TECHNICAL AND COMPLIANCE COMMITTEE
THIRD REGULAR SESSION
27 September – 02 October 2007
Pohnpei, Federated States of Micronesia

SEABIRDS AVOIDANCE EFFECT OF TORI-LINES IN THE JAPANESE LONGLINE FISHERY: COMPARISON OF TORI-LINE STREAMERS

WCPFC-TCC3-2007/DP03 Rev.1
26 September 2007

Paper prepared by Japan[1]

Abstract

The effects of tori-line streamer types on seabirds avoidance were examined with the data from Japanese observer program in southern bluefin tuna fishery. Nominal catch rates (catch/1000 hooks) and per-capita catch rates (catch/1000 hooks/albatross abundance) were compared between "WCPFC type" streamers and "Light type" (polypropylene band) streamers. There was no significant difference in these catch rates between the two streamer types ($P > 0.05$). A Catch model (generalized linear model) analysis also indicated that the two streamer types made little difference in the seabirds avoidance effect. These results indicate that "Light type" streamers have seabird avoidance effects equivalent to that of "WCPFC type" streamers.

Introduction

Yokota et al. (2007) examined effective factors of tori-poles in reducing incidental catch of albatross in a model analysis using the data collected by Japanese scientific observers in southern bluefin tuna fishery. The model analysis revealed that length of the tori-line and number of seabirds observed during line setting had significant effects on seabird catch rates and the effects of material and structure of streamers was not significant.

In the WCPFC-SC3, specification of seabird bycatch mitigation measure was discussed, and scientific information on "1b) Tori line (light streamer [e.g., polypropylene band])" was requested (WCPFC 2007). As a follow-up of Yokota et al. (2007), we made direct comparison of seabird catch rates between two types of tori-line streamers: "1a) Tori lines" (described as "WCPFC type" hereafter in this present paper), and "1b) Tori line" (light streamer) (described as "Light

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type”) [2], to provide additional information for the consideration of mitigation measures in WCPFC-TCC3.

Materials and Methods

The same data used in Yokota et al. (2007) were re-analyzed. Before comparing the catch rates between streamer types, we had to eliminate the effects of tori-line length and albatross abundance (number of albatross observed during line setting) because these two factors had significant effects on catch rates. First, we separated data by tori-line length categories, and used the data in 100 m and 150 m line categories, which had sufficient number of observed sets. We next divided the data into albatross abundance categories (“0”, “1-5”, “6-10”, “11-15”, “16-20”, “21-30” and “30<”; Fig. 1), and made two kinds of analyses, which cancel the effects of albatross abundance on catch rates: 1) comparison of nominal catch rates (catch/1000 hooks) for a limited subset of data in a particular albatross abundance category (6-10) for each tori-line length (100 m and 150m); 2) comparison of approximate per-capita catch rates (catch/1000 hooks/albatross abundance) using a broader subset of data in albatross abundance categories from “1-5” to “21-30” for each tori-line length (100 m and 150 m). In the calculation of per-capita catch rate, medians of the albatross abundance category ranges were used as denominators. We used Mann-Whitney’s *U* tests to examine the difference of catch rates between the two streamer types.

We also performed a Catch model (generalized linear model; GLM) analysis to evaluate the effect of streamer types on albatross catches, using the data of “1-5”, “6-10”, “11-15” albatross abundance categories in 100 m tori-line length (Fig. 1). In general, data of seabird capture have many zero catches. The present data also had many zero catches (Fig. 2), and therefore we assumed a negative binomial distribution was suitable as an error structure in the GLM (Murray et al., 1993). We made two models: Model I with an explanatory valuable of streamer type; Model II without the explanatory valuable of streamer type. The model functions are shown as follows:

Model I: $E(C) = (Hook) * \exp\{(Intercept) + (Albatross\ abundance) + (Steamer\ type)\}$,

Model II: $E(C) = (Hook) * \exp\{(Intercept) + (Albatross\ abundance)\}$

$$C \sim \text{Negative Binomial } (\mu, \theta),$$

where *Hook* is the observed hook number in an operation, treated as offset variable; *Intercept* is the intercept; *Albatross abundance* is the albatross abundance (categories; “1-5”, “6-10”, “11-15”); *Streamer type* is the streamer type (“WCPFC type” or “Light type”). We used the Akaike’s Information Criterion (AIC; Akaike 1973) to select the model with smaller AIC as better-fit model.

Results and Discussion

[2] In Yokota et al. (2007), “WCPFC type” and “Light type” were described as “Type A” and “Type B”, respectively.

Mean nominal catch rates of albatross for the two streamer types are shown in Fig. 3. The average nominal catch rates of the “Light type” was lower than that of the “WCPFC type”, but there was no significant difference in the catch rates between the two streamer types in both tori-line lengths (P = 0.39 for 100 m line length; P = 0.39 for 150 m line length).

Mean per-capita catch rates of the two streamer types are shown in Fig. 4. The average per-capita catch rates of the “Light type” was lower than that of the “WCPFC type”, but the catch rates did not differ significantly between the two streamer types in both tori-line length (P = 0.97 for 100 m line length; P = 0.27 for 150 m line length). Additionally, we calculated mean per-capita catch rates for each vessel and compared the vessel averages between the two streamer types. Again, there was no significant differences between streamer types (P = 0.50 for 100 m line length, N = 12; P = 0.92 for 150 m line length, N = 10).

In the model analysis, the AIC value in the Model II (AIC = 206.53) was smaller than that in the Model I (AIC = 208.48). The Model II, without the explanatory valuable of *Steamer type*, was therefore selected as the better-fit model though the difference in the AIC values was small. The model comparison suggests the difference of streamer types had negligible effect on seabird catch. Consequently this can be interpreted that the two different streamer types considered here had little difference in reducing seabird catch.

These results indicate that “Light type” streamers have seabird avoidance effects equivalent to that of “WCPFC type” streamers. Considering the practicality and the performance of the “Light type” streamers under difficult weather and oceanic conditions (Minami et al. 2007), “Light type” streamer should be a good option of mitigation measures for reducing seabird bycatch in tuna longline vessels operating in the higher latitude.

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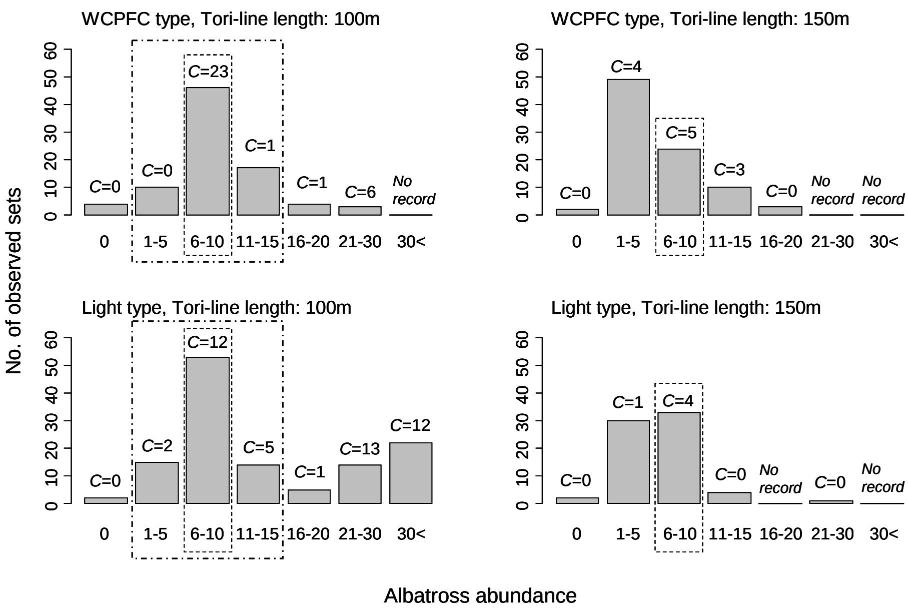

Fig. 1. Number of observed sets by albatross abundance categories (no. of albatross observed during line setting) for different types and lengths of tori-lines used during the line setting. *C* indicates total catch of albatross for each category. Data in the albatross abundance category 6-10 (shown by dotted line boxes) were used for nominal catch rate analysis. Data in the albatross abundance categories “1-5”, “6-10”, and “11-15” in 100 m tori-line length (shown by dash-dotted line boxes) were used for the generalized linear model (GLM) analysis.

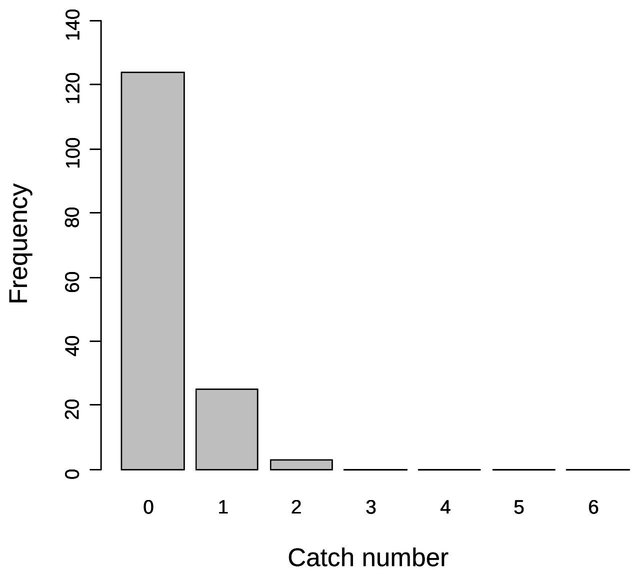

Fig. 2. Frequency distribution of observed albatross catch (data of “1-5”, “6-10”, “11-15” albatross abundance categories in 100 m tori-line length). This data were used in a GLM analysis.

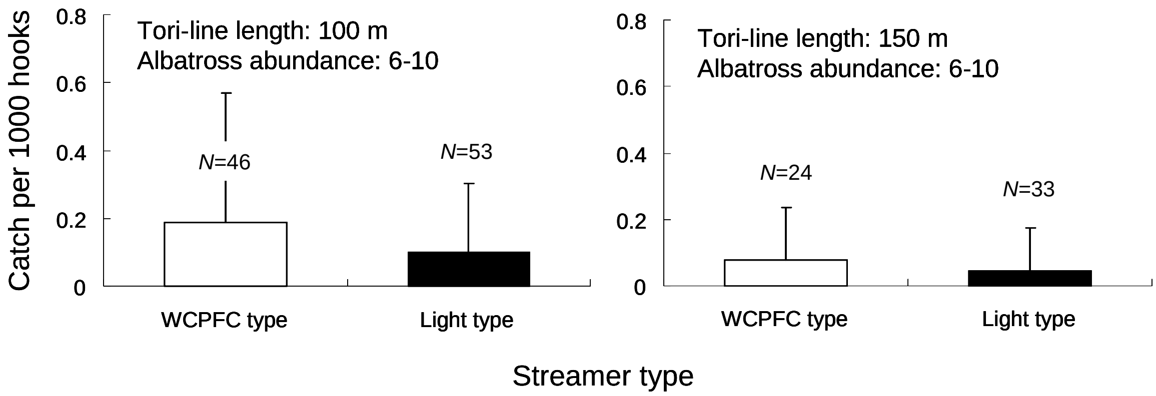

Fig. 3. Comparison of nominal albatross catch rates (catch / 1000 hooks) between two different types ("WCPFC type" and "Light type") of tori-line streamers. Only data with 6-10 albatross abundance category were used. Tori-line length 100 m (left), and 150 m (right) were treated separately. Vertical bars indicate standard deviations. *N* denotes number of sets.

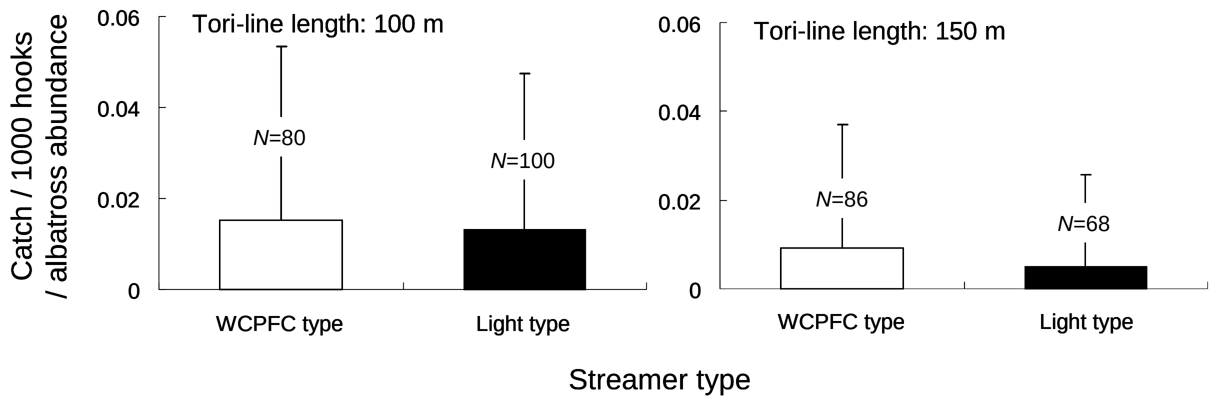

Fig. 4. Comparison of per-capita catch rates of albatross (catch / 1000 hooks / albatross abundance) between the two types of toil-line streamers. Data within the albatross abundance categories 1-5, 6-10, 11-15, 16-20, 21-30 were used. Vertical bars indicate standard deviations. *N* denotes number of sets.