



**SCIENTIFIC COMMITTEE
ELEVENTH REGULAR SESSION**

Pohnpei, Federated States of Micronesia
5-13 August 2015

**At-sea experiment to develop the mitigation measures of seabirds for small longline vessels
in the western North Pacific**

**WCPFC-SC11-2015/ EB-WP-10
Rev 1 (11 August 2015)**

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Abstract

For consideration to develop appropriate mitigation measures for small longline vessels, the effectiveness of 2 designs of tori-lines (A: tori-line without streamer, B: bundled 3 polypropylene bands) and (C) without tori-line was examined using chartered commercial longline vessel (Hanei-Maru No. 188, 19 GRT) in the western North Pacific by the on-board research. In the experiment, attacking rates of seabirds on baited hooks and their by-catch rates were recorded. Through 141 observations, streaked shearwaters, Laysan and black-footed albatrosses were mainly followed the vessel and all those were taking attack on baited hooks during line setting. Attacking rate by those three species (frequency of attacks/ 1000 hooks) in each segment of tori-line A, B and C was 9.5, 15.0 and 70.5, respectively. Number of by-caught birds in each segment of tori-line A, B and C was 1, 2 and 9 birds, respectively. These results indicated that all tori-lines deployed in this experiment substantially reduced bait attack and by-catch. Trial implementation of a light streamer tori-line showed entanglement of fishing gear during line setting. Further improvement and evaluation of tori-lines for small vessels should be necessary.

Introduction

Incidental catch (by-catch) of seabirds in tuna longline fisheries is one of negative impact on seabird population. Development of effective measures for reducing seabird bycatch have been discussed in all tuna RFMOs. In the recent WCPFC SC meetings, seabird bycatch and the mitigation measure for small longline vessels (less than 24m) in areas north of 23 degree north have been discussed. In this topic Japan submitted previous WCPFC SC meeting 2 papers. Ochi et al. (2013) reported that deployment of a single tori-line dramatically reduce albatross bycatch in the pelagic longline fisheries in the Western North Pacific. Ochi et al. (2014) provided that Japanese small longline vessels in the North Pacific have been used various designs of tori-lines as a seabird mitigation measure. There is, however, little quantitative information (e.g. frequency and species of aggregated seabirds, by-catch species and effectiveness of a tori-line). To evaluate the effectiveness of tori-lines s for small longline vessels, it is necessary to collect more information of small longline vessel's operation. This document provides information for consideration to develop appropriate mitigation measures for small longline vessels by examining the effectiveness of 2 designs of tori-lines and without a tori-line on commercial small longline vessel (< 24m) in the Western North Pacific by the on-board research.

Method

The experiment was carried out aboard a chartered longline vessel, *F/V Hanei-Maru No. 188* (19 GRT and 19.9 m in total length) from February 4 to March 11, 2015. The longline operations were staged in the Western North Pacific off Japan (Fig. 1). The longline configuration was according with the Japanese deep setting style, which mainly targets on bigeye tuna (*Thunnus obesus*) and albacore (*Thunnus alalunga*). In each operation, line setting commenced early morning and was completed in about 4h later. Line hauling began in about 1 p.m. Each operation (set) deployed 1,536 hooks with 96 baskets at a vessel speed of 8 knots.

One operation was divided into four segments (one segment consists of 144 hooks). We used different type of tori-lines among three segments (A, a tori-line without a streamer, B: bundled 3 polypropylene bands) and (C) without a tori-line for each segment in a fishing operation. The order of types of tori-lines (A, B and C) was changed daily. The last segment was used for trial implementation of a light streamer

tori-line.

We allocated two 25 minutes observation sessions for each segment during line setting. Each observation consisted of two parts, seabird abundance that aggregated in 250 m hemisphere centered at the stern of the vessel was counted with their species identified during 5-minutes. Then, during next 20 minutes, the frequency of bait attacks was counted by species. Attacking frequency was counted in each distance astern of the vessel (0-25, 26-50, 51-75, 76-100, 101-125, 126-150 astern of the vessel).

During line hauling, number of seabirds caught in each segment was recorded by species.

Result

Data from 18 operations (141 observations, 27,072 hooks) was obtained in this experiment.

Seabird assemblage during line setting

Through 141 observations, 8 species attended line settings and streaked shearwaters, Laysan and black-footed albatrosses were main seabird species that followed the vessel during line setting, and the seabird by-catch was occurred in only these three species (Table 1).

Attacking behavior

The average aerial lengths of tori-line A and B were 34.7 ± 7.3 and 44.0 ± 7.2 , respectively. A total of 780 attacks was recorded and 30.5%, 21.3% and 25.5% of them were occurred by Laysan, black-footed albatross and streaked shearwater, respectively (Table 1). The attack rate in segment C (without tori line) was more than 3 times higher than another segment area (Fig. 1).

The horizontal distribution of overall attack rates of Laysan, black-footed albatross and streaked shearwater among three segments were displayed in Fig. 2. In segment C, many attacks of three species were performed within 25m of the stern.

The total seabird by-catch numbers were, 0, 2 and 10 birds and BPUE (birds per 1,000 hooks) were estimated d 0.0, 0.29 and 1.49 in tori-line A, B and C, respectively (Table 1).

Entanglement of fishing gear

Average of wind speed and wave height during all operations were $8.4\pm 3.9\text{m/s}$ and $1.8\pm 0.5\text{m}$, respectively. In all operation, tori-line A and B did not entangle of fishing gear during line setting, however, one of 18 operations, trial implementation of a light streamer tori-line showed entanglement of fishing gear during line setting. The part of entanglement was underwater segments (Fig. 3). The marine condition was ordinary when the entanglement had occurred (wind speed: 9m/s , wave height: 1.5m).

Discussion

This study is the first report of mitigation measure of seabirds in longline small vessels in the North Pacific by the on-board research.

In the Western North Pacific off Japan, Laysan, black-footed albatross and streaked shearwater were main species, which followed longline small vessels during line setting and were by-caught. Most attacks and by-catch, however, were occurred in segment C (without tori-line area), and the segment A (tori-line without streamer) and B (bundled 3 polypropylene bands) substantially reduced bait attack and by-catch. These results indicated that both tori-line were effective as mitigation measure of seabirds. In addition, many seabird attacks were occurred in near the astern. It indicates the possibility that tori-line length of small vessels is shorter than that of large vessels.

Trial implementation of a light streamer tori-line showed entanglement of fishing gear during line setting. It is known that towing device of underwater segment was easily entangled (Sato et al. 2014). Because of small vessels is unsteadiness during operations, entanglement of fishing gear will be a high risk. It is thought that a light streamer tori-line is difficult to deploy during line setting.

In this study, seabird attacks were occurred within 25m astern using tori-line A and B. Therefore, we will investigate the effectiveness of new tori-line, short streamer attached on aerial area and double PP band tori-line, in 2016. Further improvement and evaluation of tori-lines for small vessels should be necessary.

Reference

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Table 1 · Seabird abundance during line setting, attack rate, and bycatch.

Species	Sceintific name	Average birds per obs.		Attack rate (/1000 hooks)	Bycatch		
		Mean	S.D		A	B	C
Streaked shearwater	<i>Calonectris leucomelas</i>	8.31	14.10	10.85	0	0.14 (1)	0
Laysan albatross	<i>Phoebastria immutabilis</i>	4.36	5.76	13.00	0	0	1.34 (10)
Black-footed albatross	<i>Phoebastria nigripes</i>	3.12	3.87	9.10	0	0.14 (1)	0.15 (1)
Northern fulmar	<i>Fulmarus glacialis</i>	0.56	1.28	3.36			
Gull sp.	<i>Larus sp.</i>	0.08	0.51	0.54			
Petrel sp.	<i>Pterodroma sp.</i>	0.01	0.10	–			
Strom petrel sp.	<i>Oceanodroma sp.</i>	0.01	0.10	–			
Shearwater sp.	<i>Puffnus sp.</i>	0.01	0.10	0.05			
Unkown				0.81			
Total				28.81			

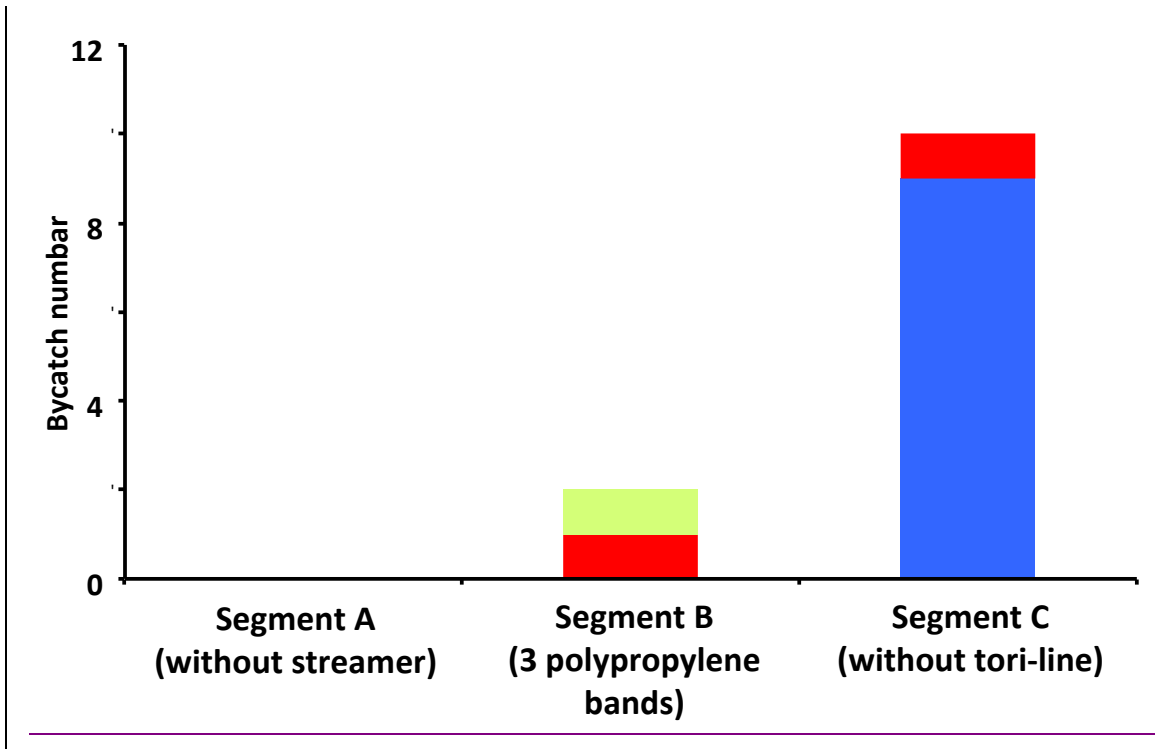


Fig. 1 Difference of attack rates (/observations) during segment area (A: tori-line without streamer area, B: bundled 3 polypropylene bands area, C: without tori-line area). Blue, red and green bar are attack rate of Laysan albatross, black-footed albatross and streaked shearwater, respectively.

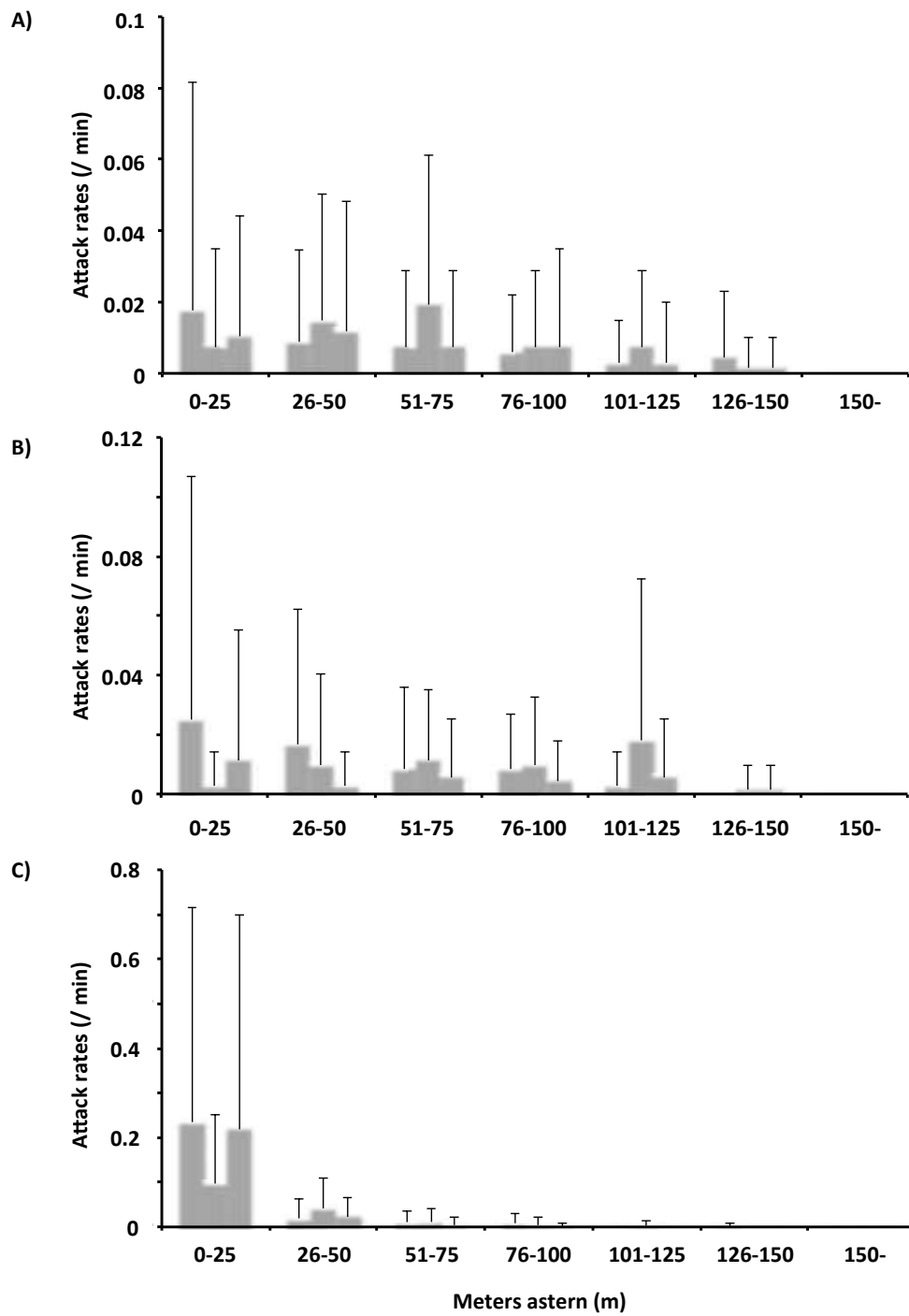


Fig. 2 Average attack rate by A) tori-line without streamer area, B) bundled 3



polypropylene bands area and C) without tori-line area as a function of distance astern. Red, green and purple bar are attack rates of Laysan albatross, black-footed albatross and streaked shearwater, respectively. Error bar indicates s standard deviations.

Fig. 3 The example of the entanglement occurred at the trial segment of a light streamer tori-line. The part of entanglement was underwater segments.