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COMMENTARY

Requisite improvements to the estimation of seabird by-catch in pelagic longline fisheries

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There is no doubt that negative interactions with fisheries are among the most pervasive of current threats to seabirds (Croxall *et al*., 2012). Longlining, both demersal (bottom) and pelagic, is a particular problem for albatrosses and petrels that have gapes large enough to swallow hooks, and risk being drowned during setting (Anderson *et al*., 2011). Largely as a consequence of this incidental mortality combined with their particular demography, the albatrosses are considered to be the most threatened of any bird family according to the World Conservation Union. Also, all albatrosses and eight species of petrel are listed under the international Agreement on the Conservation of Albatrosses and Petrels. Although many national bodies that regulate longline fisheries have passed measures leading to reductions in seabird by-catch, considerably less progress has been made by some Regional Fisheries Management Organizations, which govern vessels targeting tuna and other billfishes over vast areas of the high seas (Gilman *et al*., in press). This appears to reflect a reluctance to impose changes to operational practices that may be inconvenient or have financial implications without conclusive proof that a fishery is responsible for driving seabird population declines. This is despite the obligations of these bodies to minimize impacts on non-target species and ensure sustainable management.

For this reason, the forthcoming paper by Yeh *et al*. (2012) is particularly welcome, as it provides the first peer-reviewed paper on seabird by-catch by an Asian (Taiwanese) distant-water fleet operating in the high seas of the South Atlantic Ocean. Monitoring and addressing by-catch in these waters is critically important, as the decline of regional albatross breeding populations is greater there than in any other ocean basin. The discussion of this paper not only covers many salient issues concerning collection and interpretation of seabird by-catch data, but laudably exhorts the International Commission for the Conservation of Atlantic Tuna (ICCAT) and its contracting parties to implement minimum observer standards and increase coverage, particularly in known by-catch hot spots.

Among other things, Yeh *et al*. suggest that by-catch observation at the level of 5% of fishing effort is insufficient to understand impacts on seabird species that are caught rarely. This is certainly true; the precipitous decline from 1997 to 2007 (by 39%) of wandering albatrosses from South Georgia, which formerly represented >20% of the global population, was caused by the removal, without replacement, of just 100 breeding birds per year. Wandering albatrosses ringed on South Georgia have been reported dead in every major tuna and many demersal longline fisheries operating south of 30°S. Yet because of the variability and unpredictability of by-catch events, it is impossible to reliably estimate the total killed in each fishery unless data are available for the great majority of vessels. Seabird species vary hugely in behavioural susceptibility to capture, seasonal distribution, and hence in relative overlap with different fisheries. Although it is possible to develop a qualitative ecological risk assessment for seabirds based on largely circumstantial evidence, more quantitative analyses of impacts – which in some instances seem to be a prerequisite for a management response – require a minimum level of information on species-specific by-catch rates (Small, Waugh & Phillips, 2013). To their credit, Yeh *et al*. point out the advantages of collecting such data. This cannot be emphasized enough and can be readily illustrated with the Taiwanese data; Table 3 lists just two species (none of them albatrosses) sighted behind vessels or caught during daytime in the southwest Atlantic which were identified by Taiwanese observers. However, more than 38 species, of which 14 make substantial use of discards, were recorded behind Uruguayan longliners in an overlapping area (Jimenez *et al*., 2011). Yeh *et al*.'s recommendation that increased training be provided to observers on seabird identification therefore could not be more apt. Furthermore, it is worth considering to what extent the Taiwanese observers were able to faithfully report the number of birds killed, given their responsibilities for recording multiple operational variables and all catch, in addition to all by-catch and general bird observation. Indeed, in their review of seabird by-catch rates in the southwest Atlantic, Bugoni *et al*. (2008) point out that the most reliable information on by-catch is obtained by having dedicated seabird observers.

The reality is that by-catch observation focused only on 5% of overall effort is inadequate even for frequently-by-caught species, given the large spatial and seasonal heterogeneity in by-catch rates. Indeed, sample size limitations are apparent in the Taiwanese dataset. Although they run generalized additive models, Yeh *et al*. found that by-catch rate showed a statistically significant relationship only with fishing location and number of birds sighted behind vessels, but not season, use of streamer (tori) lines or catch per unit effort (CPUE) of target species. This is despite the abundant evidence for pronounced seasonal changes in by-catch rates, and for the effectiveness of streamer lines as a mitigation measure in pelagic longline fisheries, including in detailed studies by Yeh's co-authors. Furthermore, coverage of Taiwanese fishing effort in the two regions where virtually all their by-catch was recorded was well below the 5% observation level; just 1.3 and 4.4% in the southwest and southeast Atlantic, respectively. By applying these by-catch rates and those recorded in previous studies for vessels flagged to Brazil, Japan, Namibia, South Africa and Uruguay, to effort reported to ICCAT for the relevant $5 \times 5°$ square, Yeh *et al*. estimated the mortality from pelagic longlining in the south Atlantic between 2004 and 2008 ranged from 3446 to 6083 birds per year. It is not clear whether this estimate is any more accurate than a previous estimate for ICCAT fisheries, particularly bearing in mind that < 50% of birds killed during line setting may be retrieved in the haul (Brothers *et al*., 2010). Nevertheless, a key message from Yeh *et al*., supported by earlier reviews highlighting the 100–1000 s of birds estimated or suspected to be killed in numerous other fisheries (Bugoni *et al*., 2008; Anderson *et al*., 2011), is that independent observer programmes for by-catch still need substantial expansion and improvement. Only then will they be sufficient for comprehensive by-catch assessments, and adequate monitoring of vessel compliance and the effectiveness of recommended by-catch mitigation at ocean basin scales.

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