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Trial Use of Artificial Bait with Tuna Longline

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Abstract

We carried out test tuna longline operations using artificial bait made from liver of Japanese common squid (*Todarodes pacificus*) in January 1998. The angling performance of artificial bait and natural bait were compared.

Tunas were caught using the artificial bait, but hooking rates were lower than two natural baits. In this paper, we discuss the effectiveness of the artificial bait.

Key words: Tuna longline, Artificial bait, Hooking rate, Liver of common squid, Unused marine resources

Introduction

According to The Annual Report on State of Fisheries, the quantity of imported tuna amounted to 310 thousand tones in 1997. And the domestic tuna fisheries caught 280 thousand tons. Many countries catch tunas for export, and Japan is biggest importing country of tuna from those counties. Tuna is not only an important food for Japanese but also an important international trade commodity throughout world. So we must draw attention to the trends of tuna resources worldwide.

While longline catch tunas, that fishing gear use a large number of angling baits, such as, squid, mackerel or horse mackerel. To save the marine resources has been required of longline fishing. The other side, the price of bait adversely affects the management of tuna longline fisheries, the longline bait is an important factor in efficient management of longline fisheries.

Large quantities of squid liver are disposed of after processing as industrial waste in Japan. From the viewpoint of conserving marine resources and making better use of unused marine resources, such as squid livers, the authors examined the suitability of artificial bait made from the liver of Japanese common squid *Todar-*

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odes pacificus.

Test operations were performed to compare the effectiveness of artificial bait with that of natural bait. We discuss the effectiveness of the artificial bait, and the hooking rate of artificial bait is compared to those of common squid and pacific saury.

Materials

Artificial bait made from the livers of Japanese common squid was formed into a rectangular shape (18 cm × 4 cm × 0.8 cm). The liver was hardened using products of the Japanese sea tangle. Gauze was put inside the bait as reinforcement to improve the hooking performance.

Bait must remain on hooks for several hours after casting. But when the bait is too strong, it becomes difficult of remove from hooks when retrieving the fishing gear. Intensity comparison test of artificial and natural bait was carried out in order to improve the strength of artificial bait. Effect of water temperature and soak time in water upon the force was obtained from the test data. The structure of gauze in artificial bait was improved referring to these results.

Test Longline operations and Data

The test longline operations were performed aboard the training ship Hokusei-maru (893GT) in January 1998. The Hokusei-maru has conducted tuna-longline operations for 20 years on the same fishing ground.

Three comparative test operations to compare the performances of artificial bait and natural bait were carried out. Five control operations (operation No. HO9803-HO9807) using only squid were conducted. About 100 baskets (a unit of longline containing about 500 m of longline with 9 hooks) were used in each operation. To set the hooks at three different depths in mid-water, we used three float lines of different lengths (25 m, 50 m and 75 m).

An outline of three comparative test operations is as follows.

The first test operation (HO9801) ended at 18 : 23 on 21 January at 12°38.16N, 175°50.82W. To compare the effectiveness of the bait, the artificial bait and squid were used on alternate baskets. A total of 35 baskets of 25 m floating lines, 35 baskets of the 50 m lines and 30 baskets of the 75 m floating lines were set. We tried to set the longlines at a wide range of mid-water depths. Although the profiles of hanging shape of longline under water resembled catenary curves but difficulty of confirming the actual shapes have been reported (Yano and Abe, 1998).

The Second test operation (HO9802) ended at 18 : 06 on 23 January at 12°24.62N, 174°19.53W. Artificial bait and saury were alternatively used on baskets. The floating lines were the same as those used in the first operation.

The third operation (HO9808) ended at 18 : 57 on 30 January at 16°48.03N, 163°53 (about 317 miles from the second operations fishing ground). Artificial bait and squid were used in the same manner as in the first operation. We set 51 baskets of 25 m floating lines and 49 baskets of 50 m floating lines.

The bottom depths of all fishing grounds were grater than 5,000 m. The number of hooks totaled 7191 for the 8 operations.

Oceanography observations

The hooks are hanged covering the depth of the tuna's habitat. This habitat may very considerably depending on the depth of the thermocline. In order to measure the water temperature, oceanographic observations were recorded following each operation using a CTD. Fig. 1 shows the vertical profiles of temperature on the fishing grounds. The fishing grounds of operations HO98007 and HO98008 show somewhat different temperature profiles from the another points because of differences in locations. Temperatures range 10°C to 15°C which is considered to be the suitable temperature range for Bigeye tuna occurred from 160 m to 270 m depth.

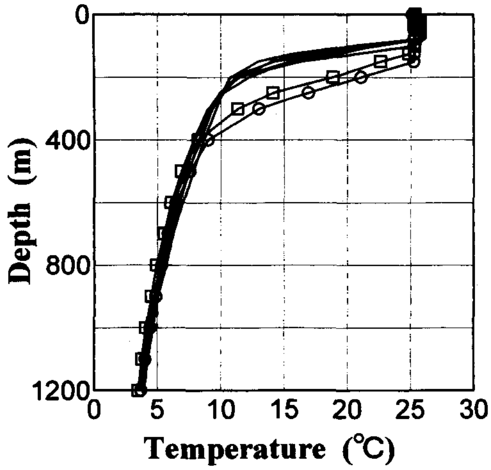

Fig. 1. Vertical profiles of temperature on the fishing grounds measured by a CTD. The fishing grounds of operations HO98007 (□) and HO98008 (○) show somewhat different characteristic of temperature profiles from another fishing grounds.

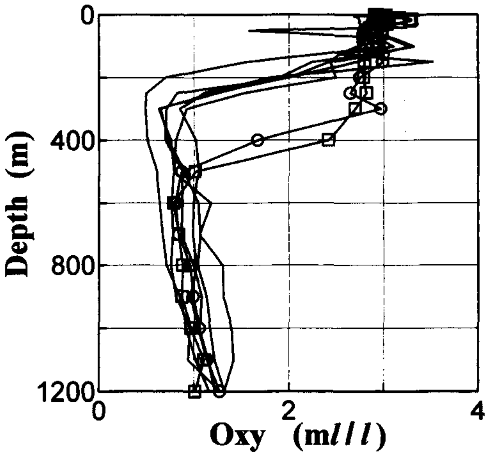

Fig. 2. Profiles of dissolved oxygen (DO) measured by a CTD. The fishing grounds of operations HO98007 (□) and HO98008 (○) show somewhat different characteristic

Fig. 2 shows the depth profiles of dissolved oxygen (DO). There might be some problems in the precision of the data, because we couldn't calibrate the DO sensor. But we consider that the tendency of changes of DO can help understanding of tuna behavior. High oxygen concentrations occurred from the surface to about 100m depth. From 100 m to 300 m depth, DO levels dropped sharply and changed little below 300 m depth.

Species, number of catch and hooking rate by kinds of baits

We used 7191 baits on all operations, including 1350 artificial baits (150 baskets), 450 saurys (50 baskets) and 5391 squids (599 baskets). Table 1 summarizes catch, which included 17 species and 171 fishes. A total of 75 sharks were collected, making sharks the most numerous group collected. A total of 50 Bigeye tuna and Albacore were collected. These two kinds are target of these operations and the others are the by-catch fish. Bigeye tuna and Albacore account for 29% of the sum total. Tunas and sharks made up 75% of the total numeric catch.

Table 2 shows the hooking rate (i.e. the number of catches per 1000 hooks) of tunas for each kind of bait. Because the number of tunas collected was small, the rates from all catches were combined (Table 3). The catch rate of saury was the

Table 1. Items and number of catches on all operations. HO9801, HO9802 and HO9808 were the operations contrasted effects of artificial and natural bait.

Operation No.	HO9801		HO9802		HO9803	HO9804	HO9805	HO9806	HO9807	HO9808		Total
bait	art.	squid	art.	sury	squid	squid	squid	squid	squid	art.	squid	
Baskets	50	50	50	50	99	100	100	100	100	50	50	
Bigeye tuna	1	2	3	3	10	10	1	1	4	2	1	38
Albacore	1	3	0	3	0	0	1	0	4	0	0	12
Swordfish	0	0	0	0	1	1	0	0	0	0	0	2
Striped marlin	0	0	0	0	0	0	0	0	0	0	1	1
Shortbill spearfish	0	0	0	0	0	0	0	0	0	0	1	1
Dolphines	0	1	0	2	4	5	0	3	1	0	0	16
Longnose lancetfish	1	2	0	1	2	3	1	4	0	0	1	15
Sharks	0	4	4	6	7	18	8	17	8	0	3	75
Rough pomfret	0	0	0	0	0	0	0	0	0	0	1	1
Sickle pomfret	0	0	0	0	0	0	0	0	0	0	1	1
Skipjack tuna	0	0	0	0	0	0	0	0	0	0	1	1
Opha	0	0	0	0	1	0	0	0	0	0	0	1
Pomfret	0	0	0	0	0	1	0	0	0	0	0	1
Grate barracuda	0	0	0	0	0	0	0	0	2	0	0	2
Daggertooth	0	0	0	0	0	0	0	0	2	0	0	2
Escolar	0	0	0	0	0	0	0	0	0	1	0	1
Unknown	0	0	0	1	0	0	0	1	0	0	0	2
Total	3	12	7	16	25	38	11	26	21	3	10	172

art. ; artificial bait

Table 2. Hooking rate of Bigeye tunas and Albacore for each kind of bait. The hooking rate means the number of catches per 1000 hooks.

	HO9801	HO9802	HO9808	mean
art. bait	4.4	6.7	4.4	5.2
squid	11.1	—	2.2	6.7
saury	—	13.3	—	13.3

art. bait; artificial bait

Table 3. Hooking rate from all catches for each kinds of bait. The hooking rate means the number of all catches per 1000 hooks.

	HO9801	HO9802	HO9808	mean
art. bait	6.7	15.6	6.7	9.6
squid	26.7	—	22.2	24.4
saury	—	35.6	—	35.6

art. bait; artificial bait

highest, and the hooking rate of the artificial bait was the least. The total number of fishes collected in one operation scattered from 11 to 38 (Table 1). It suggests that catch number were not enough to take correct data of hooking rate. Though accurate consideration cannot be made because of the insufficient number of operations, these data of hooking rate were very helpful for subsequent development of new artificial bait.

The subject for a future study

The primary aim of this study was to develop an effective artificial bait making use of unused marine resources. The results of these test operations showed that the artificial bait has a practical use. It is necessary to examine the arrangement of the bait on longline after this, whether the artificial should be used alone or be put together with natural bait on a hook. In addition, we have to develop the optimum shape and color of the bait in order to effectively catch.

Artificial bait is not natural bait living in the sea, so tunas are not accustomed to eating it. When we used the artificial bait, we expected that tunas might mistake the artificial bait for natural bait. From this point of view, it is very important to understand the feeding habits of tunas. But we have only limited information on the habits. We must undertake more test operations to get enough data to compare the efficiencies of different kinds of bait.

We think this study may expand our knowledge of the feeding habits of tunas, of the selectivity of longline gear, and the fishing machines on vessels.

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