Underwater Setting Device for Preventing Incidental Catches of Seabirds in Tuna Longline Fishing

Hisaharu Sakai†, Hu Fuxiang and Takafumi Arimoto

Tokyo University of Marine science and Technology
Konan 4-5-7, Minato, Tokyo 108-8477, Japan

†Corresponding author Tel 81-3-5463-0484, Email sakai9@s.kaiyodai.ac.jp

マグロ延縄漁業における海鳥混獲防止用水中投縄機の試作

酒井久治†，胡　夫祥，有元貴文

東京水産大学海洋生産学科　〒108-8477　東京都港区港南 4-5-7
†連絡先 : Tel 81-3-5463-0484, Email sakai9@s,kaiyodai.ac.jp

Abstract

To establish measures for preventing incidental catch of seabirds in long-line tuna fishing, an underwater setting device was experimentally manufactured for testing the release of fishhooks directly into water. The present paper introduces the structure and performance of the underwater setting device and identifies issues to resolve. During cruising, the underwater setting device (overall length: 6.4 m) did not show any cycling of elevation or inclination nor any vibration at a vessel speed of 6.4 kt, fishhooks were released into the water depth of 1.3 m, 4.2 seconds after they were set in the underwater setting device. The experiment verified the effectiveness of the underwater setting device.

1. Introduction

In tuna longline fishing, seabirds may prey on bait on fishhooks and be caught incidentally. The albatross of an endangered species and the laysan albatross in the Northern Pacific fishing grounds, as well as the Wandering albatross, found in the Southern Pacific fishing grounds, are exposed to the danger of incidental catch, and necessitate the early establishment of measures against the incidental catch of seabirds. Urgent demands have been made on major tuna fishing countries, to solve this problem.

Fishhooks are cast directly onto the sea surface in conventional tuna longline fishing. Seabirds prey on bait from the time when fishhooks reach the water surface until they sink, creating the problem of incidental seabird catch. If fishhooks could be released directly under water, deeper than the diving depth of seabirds, seabirds would not be able to prey on the bait on fishhooks. This modification would resolve the problem of incidental bird catch, the underwater setting device, a concrete measure.

An underwater setting device, using a simply structured shooter-type apparatus, was experimentally created for application on the Japanese large long-liners. The present paper reports the device structure, basic performance, problems, and the possibility of implementing an underwater setting device.

2. Underwater Setting Device

The experimental underwater setting device consists of a hopper, shooter, and nozzle made of stainless steel (SUS304). **Figure 1** shows the general overview.

The hopper is conically-shaped, with the upper half removed. Bait can be set easily, and moves to the shooter smoothly. For easy bait movement in the shooter, seawater is injected from the edge of the hopper. **(Photo 1)**

The shooter's structure consists of three linked stainless steel pipes (3.2 m in length, 69 mm in diameter). Each pipe has a 9 mm-wide groove at the top, and a V-shaped cover, welded to the bottom to increase the bending strength and reduce fluid resistance. This structure allows fishhooks from the branch lines to pass through the groove and releases only baited fishhooks under water through the shooter. **(Photo 2)**

The nozzle has a simple venturi tube structure. This increases the flow rate inside the connected shooter by using absorption to help bait movement. A fin (200×200mm) is attached to the left and right sides, and to the bottom to prevent the shooter from floating during cruising or from moving to the center of the hull due to propeller current. **(Photo 3)**

The underwater setting device, assembled from these parts, is affixed to a mount installed on the bulwark. This mount has two rotation axes to allow for lengthwise and sideway inclinations of the underwater setting device. **(Photo 4)**

According to the initial plan, this underwater setting device has a length of approximately 10 m and is released to the underwater depth of 4.5 m at an elevation (angle of the shooter against the horizon) of 60 degrees and an inclination (angle of the shooter against the perpendicular) of 0 degrees.

3. Experimental Methods

The experiment was conducted at a tuna longline fishing in March, 2003 using the research and training vessel "Shinyo-maru" (gross tonnage: 649 tons, overall length: 53 m) of the Tokyo University of Marine Science and Technology.

The underwater depths of fishhooks were measured using micro-bathometers with memory (MDS-MKV/D made by ALEC Electronics in Kobe Japan, diameter: 18 mm, overall length: 93 mm, resolution: 0.05 m). The micro-bathometers were measured at a sampling frequency of 1 Hz and their underwater weights were adjusted to almost zero by attaching floats. These micro-bathometers were buried in the abdomens of the bait .

4. Experimental Results

Photo 5 shows the vessel cruising at a speed of 6 kt, before the start of line casting.

To determine the depth measurements of fishhooks, an underwater setting device with a 6.4 m long two-series shooter was used. **Figure 2** shows the results of measuring five branch lines at the cruising speed of 6 kt. The calculated underwater depth of the nozzle was 1.3 m. Time was measured from the point when the micro-bathometer reached the water surface. The underwater release of fishhooks is assumed to occur when the measured fishhooks reach the underwater nozzle depth of 1.3 m, the measured times were 4, 3, 5, 6, and 7 seconds for fishhooks, respectively, with an average of 4.2 seconds. Thereafter, the fishhooks sank while going up and down repeatedly in propeller currents. These results confirm that fishhooks are released at the underwater depth of 1.3 m.

The effectiveness of the underwater setting device was verified by this experiment because the average released time is shorter than the 8.3-second average for fishhooks to reach the underwater depth of 1.3 m without an underwater setting device.

Figure 3 compares the average water depth of fishhooks, with and without the underwater setting device. The water depth for six seconds after line casting was deeper when the underwater setting device was used than when it was not. The water depth was reversed, but the underwater setting device was verified to effectively prevent incidental catch of seabirds, as intended by this study.

4. Discussion

In the experiment, a three-series shooter with a length of 9.6 m was used first. However, the fishhooks could not be released because they exited the nozzle groove before reaching the shooter or were caught by the nozzle groove. To prevent the fishhooks from exiting the groove, stainless steel collars were attached to the fishhooks as shown in **Photo 6**. The overall shooter length was reduced to 6.4 m. In the present experiment, only a water depth of 1.3 m could be secured.

The experimental shooter-type underwater setting device could release fishhooks into a water depth of 1.3 m and was verified to be effective for the underwater release of fishhooks intended in the present study. Although the underwater setting device can still be improved, it can be utilized as a means of preventing incidental catch of seabirds.

Further examination is needed to: 1) eliminate release failures; 2) lower the underwater depth of the release; and 3) reduce the device weight. To prevent the first, attaching stainless steel collars to prevent fishhooks from detaching was effective, but further measures may be necessary. Extending the shooter seems to resolve the second issue. However, further consideration may be necessary if the release failure rate rises. To make transportation easy and each section strong, the shooter was divided and the flanges and pipes were thickened, increasing the weight. Therefore, the strength of each section should be optimized and the shooter integrated to reduce the weight to address the third deficiency.

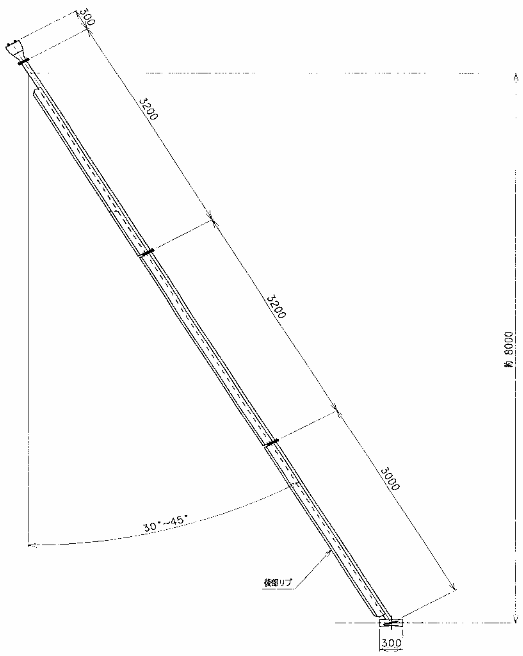

Figure 1 General overview.

Photo 1 Hopper.

Photo 2 Shooter.

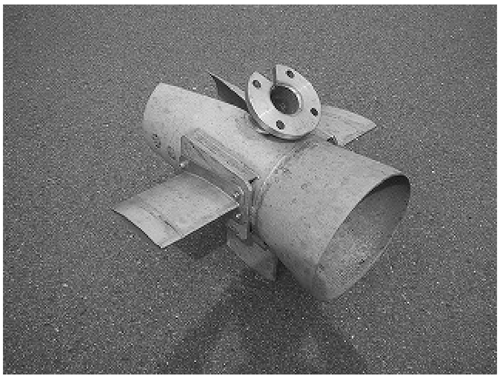

Photo 3 Nozzle.

Photo 4 Mount of underwater setting device.

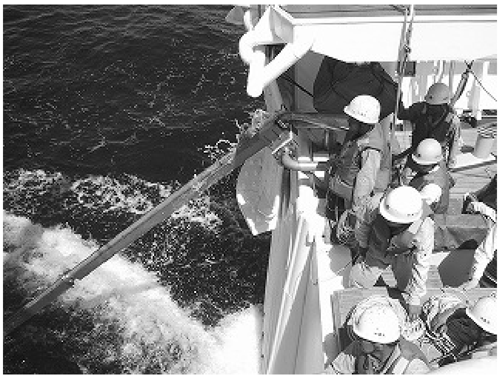

Photo 5 Operation in line casting.

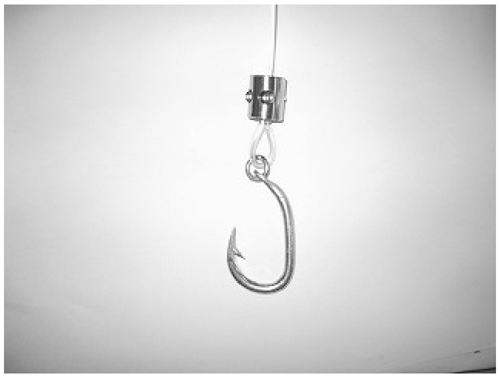

Photo 6 Measure for exiting groove.

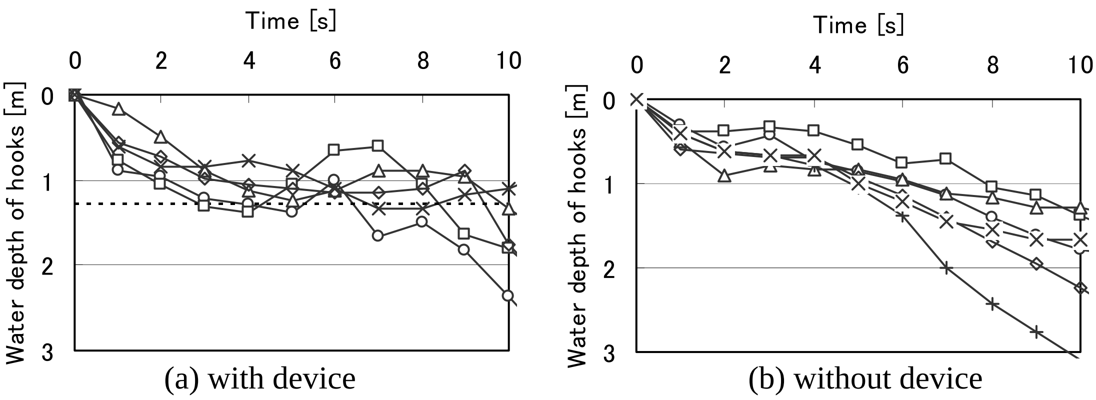

Figure 2 Results of measuring water depth on five fishhooks.

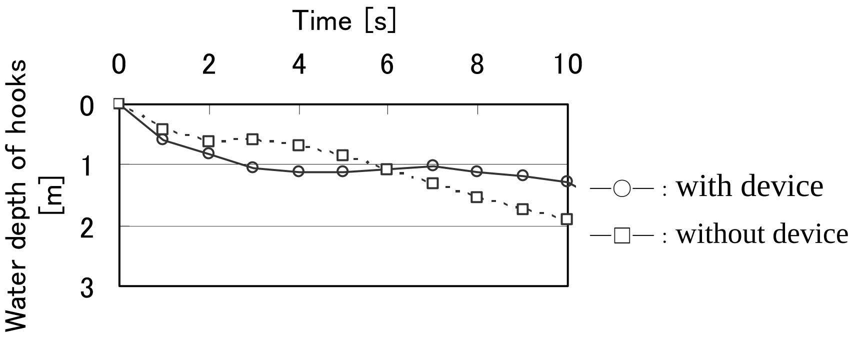

Figure 3 Comparison of the average water depth with and without the device.