Western and Central Pacific Fisheries Commission

SCIENTIFIC COMMITTEE
TWENTIETH REGULAR SESSION

Manila, Philippines
14 – 21 August 2024

Towards continuous monitoring of the echo-sounder buoy attached to AFADs around Japanese coastal areas

---

WCPFC-SC20-2024/EB-IP-12

Naoto Matsubara, Makoto Nishimoto, Yoshinori Aoki, and Yuichi Tsuda
Fisheries Resources Institute, Japan Fisheries Research and Education Agency, Japan

Towards, continuous monitoring of the echo-sounder buoy attached to AFADs around Japanese coastal areas

Naoto Matsubara, Makoto Nishimoto, Yoshinori Aoki, and Yuichi Tsuda
Fisheries Resources Institute, Japan Fisheries Research and Education Agency, Japan

Executive summary

This document provides the preliminary results of the methods for protecting the echo-sounder buoys attached to Anchored FADs (AFADs). The following methods of protecting the buoys were conducted; (1) shock-absorbing material for fishery is strapped to the buoy, (2) a donut-shaped shock-absorbing material specially designed and custom-made for the buoy is attached to the top of the buoy, and (3) the custom-made shock-absorbing material is attached to both the top and the bottom of the buoy. As a result, the method that protects both the top and the bottom of the buoy succeeded in measuring long-term data for a maximum of six months or longer. These results would potentially contribute to the continuous monitoring of echo-sounder buoy attached to AFADs.

Introduction

Echo-sounder buoys with Fish Aggregating Devices (FADs) can remotely monitor the estimated biomass of tuna species aggregating around them. Those data enable fisher man to select optimal fishing grounds, contributing the efficiency of fisheries. Recently, there have been efforts to develop abundance indices for stock assessments (ICCAT 2022; Bi et al., 2024).

The northern limit of the distribution for tuna species located around off Japan areas (Kiyofuji et al., 2019), hence this area is crucial for capturing shifts in their range contraction (Kiyofuji et al., 2014). Several anchored FADs (AFADs) have been deployed along coastal areas of Japan for small scale fisheries such as trolling and pole-and-line fishery. Attaching echo-sounder buoys to these AFADs can not only enhance the efficiency of coastal fisheries but also provide continuous data on the abundance and distribution changes of tuna species migrating to costal area of Japan over extended periods.

As the preliminary experiment, echo-sounder buoys were attached to AFADs around the coast of Japan to monitor tuna aggregation. However, it was difficult to obtain data because of the damage of buoys occurred due to collisions between the echo-sounder buoys and the AFADs. This document discusses methods to protect echo-sounder buoys for long-term monitoring. .

Methods and Material

Echo-sounder buoy (ELB3010 ISD+, Satlink Inc., Spain) was attached to 5 AFADs located around off coastal areas in Japan (one off Miyazaki Prefecture, two off Kochi Prefecture and two off Wakayama Prefecture, **Fig 1**) from November in 2021 to July in 2024. The five AFADs were of two main shapes in this study, one elliptical and the other circular. The elliptical type is equipped with the bumper behind the AFADs, and the circular type is equipped with a mooring pit for towing AFADs. The elliptical type is equipped with a bumper behind the FADs and the circular type with a towing mooring pit on land, and the echo-sounder buoys were moored by tying a rope to the bumper or pit respectively using abrasion resistant rope (Hi-Techron Rope, TEZAC Inc.) (Fig. 1 (c)). When mooring, the rope was passed directly through the hole at the bottom of the echo-sounder buoy without any metal hooks to avoid wear of the buoy hole due to friction (Fig. 1 (c)). The length of the rope between each echo-sounder buoys and the AFAD was adjusted to be 2-3 m so as not to interfere with the trolling fishery around the FAD. To avoid damage of buoy by collisions to AFADs, the methods of fixing metal rods between the AFADs and the echo-sounder buoys was considered, but as the AFADs themselves tilt with waves, the echo sounder buoys attached to the metal rods would sink into the sea or float above the sea surface, affecting the measurement of acoustic data. Therefore, the rope mooring was judged to be the best way to for attaching echo-sounder buoy on AFADs in this study. The echo-sounder buoys were tested for endurance using the following three types of protection.

(1) Type 1: Protecting by the shock-absorbing material for fishery to the buoy

The echo-sounder buoy was protected by the fishery buffer material is strapped to the buoy mooring with abrasion resistant rope (**Fig. 2** (a)). The shock-absorbing material was EVA float (TWE10, INTERCOM MARINE Inc.) which used for the protects the hull of a vessel by placing it between the vessel and the quay when anchored. 8 buffer material were roped to the sides of the buoy to provide protection around the buoy (Fig. 2 (a)).

(2) Type 2: Protecting by the custom-made shock-absorbing material attaching the top of the buoy

The method in which a donut-shaped shock-absorbing material specially designed for the buoy is custom-made and attached to the top of the buoy. The shock-absorbing material was made of a high foam content material and custom-made by OHNISHIKASEI Co.,Ltd to fit over the top of the echo-sounder buoy (Fig 2 (b)). The shock-absorbing material and buoys were joined by underwater epoxy to fill the gaps.

(3) Type 3: Protecting by the custom-made shock-absorbing material attaching the top and bottom of the buoy

The shock-absorbing material used in Type 2 was also bonded to the lower part of the buoy. The method of bonding the buffer material to the buoy was the same as in Type 2, using underwater epoxy.

Echo-sounder buoys transmit data in real time via satellite as long as the buoy is not damaged or the batteries run out. For each protection type, the transmission period of satellite buoy data was extracted and compared as the period until damage. In addition, poor data transmission due to dead batteries was determined based on the buoy's remaining battery charge status using the software for monitoring buoys (ELB3010 Maneger, Satlink Inc.). Note that some buoys were early recovered before damage, due to the memorandum of understanding on the contractual period for the use of AFADs with the prefecture.

Results

The period of data measurement in each protection type is shown in **Table 1**. Type 1 was an average duration of 32.8 ± 5.4 days, Type 2 had an average duration of 37.3 ± 19.6 days and Type 3 had the longest duration with an average of 175.4 ± 92.4 days. The damaged part of buoys were shown in Fig 3. Damage of buoys were observed mainly on the upper side of the buoy for Type 1 (**Fig. 3**(a)). For Type 2, the damage were also observed around the upper side of the buoys, as well as loss of buffer material (Fig. 3(b)). Type 3, which was recovered in the middle of data measurement, showed damage to the shock-absorbing material itself and loss of the shock-absorbing material attached to the lower part of buoys, but no major damage to the buoy itself.

Discussion

The results of the data acquisition period showed that Type 3 succeeded in obtaining data for the longest period over the half of year. However, it should be noted that in Kochi Prefecture, for example, data was not collected more than six months using any of the protection types, which may be due to different ocean environmental conditions from other areas.

The damage part of Type 1 was mainly damaged on the upper part of the buoy sides (Fig. 3 (a)). Based on the damage situation, it is considered that in Type 1, the gap between the buffer material and the buffer material collided with the AFADs, causing the damage. For Type 2, damage due to detachment of the shock-absorbing material was observed, while for Type 3, the shock-absorbing material around lower part of buoy was detached, but the buoy was less damaged. It is considered that the attachment of two shock-absorbing materials, as for Type 3, mitigated the impact of the impact on the upper part of the buoy and protected the buoy.

In this document, preliminary results of the buoy endurance tests are reported. To achieve long-term monitoring by the echo sounder buoy attached to AFADs, protection of buoy should be considered, which would lead to improve the efficiency of coastal fisheries.

Reference

Bi, R., Maunder, M., Xu, H., Minte-Vera, C., Valero, J., and Silva, A. (2024) Stock Assessment of skipjack tuna in the eastern Pacific Ocean : 2024 benchmark assessment. SAC-15-04 in https://www.iattc.org/GetAttachment/f57dece1-81ba-4771-8fa8-3362320a368a/SAC-15-04_Skipjack-tuna-benchmark-assessment-2024.pdf

Escalle, L., Hare, S.R., Vidal, T., Brownjohn, M., Hamer, P., Pilling, G., 2021. Quantifying drifting Fish Aggregating Device use by the world's largest tuna fishery. ICES J. Mar. Sci. 78, 2432–2447.

ICCAT (2022). Report of the 2022 ICCAT skipjack tuna stock assessment meeting., (online, 23-27 May 2022).

Kiyofuji, H., Ashida, H., Sugimoto, M., Horii, Y., & Okamoto, H. (2014). Abundance of skipjack migrating to the Pacific coastal water of Japan indicated by the Japanese coastal troll and pole-and-line CPUE. WCPFC-SC10/SA-WP-10.

Kiyofuji, H., Aoki, Y., Kinoshita, J., Okamoto, S., Masujima, M., Matsumoto, T., Kitagawa, T., et al. (2019). Northward migration dynamics of skipjack tuna (Katsuwonus pelamis) associated with the lower thermal limit in the western Pacific Ocean. Progress in Oceanography, 175, 55-67.

Mourot, J., Escalle, L., Thellier, T., Lopez., J, Bigler, B., Winchman, J. PNA office et al., 2022. Analyses of the regional database of stranded drifting FADs in the Pacific Ocean - WCPFC-SC19-2023/EB-WP-04 28 July 2023.in https://meetings.wcpfc.int/node/19394.

Williams, P., Ruaia, T., 2023. Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions -2022 -WCPFC-SC19-2023/GN WP-1. WCPFC.

Table 1 Summary of endurance test in each type for protection.

	The number of deployment			The number of dameged buoy	Data period (Days)
	Kochi	Miyazaki	Wakayama		
Type 1			4	2	32.8 ± 5.4
Type 2	2	1		2	37.3 ± 19.6
Type 3	2	1	2	2	175.4 ± 92.4

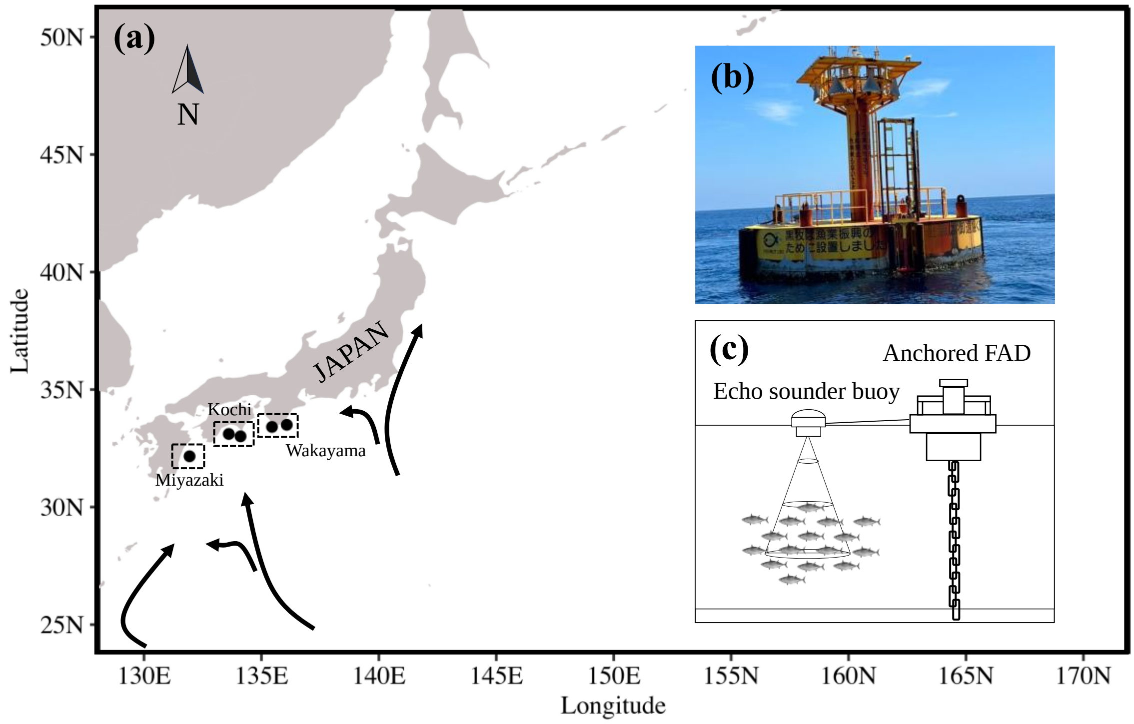

Figure 1 Locations of AFADs where the trial of protecting the echo-sounder buoys was conducted (a). Black circle and arrow indicate the location of AFADs around costal area of Japan and the potential migration route for skipjack (modified from Kiyofuji et al., 2019), respectively. These AFADs were owed by each prefecture (b). The echo-sounder buoys were attached to each FADs by mooring abrasion-resistant rope (c).

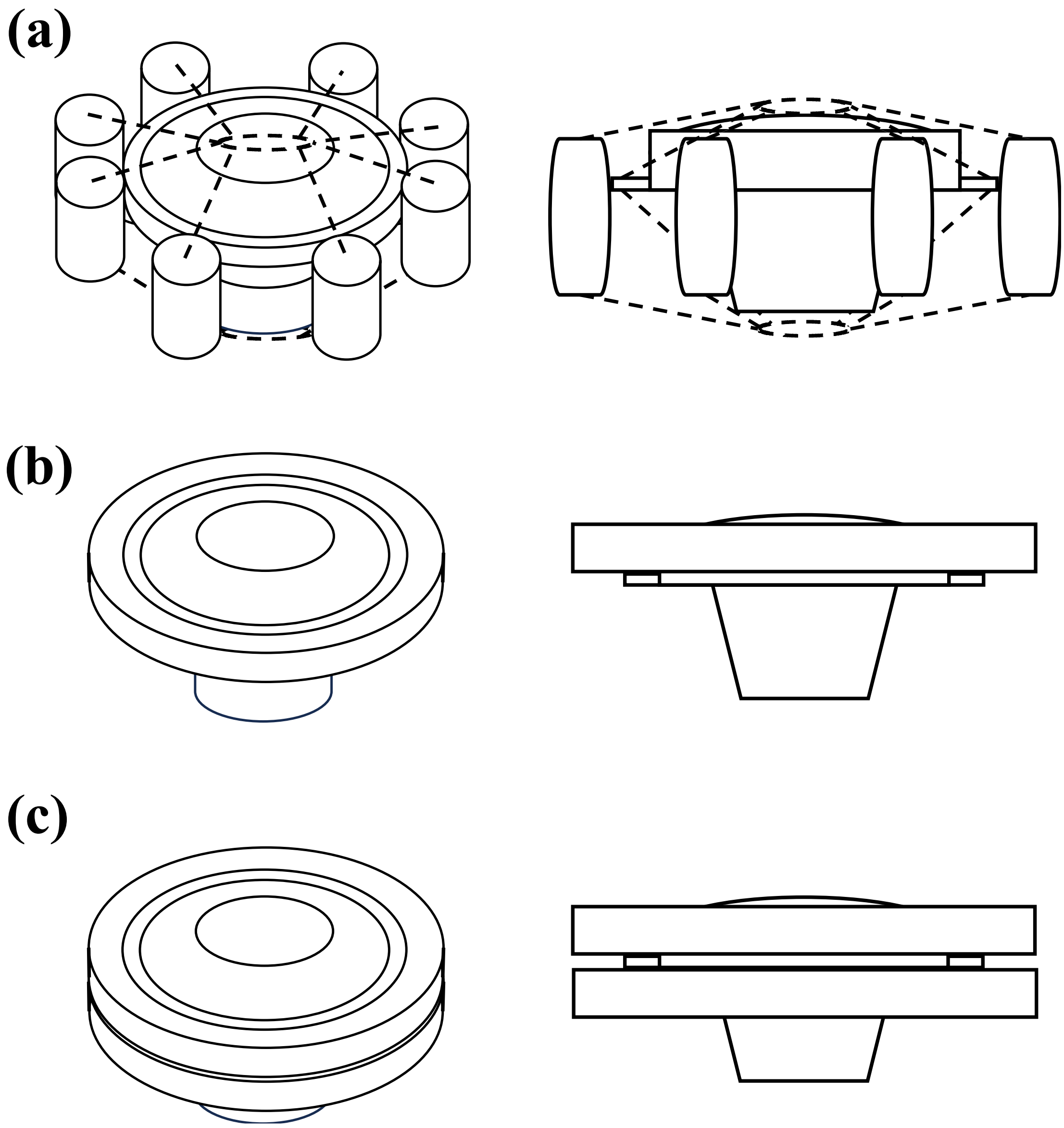

Figure 2 Top (left side) and side (right side) view of three type for the echo-sounder buoy. Type 1 is the method in which a fishery buffer material is strapped to the buoy (a), Type 2 is the method in which a donut-shaped shock-absorbing material specially designed for the buoy is custom-made and attached to the top of the buoy (b), Type 3 is the method in which the custom-made shock-absorbing material is attached to both the top and the bottom of the buoy (c).

Figure 3 The buoys in each protection type before installation (left side) and after damage right side). For Type 1, the damage around the upper side of the buoy were mainly observed (a), and for Type 2, damage around side of buoys due to shock-absorbing material falling off was also observed (b). For Type 3, damage to the shock-absorbing material itself and falling of cushioning material at the lower part of the buoy were observed, but the buoy itself was less damaged (c).