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Research paper

# Fishery-specific solutions to seabird bycatch in the U.S. West Coast sablefish fishery

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ABSTRACT

Bird scaring lines (BSLs) protect longline fishing gear from seabird attacks, save bait, reduce incidental seabird mortality and are the most commonly prescribed seabird bycatch mitigation measure worldwide. We collaborated with fishermen to assess the efficacy of applying BSL regulations from the demersal longline sablefish fishery in Alaska to a similar fishery along the U.S West Coast. In contrast to Alaska, some U.S. West Coast vessels use floats along the line to keep hooks off the seafloor, where scavengers degrade the bait and the target catch. Our results confirmed that BSL regulations from Alaska were sufficient to protect baits from bird attacks on longlines without floats, but not baits on longlines with floats. Longlines with floats sank below the reach of albatrosses (2 m depth) at a distance astern (157.7 m ± 44.8 95% CI) that was 2.3 times farther than longlines without floats (68.8 m ± 37.8 95% CI). The floated longline distance was well beyond the protection afforded by BSLs, which is approximately 40 m of aerial extent. Black-footed albatross attacked floated longlines at rates ten times more (2.7 attacks/1000 hooks, 0.48–4.45 95%CI) than longlines without floats (0.20 attacks/1000 hooks, 0.01–0.36 95% CI). Retrospective analysis of NOAA Fisheries Groundfish Observer Program data suggested that seabird bycatch occurs in a few sablefish longline fishing sectors and a minority of vessels, but is not confined to larger vessels. Analysis also confirmed fishermen testimonials that night setting reduced albatross bycatch by an order of magnitude compared to daytime setting, without reducing target catch. Night setting could be an effective albatross bycatch prevention practice if applied to the U.S. West Coast sablefish longline fishery and provide a practical alternative for vessels that elect to use floated longlines. These results highlight the importance of understanding region-specific longline gear modifications to identify effective bycatch reduction tools and the value of working collaboratively with fishermen to craft solutions.

## 1. Introduction

### 1.1. Global seabird bycatch

Incidental mortality of seabirds in longline fisheries has been an international conservation concern for decades, with reported estimates of approximately 160,000 seabirds killed in longline fisheries annually (Anderson et al., 2011; Croxall et al., 2012; Lewison et al., 2004). Albatross populations are especially vulnerable to bycatch mortality because they exhibit delayed maturity and low fecundity. Commercial fisheries have been implicated in the decline of many albatross and petrel species (Lewison and Crowder, 2003; Weimerskirch et al., 1997). Fifteen of 22 albatross species (Family Diomedeidae) are threatened with extinction, one of the highest proportions among birds (Butchart et al., 2004; Croxall et al., 2012; IUCN, 2016; Phillips, 2013).

Most seabird mortality in demersal longline fisheries occurs as seabirds attempt to forage on baited hooks during longline deployment. Seabirds become hooked or tangled and subsequently drown (Brothers, 1991; Løkkeborg, 2011). Non-lethal interactions can also occasionally occur as fishermen retrieve their longlines and seabirds congregate to

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forage on discarded bait and offal. Seabird interactions with fishing gear have negative consequences for fishery participants because of the costs of bait lost to birds, and the cost of lost fishing opportunity if excessive seabird bycatch triggers a fishery closure. The development and implementation of best practice seabird bycatch mitigation technologies are critical to achieving global seabird conservation goals and sustainable ecosystem-based fisheries management (Brothers et al., 1999; Løkkeborg, 2011).

Global bycatch avoidance best practices for demersal longlines include deterring foraging seabirds with bird scaring lines (BSLs) and setting gear after dark (ACAP, 2016a; Melvin et al., 2004). The current international best practice guidelines, set out by the Agreement on the Conservation of Albatrosses and Petrels (ACAP), additionally rely on longline weighting to sink hooks rapidly and close to the stern of the vessel, thereby reducing the amount of time bait is vulnerable to birds and birds vulnerable to hooking. When efficient fishing requires longlines to be in contact with the seafloor, adding weight to the longline can be a practical method for reducing seabird bycatch because it reduces the time that baited hooks are at the surface.

Some demersal longline fishermen use floats placed at intervals along the groundline to suspend most hooks a few meters above the sea floor. Floats provide access to target species, while avoiding non-target benthic species or scavengers that degrade baits and target catch. However, floats also slow the sinking rate of longlines, thereby increasing both the time and the distance astern that baited hooks are available to birds at the surface of the water. The delayed sinking of floated longlines may keep baited hooks at the surface and increase bycatch risk for seabirds. The hooks on floated longlines may also snag the trailing ends of bird-scaring lines if the hooks remain near the surface beyond the aerial extent of BSLs. Developing effective seabird avoidance measures for floated demersal longlines has been identified as a priority for seabird conservation and has received increasing attention from the research community (ACAP, 2016c). Researchers have documented slower longline sink profiles and elevated levels of seabird bycatch in floated demersal longline fisheries off South America and New Zealand (Debski, 2016; Pierre et al., 2013; Seco Pon et al., 2007), which suggests there may be cause for concern in floated demersal fisheries off the U.S. West Coast. In artisanal demersal longline fisheries in the Mediterranean Sea, floated demersal longline configurations (Piedra-Bola zigzag and pyramid systems) were associated with seabird attacks on baited hooks further astern compared to non-floated longline configurations, but overall seabird bycatch rates were not elevated (Cortés et al., 2017). These contrasting findings highlight the need for a thorough understanding of the fishery, vessel specifications, longline configurations, and the attending seabird community to design fishery-specific seabird avoidance measures. Longline fishermen targeting sablefish off the U.S. West Coast use both floated and non-floated demersal longline gear, thus providing the opportunity to evaluate seabird interactions with both longline configurations within the same fleet.

### 1.2. Albatross conservation on the U.S. West Coast

Three albatross species (Laysan: *Phoebastria immutablis*, black-footed: *P. nigripes*, short-tailed: *P. albatrus*) range throughout the Northeast Pacific Ocean. The short-tailed albatross, listed as endangered under the U.S. Endangered Species Act (ESA), is the focus of an intensive multi-national recovery program as well as the driving force motivating seabird bycatch prevention requirements in Alaska and the U.S. West Coast (Washington, Oregon, California) longline fisheries. The population of the endangered short-tailed albatross (4700 in 2015, USFWS, 2014; Sievert and Hasegawa, unpublished data) is less than 1% of its historical abundance. However, it is growing at ≈8% per year and beginning to re-occupy its former range (USFWS, 2014; Sievert, and Hasegawa, unpublished data). In 2011, a longline vessel targeting sablefish (*Anaplopoma fimbria*) off central Oregon caught a short-tailed albatross (Good et al., 2015; Jannot et al., 2016; USFWS, 2012). This event confirmed the suspicion that short-tailed albatrosses are vulnerable to mortality in the U.S. West Coast groundfish fishery (Melvin et al., 2001; Suryan et al., 2007) and triggered an evaluation of bycatch prevention measures in this fishery. No albatross bycatch avoidance measures were required for U.S. West Coast groundfish fisheries at that time. There is also international conservation concern for black-footed albatross (IUCN Red Listed as vulnerable, IUCN, 2016). Chronic mortality of black-footed albatross occurs in U.S. West Coast groundfish fisheries, with estimated annual takes between 51 and 215 for the 2010–13 period (Jannot et al., 2016). Other species of conservation concern (Laysan albatross and Pink-footed shearwaters (*Puffinus creatopus*; USFWS, 2008)), and species protected under the Migratory Bird Treaty Act (50 CFR Part 10 and 21) are also potentially susceptible to interactions with U.S. West Coast longline fisheries. Thus, designing and promoting effective seabird bycatch mitigation for these fisheries has far-reaching conservation benefits for many seabirds in the Northeast Pacific Ocean.

We focused our research on developing best practices for the U.S. West Coast demersal longline fishery based on recent bycatch data and findings on seabird exposure to interactions in the U.S. West Coast groundfish fishery. Guy et al. (2013) found that the demersal longline fishery for sablefish presented the greatest threat to albatrosses off the U.S. West Coast, and demonstrated that black-footed and short-tailed albatross distributions and occurrence overlapped with the demersal sablefish longline fishery, particularly in shelf-slope habitats north of 36° N latitude. Good et al. (2015) and Jannot et al. (2011) showed that most of the observed bycatch of seabirds, and albatrosses in particular, also occurs in this fishery. Based on these findings, we staged our research in the fishery posing the greatest risk to seabirds – the sablefish fishery.

### 1.3. Objectives and hypotheses

Our research objectives were to characterize sink profiles and assess seabird behavioral responses to floated and non-floated longline configurations in the presence of bird-scaring lines in the U.S. West Coast demersal longline sablefish fishery. We hypothesized that floated demersal longlines would remain at the surface further astern than non-floated longlines and that seabirds would exploit this opportunity by attacking hooks on floated longlines at higher rates beyond the protection of bird scaring lines.

In response to fishermen testimonials during workshops held in ports throughout the region, we also explored alternative seabird bycatch tools for this fishery by examining the efficacy of night fishing as a tactic for avoiding seabird bycatch. We use 12 years of data from the NOAA Fisheries West Coast Groundfish Observer Program to compare seabird bycatch rates and fish landings in the fishery for sets made at night and during the day. Because albatrosses are primarily visual foragers and exhibit greater foraging activity during daylight (Fernández and Anderson, 2000), we anticipated that the bycatch of albatrosses and other seabirds would be lower on sets made at night. We also compared catch rates of target fish during day and nighttime sets, as profitability likely influences fishermen's receptivity to night fishing as a seabird bycatch avoidance measure. Many fishes exhibit diurnal behavioral patterns that can affect catchability (e.g., Hart et al., 2010). Sablefish, in particular, enter into contact with the seafloor at sunrise, and rise up into the water column at night (Doya et al., 2014). Therefore, we anticipated that the catch per unit effort of sablefish, the target species, might differ between nighttime and daytime fishing. It was also important to ensure that the catch of non-target species did not increase when setting at night. Further, we used observer program data to examine the relative albatross bycatch rates for large (≥16.8 m) vs. small (< 16.8 m) vessels and the variation in albatross bycatch among individual vessels in order to better understand seabird bycatch trends in this fishery.