



Analysis of the Effectiveness of Blue-Dyed Bait in Reducing Seabird Bycatch in Tuna Longline Fisheries



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Introduction

Due to its “mainline + baited hooks” operation mode, longline fishing often causes severe seabird bycatch in highly productive areas where seabirds are abundant, such as frontal zones and upwelling regions. However, the effectiveness of blue-dyed bait as a mitigation measure to reduce seabird bycatch has received limited scientific attention. This paper analyzes the effectiveness of seabird bycatch mitigation measures in tuna longline fisheries, reviewing the evolution of technical regulations and management measures established by major regional fisheries management organizations (IATTC, WCPFC, IOTC, ICCAT) and the international agreement ACAP. It also summarizes recent experimental and practical outcomes of key mitigation technologies. The study first provides an overview of longline fishing operations and, through quantitative literature review and statistical analysis of bycatch data from different regional fisheries organizations, compares the effectiveness of blue-dyed bait in reducing seabird bycatch.

Data sources

The seabird bycatch data in this study were obtained from regional fisheries management organizations (IATTC, WCPFC, IOTC, ICCAT). Due to data limitations from IATTC, IOTC, and ICCAT, only WCPFC data were analyzed. Additionally, studies on blue-dyed bait were statistically analyzed to obtain preliminary results.

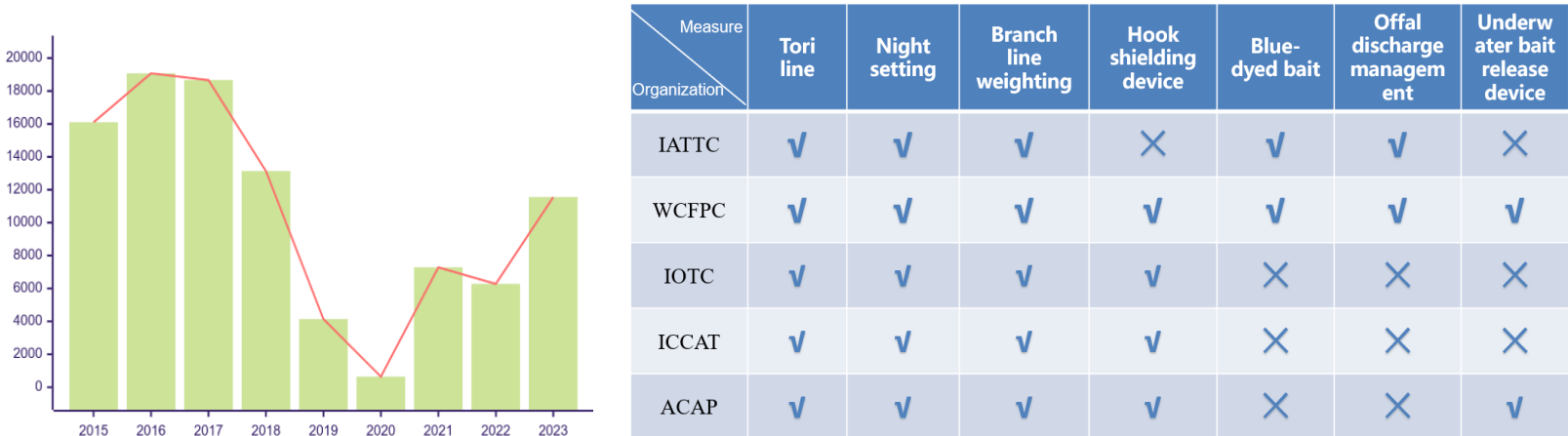


Fig 1. Seabird Bycatch Data from WCPFC over the Years and Comparative Analysis of Mitigation Measures among Different Regional Fisheries Management Organizations

Method

We conducted a database search for relevant literature using keywords such as “blue-dyed bait” and “longline fisheries,” and screened the results based on the relevance of the content. Broad search criteria were applied to capture a larger number of studies. Effect sizes were derived through relative risk analysis, combined with formulas for approximate variance and other calculations. Preliminary results have been obtained from a subset of the literature with relatively high relevance.

$$RR = \frac{a_i/n1_i}{b_i/n2_i}$$
$$\text{LogRR} = \ln RR$$
$$V_{\text{LogRR}} = \frac{1}{a_i} - \frac{1}{n1_i} + \frac{1}{b_i} - \frac{1}{n2_i}$$

Results

A total of 50 studies were screened, with data extracted from 12 that met the selection criteria (e.g, Christofer H. 2001; Gilman. 2016; Swimmer. 2005). These were used for preliminary analysis, while further detailed analyses and broader literature searches are ongoing.

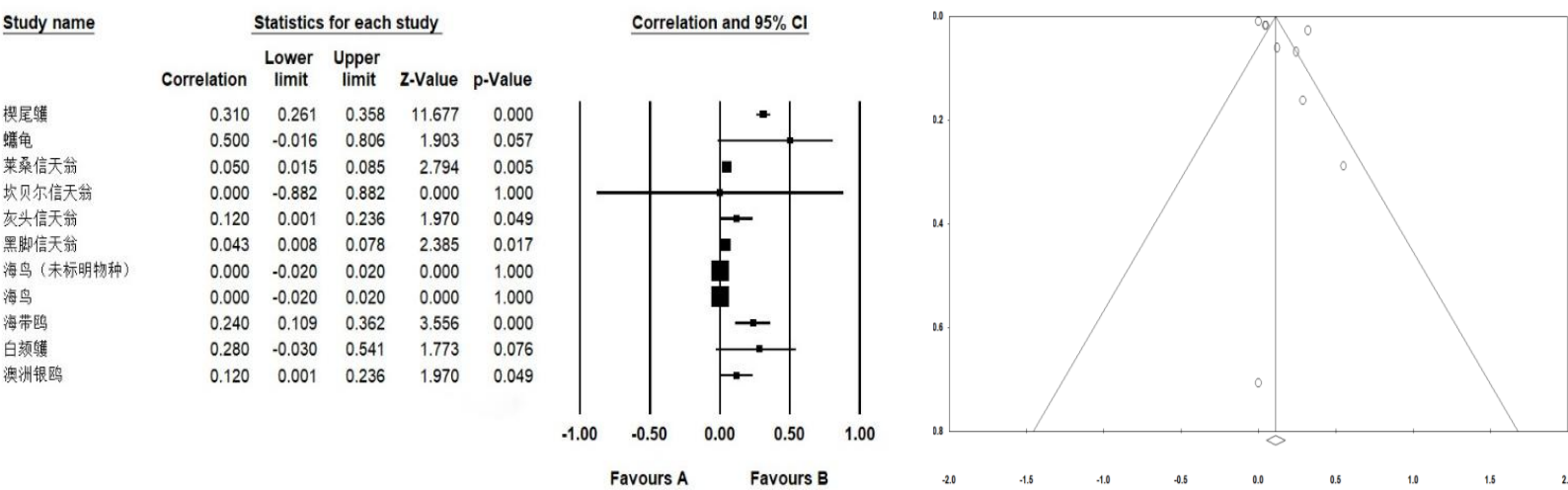


Fig 2. Analysis of Bycatch Effect Sizes among Different Species and Egger's Test.

Conclusions

This study conducted a screening and analysis of blue-dyed bait, compiling experimental bycatch data from various studies and calculating effect sizes along with relevant metrics to obtain preliminary results. The effectiveness of blue-dyed bait is not pronounced, and its cost is relatively high. Compared with other key mitigation measures, its effectiveness is lower, making it insufficient as a standalone measure; it is recommended to be used in combination with other measures. Monitoring methods that rely primarily on retrieved hook data generally underestimate bycatch events and exhibit temporal and spatial coverage gaps.