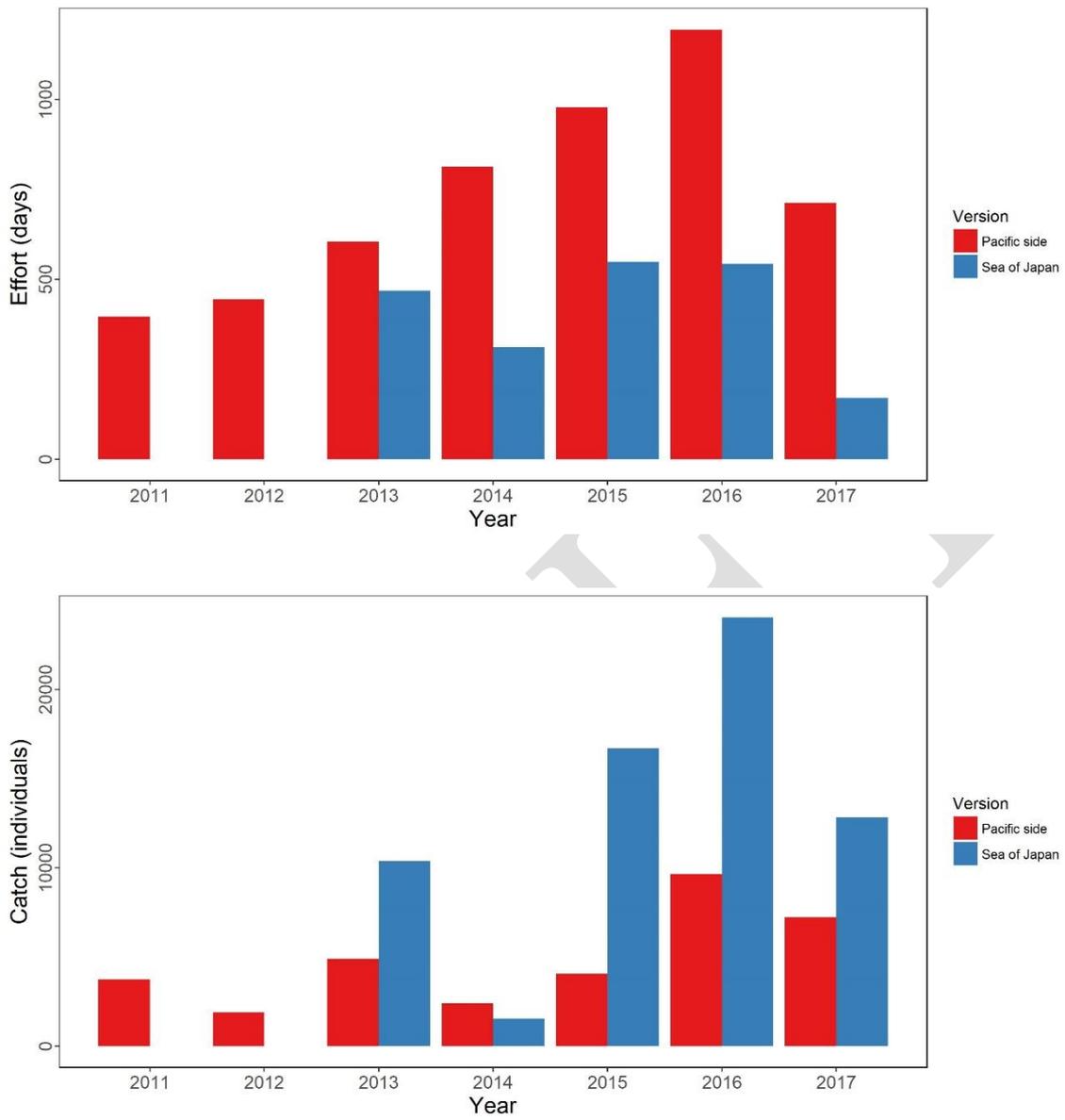


Fig. 3 Annual change of the number of catch(Upper) and operation days(Lower) for vessels participating the survey.