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COMMENTARY

Finding the missing pieces: working to solve the fisheries bycatch puzzle

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Seabird bycatch in industrial fisheries has been the focus of research and conservation concern since the late 1980s (Weimerskirch & Jouventin, 1987; Bartle, 1991; Brothers, 1991). Although bycatch, or incidental capture, of seabirds is only one of several human-mediated disturbances including invasive species, toxin contamination, disease and climate change (Arcos *et al*., 2002; Finkelstein, Gwiazda & Smith, 2003; Weimerskirch, 2004) that threatens their populations, fisheries bycatch has been implicated as a primary threat to a number of declining seabird populations (Weimerskirch *et al*., 1997; Tuck *et al*., 2011).

In contrast to the detailed statistics collected on target species, bycatch data are based primarily on information collected by observer programs. Several nations employ observers, who are independent of the fishing industry and trained to record bycatch, as observer records provide the highest quality bycatch data. Observer programs can be costly and, as a result, the percentage of fishing activity observed is typically low relative to the total fishing effort (Lewison *et al*., 2004).

For many fishing areas and fleets, observer data have never been reported. Yeh *et al*. (2013) addressed this substantial knowledge gap by using Taiwanese observer data to present the first report of the spatial distribution and magnitude of seabird bycatch by an Asian tuna longline fleet operating in the high seas of the Atlantic Ocean. As the authors point out, ICCAT (The International Commission for the Conservation of Atlantic Ocean Tuna), the regulatory body that has jurisdiction over fisheries in much of the Atlantic Ocean basin, has already identified 41 seabird populations at risk from longline fleets in this region (ICCAT 2008).

Yeh *et al*. (2013) calculate nominal bycatch rates – number of birds caught relative to the amount of fishing gear deployed – for fishing activity across the region and identify gear characteristics, such as when and where (latitude/longitude) the gear is set, whether bycatch mitigation devices are used and the amount of target catch. The authors also report the number of birds attending the vessels as a potential variable that has been linked to bycatch rates (Gilman, 2006; Lokkeborg, 2011).

The results these authors present solidify the trends in seabird bycatch reported by previous research. Tropical regions in the Atlantic were found to have far lower bycatch rates than the cooler water in the south-east and south-west Atlantic. The authors also confirm the positive correlation between the number of attending birds at a vessel and bycatch rates.

The results from this analysis also highlight a fundamental issue with characterizing bycatch across a large fishing area; bycatch rates are highly variable in space and time. Bycatch is a rare event, that is why these and other authors typically use Poisson, negative binomial distributions or zero-inflated negative binomial distributions (Hamel *et al*., 2009; Trebilco *et al*., 2010; Zydelis *et al*., 2011). Given the overdispersion of bycatch data, reporting separate bycatch rates for different areas even within an ocean basin, as these authors do, is critical.

Through these analyses, Yeh *et al*. (2013) contribute to the global characterization of seabird bycatch, putting the valuable Taiwanese observer data to work to fill an important data gap. The authors' work also highlights the priorities to improving seabird bycatch data, particularly in the Atlantic. Although ICCAT regulations require members to submit seabird bycatch data, only one ICCAT member country complied with this request in 2010. Yeh *et al*. also demonstrate the limitations with observer data and the need for continued improvements in existing observer programs. In this observer dataset as with many others, more than 70% of the seabirds were not identified to species, precluding the ability to directly link bycatch rates to population-level impacts on seabird species of conservation concern.

Yeh *et al*. (2013) provide support for much-needed changes to bycatch data collection: namely, increasing the spatial, temporal and species resolution of bycatch data to match catch data; increasing observer coverage to ensure the collection of unbiased bycatch data; standardizing the timing and structure of bycatch data collection across

nations; and strengthening data reporting regulations that govern all major fishing nations.

As Yeh *et al*. (2013) discuss, the observer data collection improvements described are necessary but not sufficient. Analysis of robust observer data is a first step toward identifying areas of high seabird bycatch where implementation of proven mitigation devices, such as bird-scaring lines, weighted lines and night setting, are needed (Gilman, 2006). The authors identify five such bycatch 'hotspots' in the south Atlantic Ocean (see figure 2) that are clear candidates for increased observer coverage, more extensive mitigation and extensive rigorous monitoring. The move toward a more robust observer data collection paired with directed mitigation implementation and enforcement suggests that the negative impacts of seabird bycatch across large ocean regions can be addressed.

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