Real-time recruitment monitoring for Pacific bluefin tuna using CPUE for troll vessels: Update up to 2020 fishing year

Ko Fujioka, Yohei Tsukahara, Saki Asai, Kirara Nishikawa,

Hiromu Fukuda and Shuya Nakatsuka

Highly Migratory Resources Division, Fisheries Resources Institute,

Japan Fisheries Research and Education Agency

5-7-1, Orido, Shimizu, Shizuoka 424-8633, JAPAN

December 2021

Working document submitted to the ISC Pacific bluefin tuna Working Group, International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), from 14 to 17 and 21 December 2021, Webinar.

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 Japan Fisheries Research and Education Agency (FRA) on a real-time basis. This paper shows a simply updated recruitment index standardized by the GLM with the data up to 2020 fishing year operated in East China Sea during winter season. The index at 2020 fishing year was slightly higher than the historical averages and the 2019 index. However, the recruitment information after 2017 fishing year might have been affected by fishing regulations. It is necessary to further consider standardization methods to account a decrease of fishing area, operations and so on., in order to correctly interpret the recent trends of recruitment. To deal with the possible effect of the fishing regulation, FRA has started an additional survey to get the data from all recruitment monitoring vessels by chartering their operations every month since 2021.

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, ISC 2020). 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. This document provides updated the recruitment information in the East China Sea during the winter season until the 2020 fishing year.

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.

The FRA 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 East China Sea in 2019 fishing year. This document presents the latest results to 2020 fishing year for updated information using the same GLM method.

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 FRA via cellular network in real-time. The received data are gathered as catch data per day and are analyzed for standardization in the FRA. 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**: 10 fishing years from 2011 to 2020 fishing year
- **Season**: 4 months in November to following February
- **Area**: Fine distinction of operation site, 2 areas in the East China Sea: Tsushima and Goto island

Results and Discussion

Figure 2 shows the standardized CPUEs estimated GLM model using real-time monitoring data, which operated in the East China Sea during the winter season. The index at 2020 fishing year was slightly higher than the historical averages and the 2019 index. However, the 95% confidence intervals in recent years since 2017 were wider than those previous ones. This was caused by artificially suspended catch due to catch limitation and/or low demand from fish farms. Especially 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.

Compared to traditional recruitment indices based on sales slip data (Nishikawa et al. 2021), the trend of the indices after the 2017 fishing season is largely different. The traditional recruitment index for 2018 is below the historical average from 1980 and much lower than for 2016, which is inconsistent with the estimated CPUE for real-time monitoring basis. Data source based on sales slip information do not include the number of live-released individuals that are not landed, which may be one factor in the underestimation of catch. Since recruitment abundance information based on real-time monitoring data could be used as an alternative sales slip data, additional information should be further assess in PBF WG meeting, including the application of spatio-temporal delta generalized liner mixture modeling techniques.

Also, FRA has started to an additional survey of a real-time monitoring vessels in 2021 by chartering all monitoring vessel for 10 operational days, so that information of more than 100 operational days could be collected in additional to the usual operations. Those chartered operations were independent from the fishery management by the local government, so the catch during the chartered operations could be included as a part of the quota for research of FRA, which is allowed by the national government. We believe this kind of additional survey data contributes to higher spatial and temporal data coverage than the recent years.

References

Nishikawa, K., Tsukahara, Y., Fujioka, K., Fukuda, H. and Nakatuka, S. 2021. Updated of Age-0 index based on catch per unit effort data from Japanese troll fishery and its associated issues. ISC/21/PBFWG-01/05.

Tsukahara, Y. and Chiba, K. 2019. Real-time recruitment monitoring for Pacific bluefin tuna using CPUE for troll vessels: Update up to 2019 fishing year. ISC/19/PBFWG-2/12.

ISC 2013. ISC13 Plenary. Report of the Pacific bluefin tuna working group workshop. 68p.

ISC 2016. 2016 Pacific bluefin tuna stock assessment. Report of the Pacific bluefin tuna working group. 140p.

ISC 2018. Stock assessment of Pacific bluefin tuna (*Thunnus orientalis*) in the Pacific Ocean in 2018. Report of the Pacific bluefin tuna working group. 154p.

ISC 2020. Stock assessment of Pacific bluefin tuna in the Pacific Ocean in 2020. Report of the Pacific bluefin tuna working group. 156p.
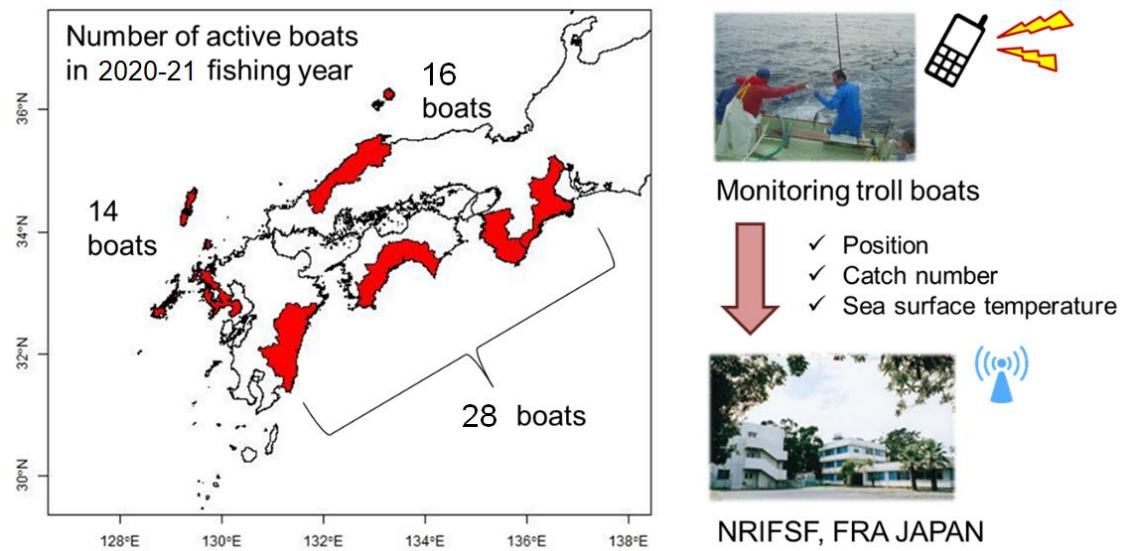
Figure 1 Concept of Japan's real-time recruitment monitoring in 2020-2021 fishing year.
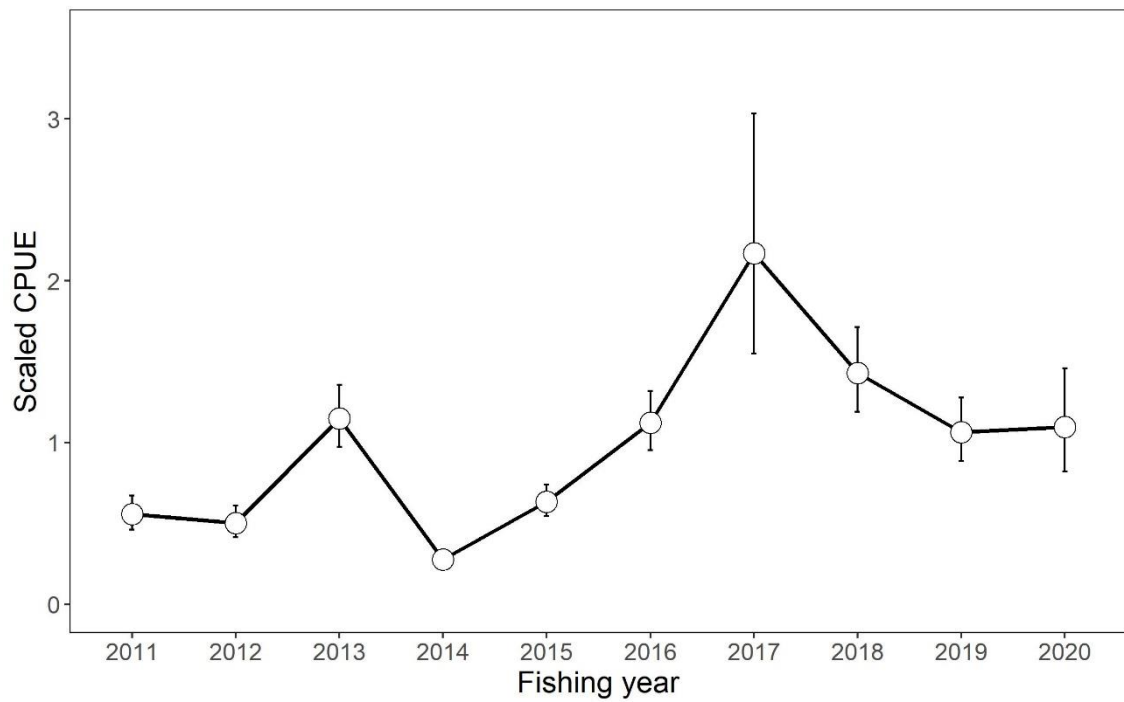
Figure 2 The standardized CPUE using real-time troll monitoring data in the East China Sea during the winter season, scaled by historical average. The open circles indicate estimates with 95% confidence intervals.
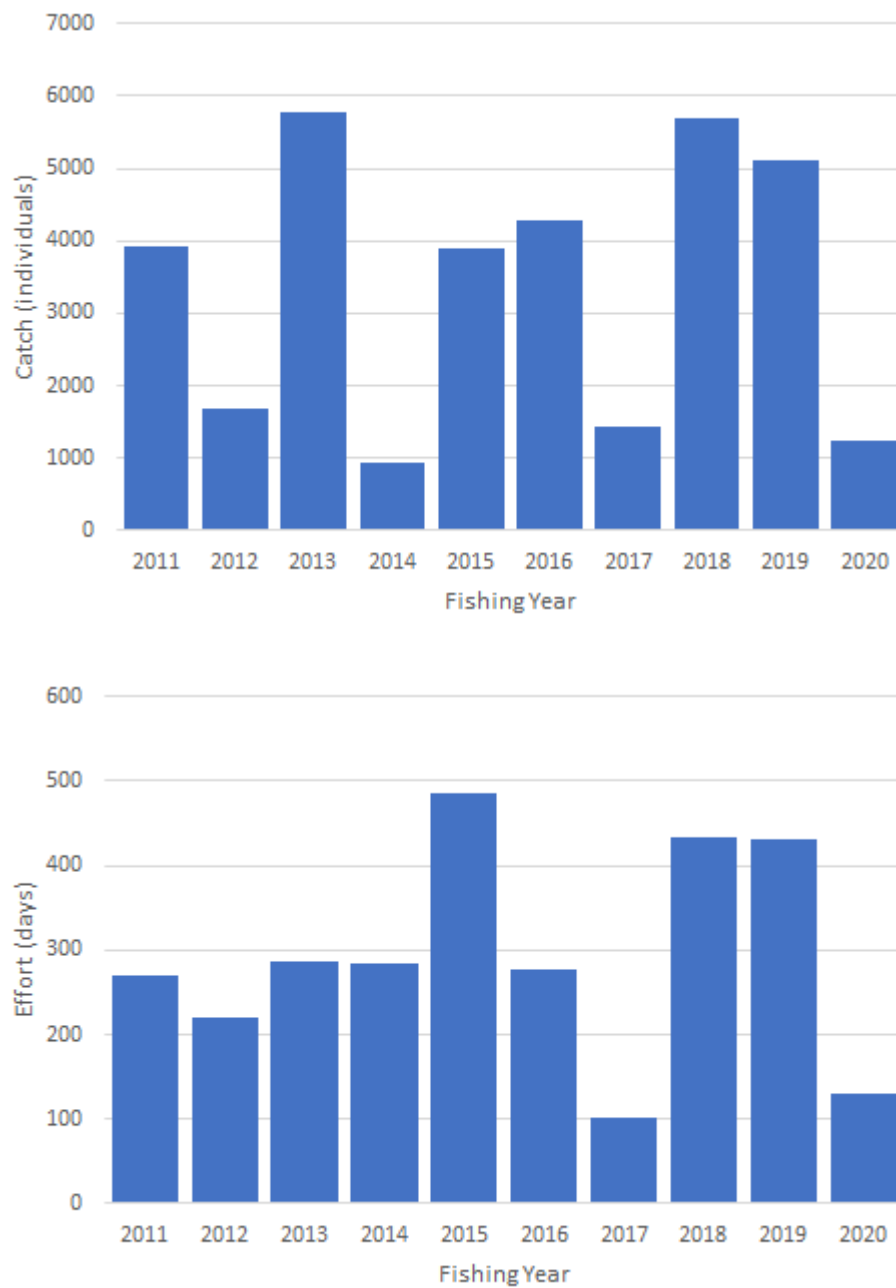
Figure 3 Annual change of the number of catch (Top) and operation days (Bottom) for vessels participating the real-time monitoring survey in the East China Sea.