Western and Central Pacific Fisheries Commission

SCIENTIFIC COMMITTEE
TWENTIETH REGULAR SESSION

Manila, Philippines
14 – 21 August 2024

Assessing the Impact of Artificial Bait on Target Catch and Bycatch in Experimental Longline Fisheries

WCPFC-SC20-2024/EB-IP-19

Shintaro UENO, Daisuke OCHI and Daisuke SHIODE

Assessing the Impact of Artificial Bait on Target Catch and Bycatch Species in Experimental Longline Fisheries

Shintaro UENO [1], Daisuke OCHI [1] and Daisuke SHIODE [2]

SUMMARY

In longline fisheries, it is well-known that bait type significantly influences the catch of target and the bycatch. However, there is little information available on the impact of using artificial bait. Therefore, this study conducted at-sea fishing experiments to investigate the impact of artificial bait on catch rate and bycatch species. In the experiment, two types of real bait and two types of artificial bait were prepared and compared. As a result, while no bycatch of seabirds or sea turtles was observed with the artificial bait interactions with thresher sharks and a giant devil ray were found. This research is still in progress, and additional verification is planned in the future regarding bycatch processes and the impact of target depth.

INTRODUCTION

Incidental bycatch in tuna longline fisheries has become a risk factor for the conservation of vulnerable seabirds, sea turtles, and other ecologically related species, leading to ongoing development of bycatch mitigation techniques. While technical approaches to bycatch mitigation for tuna longline fishery are being considered from various perspectives, many techniques focus on modifications to terminal fishing gear (Gilman et al. 2016; Santos et al. 2020). Changing bait type is one such mitigation technique involving terminal gear modification (Gilman et al. 2020). For example, the use of fish bait for sea turtles has been reported to reduce bycatch risk (Watson et al. 2005; Yokota et al. 2009, 2011) and has been adopted as a sea turtle mitigation measure by the WCPFC (**CMM 2018-04**). The effects of bait changes on other taxonomic groups have also been examined, but the impacts have been shown to be multifaceted rather than unidirectional (Epperly et al. 2020; Gilman et al. 2020; Ochi et al. 2024).

While many studies have investigated organic baits, there are very few reports on the effects of inorganic baits, namely artificial baits, on bycatch mitigation. Since tuna species are caught using artificial lures in recreational fishing, it is believed that they rely heavily on visual cues for predation. However, seabirds and sea turtles may use different senses (such as smell or taste), which could potentially lead to bycatch mitigation effects.

Therefore, this study reports preliminary results confirming the effects of using artificial bait on bycatch and catch through fishing experiments, and briefly discusses the possibility of artificial bait as bycatch mitigation for seabirds, sea turtles or other species.

1 Fisheries Resources Institute, Japan Fisheries Research and Education Agency
2 Tokyo University of Marine Science and Technology

METHODS

Longline experiments using artificial bait were conducted in offshore waters of Japan in the North Pacific from April to June in 2021-2023 by a chartered R/V, the 37 Den-maru. The operating areas are shown in **Fig. 1**. The gear configuration consisted of 4 branchlines, 240 baskets, and a total of 932 hooks per set, set as Japanese shallow setting style targeting swordfish. For bait, mackerel (hereafter as FISH) and artificial bait were used in 2021, while FISH bait, Japanese flying squid (hereafter as SQUID), and artificial bait were used in 2022 and 2023. The artificial baits used were rubber squid bait (hereafter as SQ-FAKE) and a bunch of plastic strands like rubber jig skirts (hereafter referred to as SKIRT; **Fig. 2**). The SQ-FAKE bait was threaded with a weight (11-14g) and hook, with a small LED attached inside (same as tested in Ochi et al. 2017) or directly above the bait. The SKIRT bait had no LED in the 2021 operations, but LEDs were attached directly above in the 2022 and 2023 operations. **Table 1** shows the fishing effort for each bait type in this survey. During the experimental operations, the species caught and the type of bait used were recorded. This report examines the effects of artificial bait on target and non-target species based on the species caught and CPUE for each bait type.

RESULTS AND DISCUSSION

A total of 31 species were caught during the operations. **Table 2** shows the main species caught by bait type. The most frequently caught species was the blue shark, followed by longnose lancetfish and swordfish. Both the number of species caught and the total catch were highest for fish bait, while artificial baits (both SQ-FAKE and SKIRT) caught fewer species and individuals than organic bait (FISH or SQUID). For the target species, swordfish, only one individual was caught with artificial bait (SQ-FAKE). Regarding the bait effect on sharks, FISH and SQUID bait caught many blue sharks and shortfin mako sharks, while artificial baits did not catch these two species. On the other hand, artificial bait (SQ-FAKE) caught one each of thresher sharks (bigeye thresher and pelagic thresher) and also caught a giant devil ray. Additionally, while organic bait resulted in bycatch of Laysan albatross and loggerhead sea turtle, artificial baits did not catch these species.

Table 3 shows the CPUE of caught species by bait type. Artificial baits had lower CPUE for the target species, swordfish, compared to organic baits, while the CPUE for tuna species was approximately equal to that of FISH and SQUID bait. On the other hand, the CPUE for thresher sharks and giant devil ray was higher for artificial bait (SQ-FAKE bait) compared to FISH bait.

The results of this experimental operation revealed that the low catch rate of target species is a challenge for artificial baits. However, there was no bycatch of seabirds or sea turtles, suggesting that artificial baits could be effective in reducing bycatch of these taxa. Nevertheless, the interactions with thresher shark and giant devil ray was higher with artificial baits, indicating that further information needs to be collected regarding the impact on vulnerable species.

In this report, due to the low number of catch events, we did not perform statistical comparisons for artificial baits. However, we plan to conduct analyses with additional data in the future. In parallel with the survey, we have

been recording the capture process using camera loggers. Therefore, we intend to conduct comparative analyses using video analysis in the future. Additionally, it is necessary to investigate the catch characteristics of artificial baits in different gear configurations and depths, such as deep-set longlines.

ACKNOWLEDGMENT

The operation experiment for this study was conducted with the great cooperation of the crew, including the fish master, Tsujino D. of the 37 Den-maru. This research was conducted as a part of the research and assessment program for internationally managed fisheries resources, the Fisheries Agency of Japan.

REFERENCE

Epperly SP, Watson JW, Foster DG, Shah AK (2012) Anatomical hooking location and condition of animals captured with pelagic longlines: The grand banks experiments 2002-2003. *Bulletin of Marine Science* **88**, 513–527.

Gilman E, Chaloupka M, Bach P, Fennell H, Hall M, Musyl M, Piovano S, Poisson F, Song L (2020) Effect of pelagic longline bait type on species selectivity: a global synthesis of evidence. *Reviews in Fish Biology and Fisheries* **30**, 535–551. https://doi.org/10.1007/S11160-020-09612-0/TABLES/2

Gilman E, Chaloupka M, Swimmer Y, Piovano S (2016) A cross-taxa assessment of pelagic longline by-catch mitigation measures: conflicts and mutual benefits to elasmobranchs. *Fish and Fisheries* **17**, 748–784. https://doi.org/10.1111/faf.12143

Ochi, D., Katsumata, N., Oshima, K. (2017) An at-sea trial of seabird mitigation gears including three weighted branch line specifications for tuna longline fisheries. WCPFC-SC13-EB-IP-17

Ochi, D., Okamoto, K., Ueno, S. (2024). Multifaceted effects of bycatch mitigation measures on target or non-target species for pelagic longline fisheries and consideration for bycatch management. Marine and Freshwater Research, 75(2), MF23148.

Santos CC, Rosa D, Coelho R (2020) Progress on a meta-analysis for comparing hook, bait and leader effects on target, bycatch and vulnerable fauna interactions. *Collective Volume of Scientific Papers ICCAT* **77**, 182–217.

Watson JW, Epperly SP, Shah AK, Foster DG (2005) Fishing methods to reduce sea turtle mortality associated with pelagic longlines. *Canadian Journal of Fisheries and Aquatic Sciences* **62**, 965–981. https://doi.org/10.1139/f05-004

Yokota K, Kiyota M, Okamura H (2009) Effect of bait species and color on sea turtle bycatch and fish catch in a pelagic longline fishery. *Fisheries Research* **97**, 53–58. https://doi.org/10.1016/J.FISHRES.2009.01.003

Yokota K, Minami H, Kiyota M (2011) Effectiveness of tori-lines for further reduction of incidental catch of seabirds in pelagic longline fisheries. *Fisheries Science* **77**, 479–485. https://doi.org/10.1007/s12562-011-0357-4

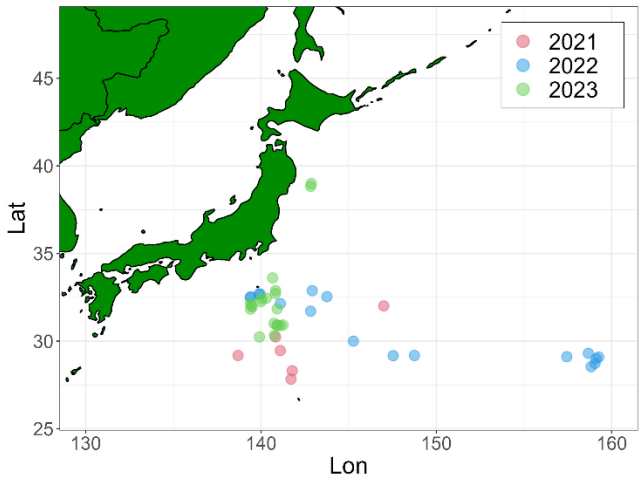

Figure 1. Locations of longline operation experiment in this study.

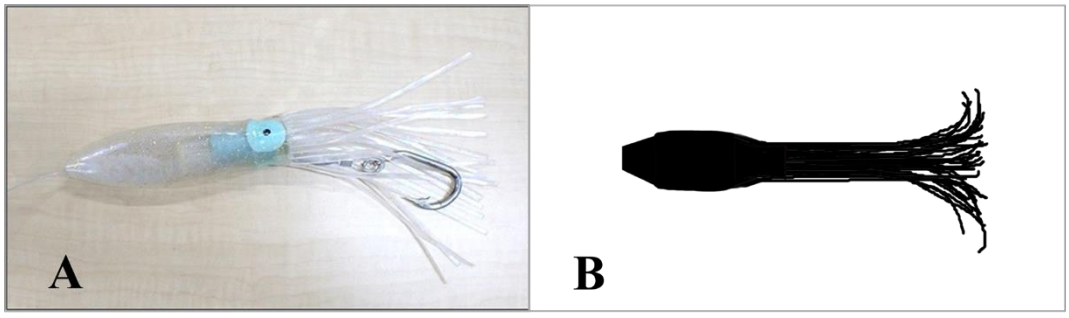

Figure 2. Artificial bait used in this study (A: Rubber squid bait (**SQ-FAKE)**, B: Skirt bait (**SKIRT**)).

Table 1. Total effort by bait type.

Year	Number of operation	Total hooks	Bait type			
			FISH	SQUID	SQ-FAKE	SKIRT
2021	6	5112	2544	0	2568	0
2022	17	14168	12244	727	585	612
2023	20	17040	13460	2000	760	820
Total	43	36320	28248	2727	3913	1432

Table 2. Number of individuals caught by bait type.

Taxon	Species	Bait type				Total
		FISH	SQUID	SQ-FAKE	SKIRT	
Tuna	Albacore	7	0	1	0	8
	Yellowfin tuna	4	1	0	0	5
	Bigeye tuna	2	0	1	0	3
	Pacific bluefin tuna	2	1	0	0	3
Billfish	Swordfish	72	5	1	0	78
	Striped marlin	34	3	0	0	37
Other fishes	Longnose lancetfish	83	2	2	0	87
	Dolphinfish	50	0	0	0	50
	Escoler	11	0	2	2	15
	Snake mackerel	10	0	0	1	11
	Oilfish	6	0	1	0	7
	Skipjack tuna	0	0	1	0	1
Shark	Blue shark	500	75	0	0	575
	Shortfin mako	60	6	0	0	66
	Silky shark	19	3	0	0	22
	Bigeye thresher	9	0	1	0	10
	Smooth hammerhead shark	4	0	0	0	4
	Oceanic whitetip shark	3	0	0	0	3
	Scalloped hammerhead shark	3	0	0	0	3
	Pelagic thresher	1	0	1	0	2
	Longfin mako	2	0	0	0	2
Ray	Pelagic stingray	3	0	0	0	3
	Giant devil ray	1	0	2	0	3
Sea bird	Laysan albatross	1	0	0	0	1
Sea turtle	Loggerhead turtle	3	3	0	0	6

Table 3. Nominal CPUE of each species by bait type.

Taxon	Species	Bait type			
		FISH	SQUID	SQ-FAKE	SKIRT
Tuna	Albacore	0.25	0.00	0.26	0.00
	Yellowfin tuna	0.14	0.37	0.00	0.00
	Bigeye tuna	0.07	0.00	0.26	0.00
	Pacific bluefin tuna	0.07	0.37	0.00	0.00
Billfish	Swordfish	2.55	1.83	0.26	0.00
	Striped marlin	1.20	1.10	0.00	0.00
Other fishes	Longnose lancetfish	2.94	0.73	0.51	0.00
	Dolphinfish	1.77	0.00	0.00	0.00
	Escoler	0.39	0.00	0.51	1.40
	Snake mackerel	0.35	0.00	0.00	0.70
	Oilfish	0.21	0.00	0.26	0.00
	Skipjack tuna	0.00	0.00	0.26	0.00
Shark	Blue shark	17.70	27.50	0.00	0.00
	Shortfin mako	2.12	2.20	0.00	0.00
	Silky shark	0.67	1.10	0.00	0.00
	Bigeye thresher	0.32	0.00	0.26	0.00
	Smooth hammerhead shark	0.14	0.00	0.00	0.00
	Oceanic whitetip shark	0.11	0.00	0.00	0.00
	Scalloped hammerhead shark	0.11	0.00	0.00	0.00
	Pelagic thresher	0.04	0.00	0.26	0.00
	Longfin mako	0.07	0.00	0.00	0.00
Ray	Pelagic stingray	0.11	0.00	0.00	0.00
	Giant devil ray	0.04	0.00	0.51	0.00
Sea bird	Laysan albatross	0.04	0.00	0.00	0.00
Sea turtle	Loggerhead turtle	0.11	1.10	0.00	0.00