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Review

The incidental catch of seabirds in gillnet fisheries: A global review

Ramūnas Žydelis [a,*], Cleo Small [b], Gemma French [b]

[a] DHI, Agern Allé 5, DK-2970 Hørsholm, Denmark
[b] BirdLife International Global Seabird Programme, Royal Society for the Protection of Birds, Sandy, Bedfordshire SG19 2DL, UK

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ABSTRACT

Based on bird feeding ecology we identified 148 seabird species as susceptible to bycatch in gillnets, of which 81 have been recorded caught. The highest densities of susceptible species occur in temperate and sub-polar regions of both hemispheres, with lower densities in tropical regions. Gillnet fisheries are widespread and particularly prevalent in coastal areas. A review of reported bycatch estimates suggests that at least 400,000 birds die in gillnets each year. The highest bycatch has been reported in the Northwest Pacific, Iceland and the Baltic Sea. Species suffering potentially significant impacts of gillnet mortality include common guillemot (*Uria aalge*), thick-billed guillemot (*Uria lomvia*), red-throated loon (*Gavia stellata*), Humboldt penguin (*Spheniscus humboldti*), Magellanic penguin (*Spheniscus magellanicus*), yellow-eyed penguin (*Megadyptes antipodes*), little penguin (*Eudyptula minor*), greater scaup (*Aythya marila*) and long-tailed duck (*Clangula hyemalis*). Although reports of seabird bycatch in gillnets are relatively numerous, the magnitude of this phenomenon is poorly known for all regions. Further, population modelling to assess effects of gillnet bycatch mortality on seabird populations has rarely been feasible and there is a need for further data to advance development of bycatch mitigation measures.

Contents

* Corresponding author. Tel.: +45 4516 9025.
E-mail addresses: rzy@dhigroup.com (R. Žydelis), Cleo.Small@rspb.org.uk (C. Small).

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1. Introduction

The status of seabird populations is deteriorating faster compared to other bird groups, and bycatch in fisheries is identified as one of the principle causes of declines (Croxall et al., 2012). The problem of seabird bycatch in gillnet fisheries has long been known in the Pacific, Atlantic oceans and Baltic Sea (Tull et al., 1972; Ainley et al., 1981; Piatt and Nettleship, 1987; Stempniewicz, 1994), and gillnets have been the cause of some of the highest recorded mortalities of seabirds worldwide. In the North Pacific, drifting gillnets were estimated to be killing c. 500,000 birds per year, prior to a UN moratorium in 1992 (DeGange et al., 1993; Uhlmann et al., 2005). A review by Robins (1991) found 60 species of seabirds had been reported caught in gillnets worldwide, and that net mortality was a major contributor to declines of auk populations in California, Newfoundland, the Canadian Arctic, west Greenland and northern Norway. A regional review revealed that between 100,000 and 200,000 seabirds could be being killed annually in gillnets in the Baltic and North Sea region alone (Žydelis et al., 2009).

Surprisingly, the global magnitude and significance of seabird bycatch in gillnet fisheries remain largely unknown (Robins, 1991; Žydelis et al., 2009). Assessment is hampered by large and diverse artisanal fisheries (i.e. small-scale fisheries for subsistence or local markets, typically using traditional fishing gears and small boats), and data on fishing effort and catch of target and non-target species are very sparse.

The objectives of this review were to:

- identify seabird species susceptible to and impacted by gillnet fishing;
- summarise seabird bycatch in gillnet fisheries globally by region and identify likely data gaps;
- assess factors determining bird captures in gillnets;
- review bycatch mitigation measures in use or under development;
- identify areas where conservation actions are most needed.

2. Materials and methods

2.1. Literature search

We reviewed a broad array of scientific publications, published and unpublished reports to collate available data on seabird bycatch in gillnet fisheries worldwide. We identified literature sources by querying the Internet and academic databases (e.g., ISI Web of Knowledge and Zoological Record (TM)), and examining reports otherwise known to authors of this review. Our focus was on existing fisheries, although where useful we mention fisheries that are no longer active.

Due to the high variability in metrics used when assessing and reporting seabird bycatch in gillnet fisheries (Žydelis et al., 2009), it was not possible to summarise the studies in a standardised way. We therefore summarised results by pooling the reported bycatch estimates from non-overlapping regions. We included all information available, including some based on small sample sizes, on the assumption that they represent the best available knowledge to date.

We focused this review on seabird bycatch in marine waters only and considered only seabird species listed in Croxall et al. (2012). We summarised the results by ocean regions using the FAO fishing area boundaries (http://www.fao.org/fishery/area/search/en), some of which were grouped (Fig. 1).

2.2. Gillnet fishing methods

Gillnets are a non-mobile fishing gear with a mesh that traps fish and other organisms. Mesh sizes vary according to target species, ranging from 15 mm to over 250 mm. The net acts as a wall that is weighted or anchored at the bottom and buoyed at the top (the "float" or "cork" line) to keep it vertical in the water column. This blocks the pathway of larger organisms, creating a risk of entanglement for non-target species such as seabirds, turtles, sharks and marine mammals. The gillnet is known as a "fixed gillnet" or "set-net" if it is attached to the seabed by a weighted anchor at each end. The gillnet is a "driftnet" if it is suspended in the water column (one end is buoyed and the other is attached to the stern of a fishing vessel or buoy). Traditionally, nets were made from hemp, cotton or multifilament nylon, which were usually highly visible to seabirds. In recent decades, monofilament has been increasingly used, being cheaper, longer lasting and easier to handle, but also less visible to seabirds and other non-target taxa, increasing the potential for bycatch. In 1992, the United Nations imposed a moratorium on the use of large-scale (>2.5 km long) driftnets on the high seas (U.N. Resolution 46/215), but small-scale driftnetting continues and driftnets, set-nets and other types of gillnets (e.g., trammel nets) persist within many EEZs. Analysis of gillnet fishing effort revealed that this type of fishing takes place in nearshore waters of all continents except Antarctica, and is the most intensive along coasts of SE Asia and in the NW Pacific (Waugh et al., 2011; Sea Around Us Project, 2013). In this review we considered reported bird bycatch in all types of gillnets.