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Examination of effectiveness of seabird bycatch mitigation measures for small-scale longline vessels fishing north of 23ºN specified in CMM 2015-03

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Abstract

This paper shows results from on-board researches conducted in 2015 and 2016 in order to examine effectiveness of tori line for small-scale longline vessels fishing north of 23°N, agreed at WCPFC12. The effectiveness of tori lines of different materials for small- scale longline vessels was tested using a commercial small-scale longline vessel from February to March in the Western North Pacific off Japan. Experimental fishing operations demonstrated substantial reduction of frequency of seabird’s attacks on baited hook during line setting and number of seabirds bycaught compared to case of no tori line regardless of the difference in material of tori line. Trial implementation of a short streamer tori line on the small-scale longline vessel caused entanglement of fishing gear during line setting.

Introduction

Incidental catch (bycatch) of seabirds in tuna longline fisheries is one of negative impact on seabird population. Development of effective measures to reduce seabird bycatch has been discussed in all tuna RFMOs.

In SCs of the past 3 years, Japan submitted the results of research on development of mitigation measure, especially tri line, for small-scale longline vessels fishing north of 23°N which were exempted from implementation of mitigation measure under CMM2012-07. At SC9 Japan evaluated the effectiveness of various mitigation measures on longline operations in the North Pacific Ocean (Ochi et al. 2013). The results clearly showed that the single use of tori line measure effectively reduced seabird attack and bycatch rates in pelagic longline operations in the Western and Central North Pacific Ocean even without using weighted branch lines. At SC10 Japan presented information on the utilization of seabird mitigation techniques voluntarily used in Japanese small longline vessels operated in the North Pacific Ocean (Ochi et al. 2014). In that survey, almost all fishing masters were concerned about usage of long streamers, double tori line and towing devices, because those devices caused tori-line entanglement with fishing gear in rough sea. This fishing master's concern also suggests that careful examination is necessary before deciding appropriate designs of tori line for small scale longliners for safety reason as well as for fishing efficiency. At SC11 Japan reported results of examination on the effectiveness of tori line without streamer of different material on small longline vessels (Hanei-Maru No. 188, 19 GRT) in the North Pacific Ocean (Katsumata et al. 2015). The results indicated that tori line without streamer deployed in this experiment substantially reduced seabird bait attack and bycatch regardless of the difference in material. This survey also showed that trial implementation of a short streamer on the small-scale longline vessel caused entanglement of fishing gear during the line setting. Taking into consideration those results, seabird bycatch mitigation measures for small-scale (< 24m) longline vessels fishing in north of 23°N were agreed in the WCPFC12 (CMM2015-03). This paper shows results from on-board researches conducted in 2015 and 2016 in order to examine the effectiveness of tori line for small-scale longline vessels fishing north of 23°N.

Methods

Methods were not changed in 2015 and 2016. Fishing experiments were carried out on the commercial small-scale longline vessel '*Hanei-Maru No. 188*' (19.9 m and 19 GRT) from February to March in 2015 and 2016 in the Western North Pacific off Japan (Fig. 1). Gear configuration was the Japanese deep setting style mainly targeting bigeye tuna (*Thunnus obesus*) and albacore (*Thunnus alalunga*). Line settings were conducted in morning after sunrise and took about 4 hours. Hauling was began at around 1 pm. Total of 1,536 hooks with 96 baskets were used for the fishing operation and baited hooks were drop at a vessel speed of about 8 knots.

We used the following tori lines of different materials for small-scale longline vessels: tori line A, tori line of polyethylene without streamers; tori line B, tori line composed of bundled 3 polypropylene bands without streamer.

Main line of logline gear was decided into four segments. Tori lines A and B were allocated to 2 of 4 segments, named as Segments A and B, respectively. One of remaining 2 segments, named as Segment C had no tori line. The last segment was used for trial implementation of a short streamer tori line, which was named as Segment D. Order of four segments were changed by operation (Fig. 2).

Observations of seabirds aggregating to rearward of the stern were made during line setting in order to obtain number of attacks on baits by seabirds. Duration of the observations was 20 to 25 minutes for each segment. During the observation, the first 5 minutes were spent for count and species identification of seabirds that aggregated within a 250 m radius from the stern. Remaining 15 to 20 minutes were allocated to count the number of times that seabirds attacked on hooked baits. We recorded the number of attacks by distance from the stern. The distance from the stern were categorized the following 7 bins: 0-25, 26-50, 51-75, 76-100, 101-125, 126-150 and >151 m).

Number of seabirds bycaught was counted by segment and by species during hauling. Generalized linear model (GLM) was used to analyze the effects of tori lines on bycatch number of seabirds by operation. We used the GLM with log-link function assuming negative-binomial distribution. The bycatch number was set as a response variable. Segment, year and their interaction term were set as explanatory variables. Final model was selected by Akaike's Information Criterion.

Results

Seabird observed and bycatch number

Total of 35 fishing operations were conducted in on-board research in 2015 and 2016. 11 species occurred in the observation during line setting (Table 1). Streaked shearwaters, Laysan and black-footed albatrosses were more frequent than other species and hooked in the fishing experiments.

Attacking behavior

Average aerial length of tori-line in Segments A, B and D were 42.2 ± 8.7m, 43.8±10.4m and 39.5±9.2m, respectively. A total of 2977 attacks were observed and streaked shearwater, Laysan and black-footed albatrosses accounted for 68.1%, 18.0% and 7.4% of them, respectively. The number of attacks per observation) in Segment C was more than 2 times higher than Segments A, B and D (Fig. 3). In Segment C, many attacks of three species occurred within 25 m from the stern (Fig. 4).

Bycatch

Total numbers of seabird bycatch were 12, 24, 57 and 17 seabirds for Segments A, B, C and D, respectively (Table 1). Maximum number of bycatch of 57 seabirds was recorded in Segment C of no tori line. In contrast, numbers of bycatch for Segment A of the tori line without streamer was the lowest in the segments (Fig. 5).

BPUEs (individuals per 1000 hooks) were 0.91, 1.79, 4.30 and 1.28 in Segments A, B, C and D, respectively (Table 1). Segment C recorded the highest BPUE, meanwhile Segment A of simple tori line was the lowest, 21% of BPUE for Segment C. The selected model on bycatch number was composed of segment and year (Table 2). Effect of Segment A became the lowest in segments (Fig. 6).

Others

Trial implementation of a short streamer tori line caused entanglement of fishing gear during line setting.

Discussion

Results from fishing experiments shown in this paper supported the effectiveness of tori lines without streamer for seabird bycatch mitigation based on results from fishing experiments of two years. It was found that two types of tori line without streamer substantially reduced opportunity of seabird's attack on baited hook and bycatch number compared to the case of no tori line regardless of the difference in materials. Especially tori line of polyethylene without streamer recorded the lowest BPUE in the segments.

Result of the trial implementation of a short streamer tori line showed that application of the tori line with streamer has a potential to cause operational troubles for small-scale longline vessels; limited working space and instability nature for wind and wave. The application has even a potential to increase the risk for crews during line settings.

References

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Table 1 Summary of results on observations during line setting and BPUE (bycatch number per 1000 hooks) by species. Number in parenthesis indicates bycatch number.

Species	Sceintific name	No. of seabirds observred	Average birds per observation		Attack rate (ind./min)		BPUE (bycatch number per 1000 hooks)			
			Mean	S.D.	Mean	S.D.	Segment A	Segment B	Segment C	Segment D
Streaked shearwater	*Calonectris leucomelas*	5422	19.50	26.80	0.070	0.337	0.38 (5)	0.97 (13)	0.75 (10)	0.30 (4)
Laysan albatross	*Phoebastria immutabilis*	1899	6.83	8.23	0.016	0.097	0.53 (7)	0.67 (9)	2.94 (39)	0.98 (13)
Black-footed albatross	*Phoebastria nigripes*	704	2.53	3.06	0.006	0.031	0	0.15 (2)	0.60 (8)	0
Large gull sp.	*Larus sp.*	109	0.39	1.33	0.001	0.024				
Northern fulmar	*Fulmarus glacialis*	83	0.30	1.05	0.002	0.021				
Small gull sp.	*Larus sp.*	59	0.21	0.75	0.001	0.029				
Strom petrel sp.	*Oceanodroma sp.*	12	0.04	0.25						
Short-tailed shearwater	Puffinus tenuirostris	2	0.01	0.08						
Unknown shearwater sp.	*Puffnus sp.*	2	0.01	0.12	0.0001	0.0016				
Petrel sp.	*Pterodroma sp.*	1	0.004	0.06						
Unknown					0.001	0.007				
Total		8293			0.098	0.362	0.91 (12)	1.79 (24)	4.30 (57)	1.28 (17)

Table 2 ANOVA table for GLM analysis on number of bycatch.

Effects	Chisq	Df	Pr(>Chisq)	
Segment	18.265	3	0.0003878	***
Year	34.565	1	4.12E-09	***

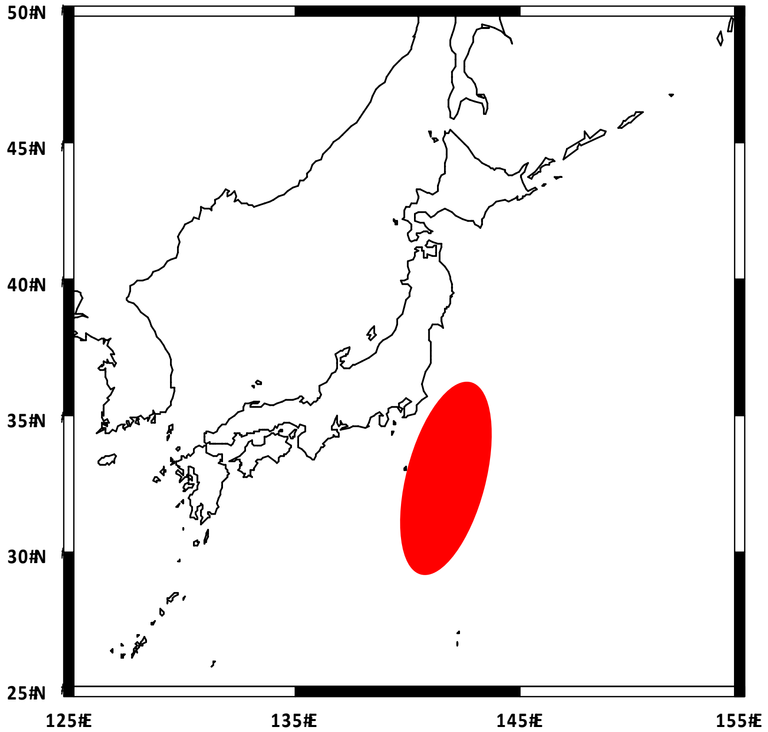

Fig. 1 Area where fishing experiments in this study were conducted.

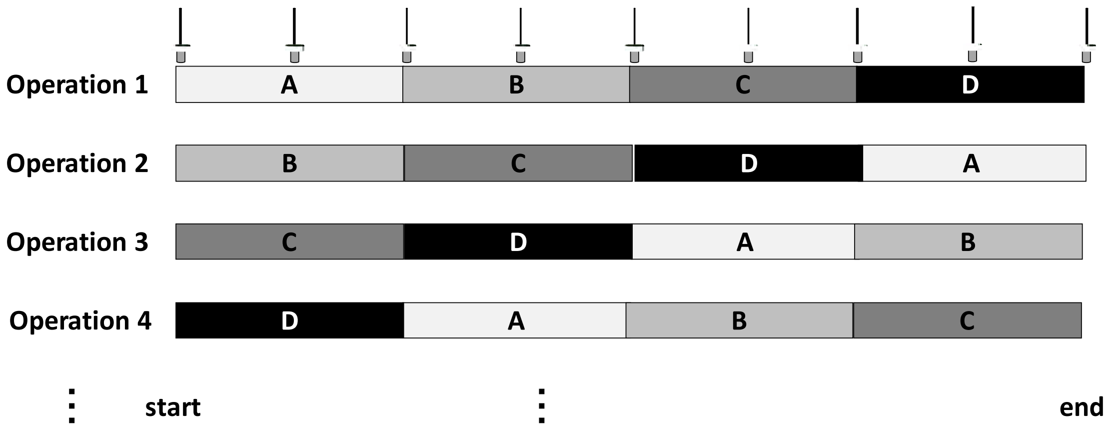

Fig. 2 Experimental design. Segment A, use of tori line of polyethylene without streamer; Segment B, use of tori line composed of 3 bundled polypropylene line; Segment C, no tori line; Segment D, use of short streamer tori line.

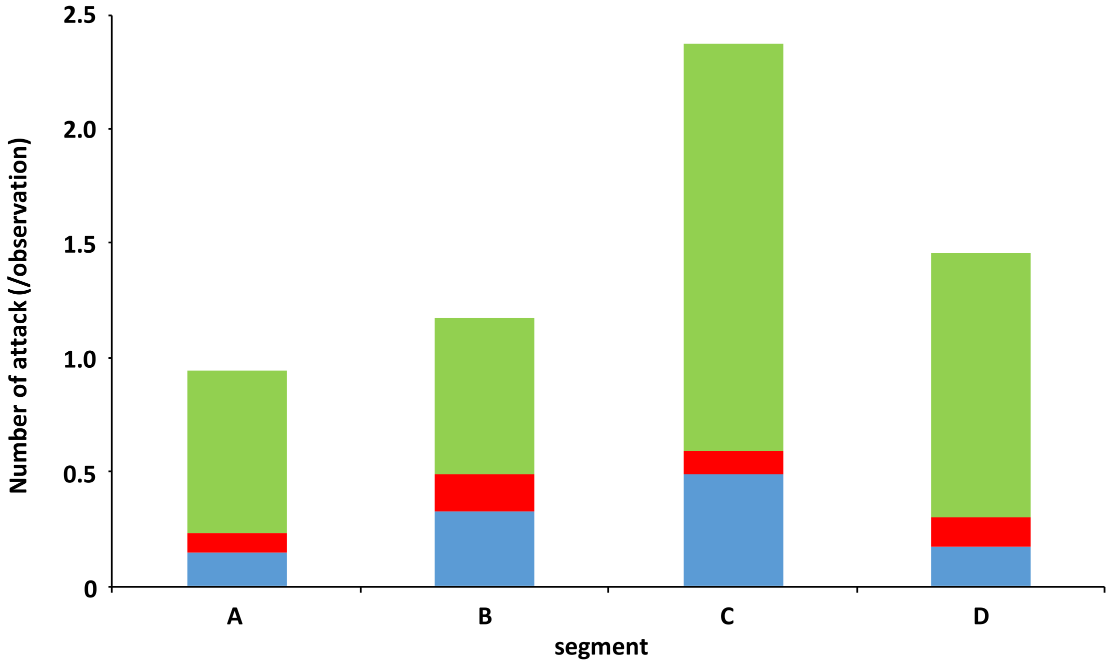

Fig. 3　Number of attacks per observation by segment (Segment A, use of tori line of polyethylene without streamer; Segment B, use of tori line composed of 3 polypropylene band without streamer, Segment C, no tori line; Segment D, use of short streamer tori line). Blue, red and green bars are that for Laysan albatross, black-footed albatross and streaked shearwater, respectively.

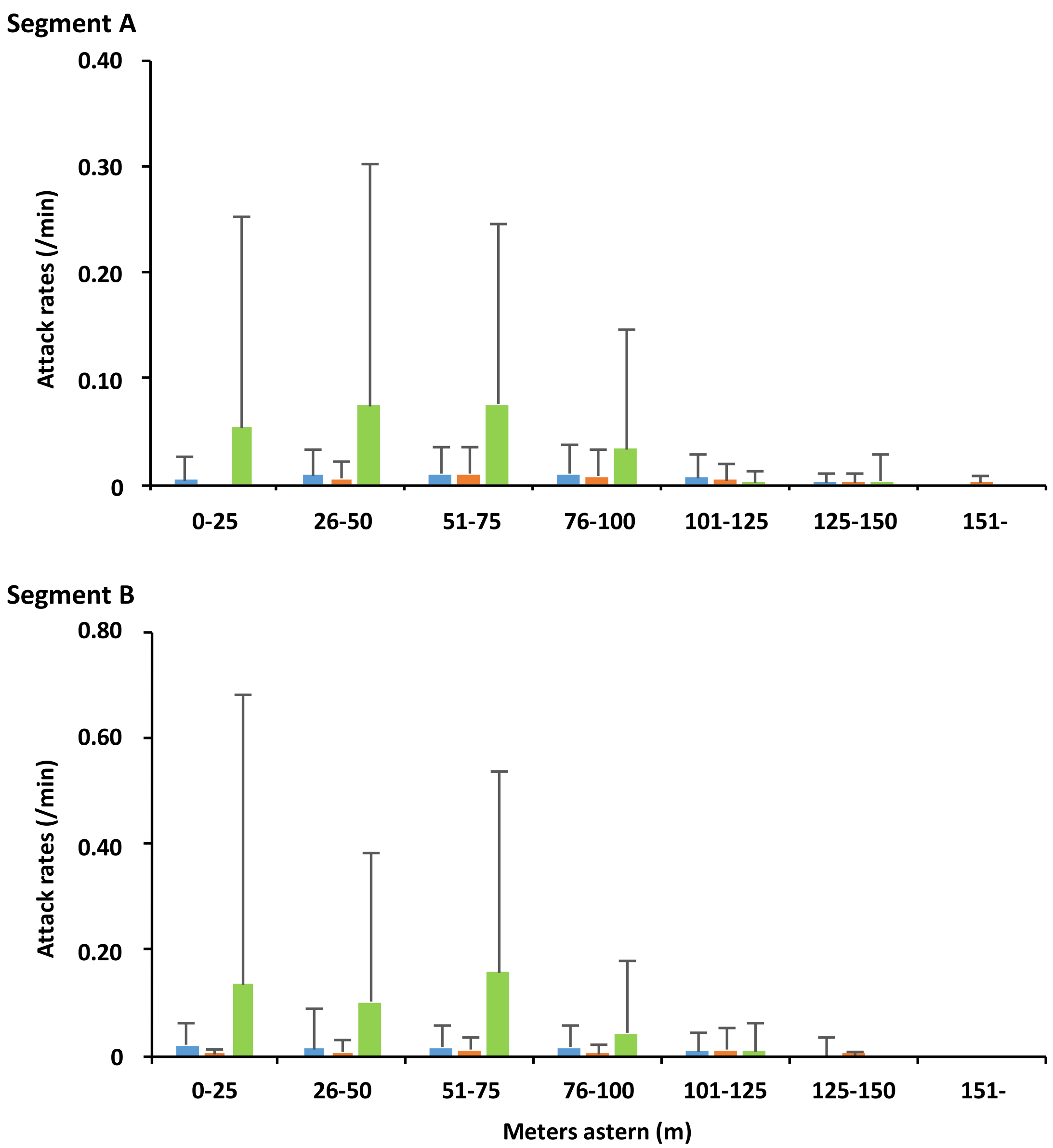

Fig. 4 Average attack rate by segment and distance from the stern (Segment A, use of tori line of polyethylene without streamer; Segment B, use of tori line composed of 3 bundled polypropylene band without streamer; Segment C, no tori line; Segment D, use of short streamer tori line). Blue, red and green bars are attack rate of Laysan albatross, black-footed albatross and streaked shearwater, respectively. Error bar indicate standard deviations.

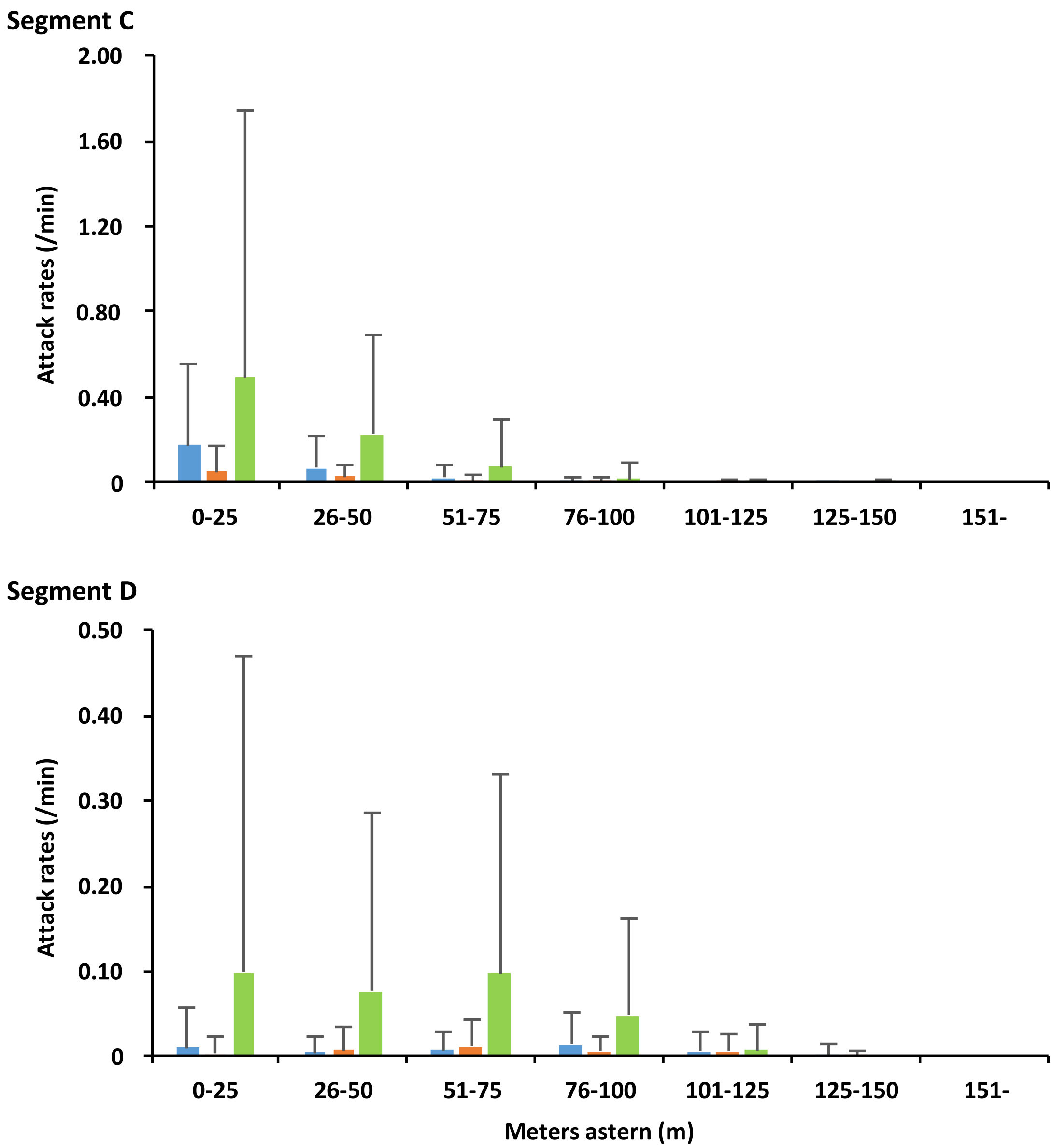

Fig. 4 Continued.

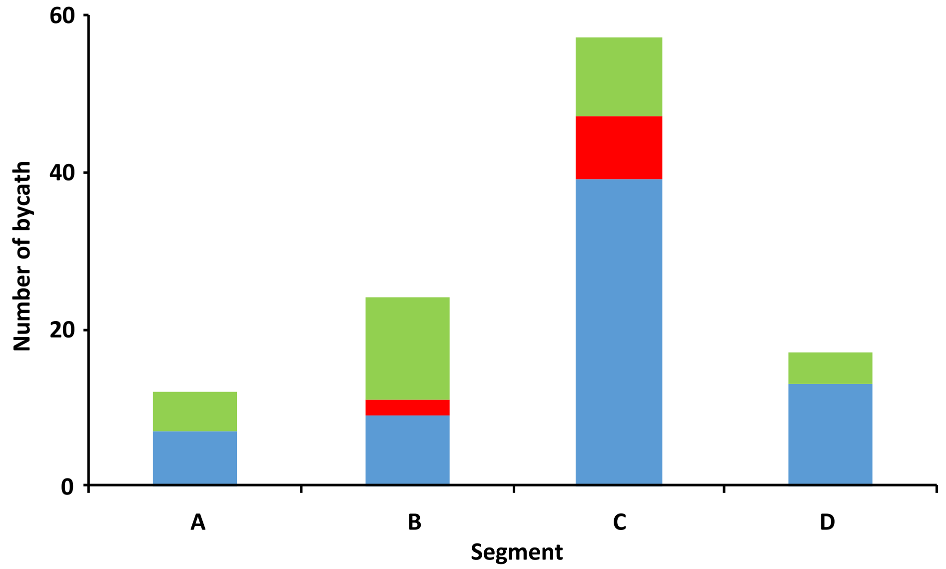

Fig. 5 Bycatch number by segment (Segment A, use of tori line of polyethylene without streamer; Segment B, use of tori line composed of 3 polypropylene band without streamer; Segment C, no tori line; Segment D, use of short streamer tori line). Blue, red and green bars are bycatch number of Laysan albatross, black-footed albatross and streaked shearwater, respectively.

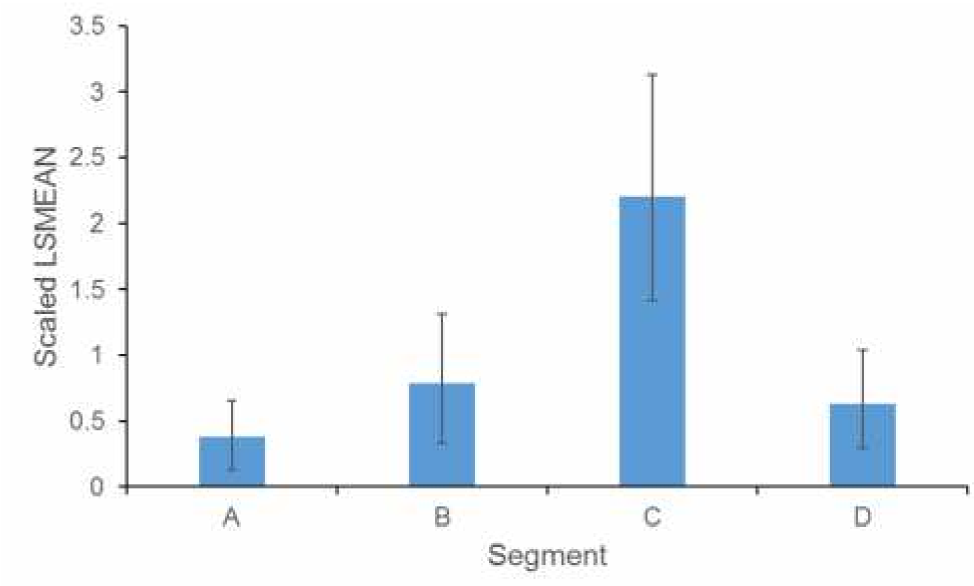

Fig. 6 Magnitude of effects by segment for GLM analysis on bycatch number (Segment A, use of tori line of polyethylene without streamer; Segment B, use of tori line composed of 3 polypropylene band without streamer; Segment C, no tori line; Segment D, use of short streamer tori line). Each effects were calculated from least square means (LSMEAN). Vertical

bars indicate 90% confidential intervals.