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COMMENTARY

Challenges in seabird by-catch mitigation

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Among a number of at-sea and land-based threats affecting the conservation status of seabirds, the incidental mortality in fisheries is the most pervasive, particularly affecting species like albatrosses and petrels characterized by very low productivity (one egg clutch and low breeding frequency) and reproductive rate (delayed maturity and long generation time). These life-history traits make this group of seabirds particularly sensitive to even minor increases in juvenile and adult mortality like the one resulting from the interaction with fisheries. Albatross and a large number of petrel species show extreme travelling capabilities, crossing boundaries and feeding in a range of marine environments in relatively short time scales. Hence, cooperation at the international level is essential to improve the conservation status of these threatened species, some of which are endangered or critically endangered with extinction (see Croxall *et al*., 2012, http://www.acap.aq).

Seabird by-catch in fisheries became a conservation issue some two decades ago with the first studies reporting incidental mortality in longliners and trawlers (Bartle, 1991; Brothers, 1991). In the 1990s, conservation efforts were primarily focused in pelagic and demersal longline fisheries, although over the years, the incidence and scale of seabird by-catch in trawlers also became evident (e.g. Sullivan, Reid & Bugoni, 2006). These interactions between seabirds and fisheries are not evenly distributed in the oceans, but are particularly concentrated in highly productive waters. Those around New Zealand and Australia, the Humboldt system (comprising Chile, Peru and Ecuador), the North Pacific, the Patagonian shelf (including Argentina, Uruguay and southern Brazil) and the Benguela system (including South Africa, Namibia and Angola) have been identified as regions where seabirds (among other top predators) and fisheries converge and priority attention to conservation efforts is needed (Lewison *et al*., 2014).

Because of their higher level of fishing effort, seabird mortalities from trawl fleets occurring in some regions may be more significant than those in longline fleets. Moreover, current evidence strongly suggests that by-catch in trawl fisheries could be largely underestimated because of cryptic mortality (i.e. seabirds killed but not retrieved on deck during hauling). Although this was also recognized in longline fisheries, this issue could be more important in trawlers given that only a small proportion of birds colliding or becoming entangled with the fishing gear are retrieved aboard (e.g. Abraham & Thompson, 2009). Special attention should be given to the interaction with trawl fisheries in order to refine observer protocols, adequately quantify the levels of incidental mortality and implement conservation measures. Initial reports from South African trawl fisheries indicated an alarming *c.* 18 000 seabirds killed per year, a large proportion of which were albatrosses (Watkins, Petersen & Ryan, 2008). Following this assessment, and as a result of the fishery entering the Marine Stewardship Council certification scheme, a number of conservation actions were undertaken, including the implementation by mid-2006 of a permit condition requiring the use of bird-scaring lines (BSLs) in the fishery. Industry was engaged and supported the process. The assessment conducted by Maree and collaborators (2014) not only updated the numbers to recent years but also refined former estimations by correcting the level of fishing effort using logbook data that was not previously available. This paper highlighted the effectiveness of BSLs as a by-catch mitigation method, reducing mortality rates up to 95%. But the paper also noted the risks associated with estimating total mortalities with short-term datasets or incomplete data on fishing effort and/or level of seabird interactions. Some of these shortcomings have been addressed and discussed in previous papers, following the original publication by Watkins and collaborators (Moore & Zydelis, 2008; Ryan & Watkins, 2008).

Current estimations of annual fatalities in South African fisheries are in the order of 1000 seabirds, out of which less than 100 are albatrosses, implying a reduction in the by-catch of more than 90% because of both effective by-catch mitigation and a significantly reduced level of fishing effort (Maree *et al*., 2014). The progress achieved in this trawl fishery should be seen as a case study to be replicated in neighbouring waters and other important fishing grounds around the globe. The south-west Atlantic offers

some good examples of trawl fisheries where seabird incidental mortalities have been characterized and quantified (e.g. Favero *et al*., 2011) but where no mitigation has been put in place, although the importance of the by-catch issue is clearly evident. Urgent conservation actions are needed in these fisheries to minimize seabird by-catch. To that end, it will be critical to work both at a national and international level on a conservation strategy that includes (1) further developing and refining mitigation methods, understanding that in most cases, solutions to by-catch are fishery-specific and may require local adjustments; (2) building capacities within observer programmes to enhance the quality of data acquired and ensure the proper use of mitigation methods; (3) engaging with the fishing industry to maximize implementation and compliance, and to address logistic and safety issues associated with the use of some mitigation measures; and (4) working with governments, administrators and decision makers to promote better fishing practices through the adoption and, most importantly, the implementation of conservation measures.

Aside from the fact that the level of implementation of seabird conservation measures currently adopted (both in international waters and within exclusive economic zones) is in many cases uncertain, there is a large number of fisheries that lack any regulations at all to address this issue. While the problem in longline and trawl fisheries is now better understood, urgent attention should be paid to other fishing gears, like purse-seine and gill nets, where the information available and the development of seabird by-catch mitigation measures is very limited (but see Zydelis, Small & French, 2013). Seabird by-catch occurring in artisanal, small-scale (e.g. Moreno *et al*., 2006) and even recreational fisheries deserves a special mention, given the limited capabilities to implement mitigation in small vessels because of a variety of operational reasons. Some of these small-scale fleets consist of thousands of boats operating in waters where seabirds range. When the scale of these fleets is taken into account, even very rare (almost undetectable) by-catch events per boat may have a profound effect in some populations. This is an important conservation issue that will challenge seabird scientists and conservationists in the near future.

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