Estimated Short-tailed Albatross Bycatch in the U.S. West Coast Groundfish Fisheries, 2002 - 2019

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Executive Summary

In accordance with the National Marine Fisheries Service (NMFS) Biological Opinion on Continuing Operation of the Pacific Coast Groundfish Fishery, this document reports observed takes of U.S. Endangered Species Act (ESA)-listed short-tailed albatross (*Phoebastria albatrus*) in the west coast groundfish fishery and estimated fleet-wide bycatch in the Limited Entry sablefish longline sector for the latest biennium (2018-2019).

Bycatch of short-tailed albatrosses in commercial fisheries continues to be a major conservation concern for this species. Since 1983, 21 short-tailed albatross takes have been documented throughout the North Pacific. The only observed short-tailed albatross mortality in the Pacific Coast Groundfish Fisheries was documented off the Oregon coast on April 11, 2011 in the Limited Entry sablefish longline sector.

In response to the 2011 mortality event, the Pacific Fishery Management Council (PFMC) adopted recommendations for seabird bycatch mitigation, requiring streamer lines be deployed during setting operations on commercial fixed gear vessels 55' (17 m) or greater in length. In 2020, the requirements were expanded to cover vessels 26' (8 m) or greater in length and added an alternative to streamer lines which was setting gear at night, defined as between one hour after sunset and one hour before sunrise.

No short-tailed albatross takes were documented in the U.S. West Coast groundfish fisheries in (2018-2019), and we continue to estimate bycatch over the full time series (2002-2019) using Bayesian methods. We compared 12 Bayesian time-series models to obtain the single best model to describe bycatch. The best model used a constant bycatch rate and a Poisson process to describe bycatch, and inferred annual expected mortality, given specified levels of observed effort and estimated fleet-wide bycatch using the percent of observer coverage. Fleet-wide estimates of mean bycatch ranged from 0.2 to 1.8 STAL/year, while the confidence limits of those annual estimates ranged from 0.0 to 6.6 STAL/year. The take threshold established by the Biological Opinion is five estimated or one observed albatross over a two-year period, neither of which have been exceeded.

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Introduction and Background

In accordance with the National Marine Fisheries Service (NMFS) Biological Opinion Regarding the Effects of the Continued Operation of the Pacific Coast Groundfish Fishery as governed by Pacific Coast Groundfish Fishery Management Plan and implementing regulations at 50 CFR Part 660 (USFWS 2012, p. 37), this document provides an analysis of observed takes and fleet-wide bycatch estimates of U.S. Endangered Species Act-listed short-tailed albatross (*Phoebastria albatrus*) in U.S. west coast groundfish fisheries.

The short-tailed albatross was likely once the most abundant albatross in the North Pacific, with possible breeding sites also in the North Atlantic (Olson and Hearty 2003). Starting before and continuing after the turn of the 20th century, millions of these birds were hunted for feathers, oil, and fertilizer; by 1949, no birds were observed breeding and the species was thought to be extinct (USFWS 2008). The species began to increase in numbers during the 1950s, and currently occurs throughout the North Pacific Ocean.

The short-tailed albatross was federally listed as endangered throughout its range, including the United States, on July 31, 2000 (65 FR 147:46643-46654, USFWS 2000). Under the Endangered Species Act, the Short-tailed Albatross Recovery Plan was finalized in September 2008 (USFWS 2008). There have been three subsequent 5-year reviews (USFWS 2009, 2014, 2020), none of which have recommended changing listing status

The short-tailed albatross is a colonial, annually breeding species, with each breeding cycle lasting about 8 months. Currently, three primary breeding colonies exist in the western Pacific: Torishima, in the Seven Islands of Izu, Minami-kojima, in the Senkaku Islands, and Mukojima, in the Ogasawara (Bonin) Islands (USFWS 2020). Approximately 80- 85% of the breeding population nests on Torishima Island, Japan, which is an active volcano. At Torishima, birds begin to arrive in early October and a single egg is laid between late October and late November; incubation lasts 64 to 65 days; and hatching occurs in late December through January (Hasegawa and Degange 1982). Chicks begin to fledge from late May into June (Austin 1949). First breeding attempts can occur when birds are five years old, but more commonly occur at age six (USFWS 2008).

The breeding colony in the Senkaku Islands is in disputed ownership among China, Japan and Taiwan, making access impossible since 2002. The current estimate for breeding adults on the Senkaku Islands is 1,176 birds (USFWS 2020), but this estimate is unverified, and it is predicated on the assumption that the Senkaku Islands have continued to increase at the same 8.9% growth rate as has been calculated for the Torishima Island colony. Satellite images taken of the Senkaku Islands during 2015 confirmed short-tailed albatross presence during the breeding season, and estimates based on these images were closely in line with model estimates for the population; however, due to inadequate image quality, verified counts of the population have not been achieved (USFWS 2020).

A breeding colony was re-established by translocating 10 chicks in 2008 to Mukojima, a non-volcanic island south of Torishima in the Ogasawara (Bonin) Islands. All chicks in this cohort survived to fledging; from 2009-2012, 15 chicks per year were moved to Mukojima all but one were reared to fledging (Deguchi et al. 2014). The translocation efforts may be

attracting additional breeding adults to Mukojima Island, as breeding has been attempted every year since the 2012–13 breeding season. Unfertilized eggs were produced during the 2012-13, 2013-14, and 2014-15 breeding seasons, and single chicks were produced annually from the 2015-16 through the 2018-19 breeding season (USFWS 2020).

In 2016, a single pair appeared together on Midway Atoll's Sand Island. The male was banded at Torishima in 2003 and has been visiting the island since 2006; its partner was suspected to be an individual that was banded at Torishima in 2008 and was first observed on Sand Island in early 2012. In 2017, following courting and nesting activity, the pair usurped a neighboring nest of a black-footed albatross (*P. nigripes*) and raised their chick to fledging in mid-June. The pair successfully produced a chick of its own during each of the last three years (Cooper 2021). Previously, a short-tailed albatross pair hatched and successfully reared three chicks in four attempts on Midway Atoll's Eastern Island from the 2010/11 to 2013/14 breeding seasons; however, the male was found dead in December 2014 (Cooper 2018). The hatching in 2011 marked the first confirmed hatching of a short-tailed albatross outside of the islands surrounding Japan in recorded history. Observations of eggs and reports from the 1930s suggested that short-tailed albatross may have nested on Midway Atoll in the past.

A female-female pair of short-tailed albatross has laid eggs at Kure Atoll in the Northwestern Hawaiian Islands consistently since 2010; no eggs have hatched, presumably because they are infertile (Cooper 2018).

The short-tailed albatross is making good progress toward meeting delisting recovery criteria. These criteria include the current total population (7,365 individuals) exceeding 4,000 individuals and the 3-year running average population growth rate (8.9 %, USFWS 2020) exceeding ≥6 % for ≥7 years. The greatest challenge to recovering the species is likely to be the growth of new colonies at islands other than the main breeding site at Torishima and verification of the population growth rate on Senkaku Islands, which has not been visited since 2002 (USFWS 2020).

A recent paper found morphological differences between Senkaku- and Torishima-type birds; based on these differences as well as genetic and ecological differences revealed in previous studies, they believe the types should be classified as different cryptic species (Eda et al. 2020). To date, there has been no change in the species' classification.

Short-tailed Albatross Bycatch

Bycatch of short-tailed albatrosses in commercial fisheries continues to be a major conservation concern, especially for younger age classes (ca. 2/3 of the 21 reported fishing mortalities were < 4 years old; Table 1). Two birds were reported in the 1980s, six birds were reported from 1991-2000, five birds were reported from 2001-2010, and eight birds were reported from 2011-2020. Most of the mortalities in commercial fisheries (15 of 21) were reported from Alaskan waters. There were no mortalities documented in Alaskan fisheries during the 2018-2019 period which is the subject of this report; however, two mortalities were recorded in hook-and-line fisheries in Alaska in 2020 (NOAA Fisheries 2020a,b).

Table 1: Short-tailed albatross mortalities associated with Pacific Ocean fisheries reported since 1983, including reporting date, the fishery, if it was reported by an observer program, in an observer sample, the bird 's age, the location, and the source.

Report Date	Fishery	Observer program	In sample*	Bird age	Location	Source
7/15/1983	Net	No	n/a	4 months	Bering Sea	USFWS (2008)
10/1/1987	Halibut	No	n/a	6 months	Gulf of Alaska	USFWS (2008)
8/28/1995	IFQ sablefish	Yes	No	1 year	Aleutian Islands	USFWS (2008)
10/8/1995	IFQ sablefish	Yes	No	3 years	Bering Sea	USFWS (2008)
9/27/1996	Pacific cod hook-and-line	Yes	Yes	5 years	Bering Sea	USFWS (2008)
4/23/1998	Russian salmon drift net	n/a	n/a	< 1 year	Bering Sea, Russia	USFWS (2008)
9/21/1998	Pacific cod hook-and-line	Yes	Yes	8 years	Bering Sea	USFWS (2008)
9/28/1998	Pacific cod hook-and-line	Yes	Yes	Sub-adult	Bering Sea	USFWS (2008)
7/11/2002	Russian **	n/a	n/a	3 months	Sea of Okhotsk, Russia	YIO (2011) in USFWS (2014)
8/29/2003	Russian demersal longline	n/a	n/a	3 years	Bering Sea, Russia	YIO (2011) in USFWS (2014)
8/31/2006	Russian **	n/a	n/a	1 year	Kuril Islands, Russia	YIO (2011) in USFWS (2014)
8/27/2010	Pacific cod hook-and-line	Yes	Yes	7 years	Bering Sea/Aleutian Islands	NOAA Fisheries (2010)
9/14/2010	Pacific cod hook-and-line	Yes	Yes	3 years	Bering Sea/Aleutian Islands	NOAA Fisheries (2010)
4/11/2011	Sablefish demersal longline	Yes	Yes	1 year	Pacific Ocean/Oregon	USFWS (2012)
10/25/2011	Pacific cod hook-and-line	Yes	Yes	1 year	Bering Sea	NOAA Fisheries (2011)
5/24/2013	Hook-and-line seabird bycatch research	No	n/a	1 year	Pacific Ocean, Japan	YIO, pers. comm.
9/7/2014	Greenland turbot hook-and-line	Yes	No	5 years	Bering Sea/Aleutian Islands	NOAA Fisheries (2014a)
9/7/2014	Greenland turbot hook-and-line	Yes	Yes	Sub-adult	Bering Sea/Aleutian Islands	NOAA Fisheries (2014b)
12/16/2014	Pacific cod hook-and-line	Yes	Yes	< 1 year	Bering Sea/Aleutian Islands	NOAA Fisheries (2014c)
9/26/2020	Pacific cod demersal longline fishery	Yes	Yes	9 years	Bering Sea/Aleutian Islands	NOAA Fisheries (2020a)
10/16/2020	Pacific cod demersal longline fishery	Yes	Yes	2 years	Bering Sea/Aleutian Islands	NOAA Fisheries (2020b)

* "In sample" refers to whether specimen was in catch sample analyzed by a fisheries observer

** Specifics regarding the type fishery are unknown

n/a = not applicable

The incidental take of a short-tailed albatross in the U.S. West Coast sablefish longline fishery in April 2011 brought attention to seabird-fisheries interactions in groundfish fisheries along the west coast. This bycatch event of a short-tailed albatross off Oregon was significant, as the other documented mortalities occurred in Bering Sea, Gulf of Alaska, and Aleutian Islands fisheries (Good et al. 2019). A formal consultation with the U.S. Fish and Wildlife Service on the effects of the U.S. West Coast groundfish fishery on the endangered short-tailed albatross followed (USFWS 2012), leading to recommendations for vessels to deploy streamer lines during setting operations on commercial fixed gear vessels ≥55 feet (17 meters) in length (PFMC 2013). In 2015, the use of streamer lines on non-tribal vessels ≥55 feet long became mandatory (80 FR 71975; NMFS 2015), while tribal vessels would continue to use streamer lines voluntarily. Around this time, a NOAA Fisheries Cooperative Research-funded study was characterizing seabird bycatch on U.S. West Coast sablefish longline vessels. Their analyses of observer program data and field research found that: 1) smaller sablefish longline vessels (between 26 and 55 feet in length) also had bycatch issues, 2) streamer lines were generally effective in reducing seabird interactions, and 3) night-setting was a promising alternative to streamer lines for reducing seabird interactions (Gladics et al. 2017).

A key finding from this study was that streamer line effectiveness depended upon gear configuration. For vessels using longlines without floats, the hooks sank below the reach of bait-attacking birds largely within the protection of streamer lines (~69 m astern), and streamer lines were effective in deterring bird attacks. However, on vessels using longlines with floats added to the groundline to protect their catch from scavengers, hooks sank more slowly and reached a depth below the reach of bait-attacking birds at a distance well beyond the protection afforded by streamer lines (~158 m astern; Gladics et al. 2017). Attack rates of black-footed albatross (a proxy of their bycatch risk as well as for the endangered short-tailed albatross) were 10x greater overall on longlines with floats than on those without floats and as much as 15x greater in the area beyond the aerial extent of streamer lines (Gladics et al. 2017).

This research informed new recommendations for seabird bycatch mitigation in a revised U.S. Fish and Wildlife Service biological opinion (USFWS 2017); NMFS then revised its regulations based on these recommendations to require sablefish longline vessels ≥ 26 feet in length to either use streamer lines or to employ "night setting" (from one hour after sunset to one hour before sunrise; NMFS 2019).). Although these regulations expanded the use of streamer lines in the fleet, the continuing use of longlines with floats remains a potential risk to short-tailed albatross, especially for those fishers unwilling or unable to fish at night. The PFMC requested that NMFS and the industry collaborate on research to identify potential solutions to the ongoing elevated risk of bycatch for vessels that use longlines with floats. In response, NMFS has provided funds from the Cooperative Research Program to the NWFSC and collaborators at Oregon SeaGrant to investigate potential mitigation strategies for various gear configurations across the sablefish longline fleet, with the goal of recommending operationally feasible options to protect longlines with floats from bird attacks and to minimize seabird bycatch.

U.S. West Coast Groundfish Fisheries

The U.S. West Coast groundfish fishery (WCGF) is a multi-species fishery that utilizes a variety of gear types. The fishery harvests species designated in the Pacific Coast Groundfish Fishery Management Plan (PFMC 2011) and is managed by the PFMC. Over 90 species are listed in the management plan, including a variety of rockfish, flatfish, roundfish, skates, and sharks. These species are found in both federal waters (> 5.6 km off-shore) and state waters (0-5.6 km offshore). Groundfish are both targeted and caught incidentally by trawl nets, hook-and-line gear, and fish pots.

Under the FMP, the groundfish fishery consists of four management components:

- The Limited Entry (LE) component encompasses all commercial fishers who hold a federal Limited Entry permit. The total number of Limited Entry permits available is restricted. Vessels with an LE permit are allocated a larger portion of the total allowable catch for commercially desirable species than vessels without an LE permit.
- The Open Access (OA) component encompasses commercial fishers who do not hold a federal LE permit. Some states require fishers to carry a state-issued permit for certain OA sectors.
- The Recreational component includes recreational anglers who target or incidentally catch groundfish species. Recreational fisheries are not covered by this report.
- The Tribal component includes native tribal commercial fishers in Washington State that have treaty rights to fish groundfish. Tribal fisheries are not included in this report, with the exception of the observed tribal at-sea Pacific hake (*Merluccius productus*) (a.k.a. whiting) sector.

These four components are further subdivided into sectors based on gear type, target species, permits and other regulatory factors (see Appendix 1). The analyses in this report focus on data from the LE hook-and-line sablefish sector. The longline sector targets groundfish species, mainly sablefish, using longlines (both with and without floats) and catch is delivered to shore-based processors.

Northwest Fisheries Science Center Observer Program

The NWFSC Groundfish Observer Program's goal is to improve estimates of total catch and discard by observing commercial sectors of groundfish fisheries along the U.S. west coast that target or take groundfish as bycatch. The observer program has two units: the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP). The WCGOP Program was established in May 2001 by NOAA Fisheries (a.k.a., National Marine Fisheries Service, NMFS) in accordance with the Pacific Coast Groundfish Fishery Management Plan (50 CFR Part 660) (50 FR 20609). This regulation requires all vessels that catch groundfish in the US EEZ from 3-200 miles offshore carry an observer when notified to do so by NMFS or its designated agent. Subsequent state rule-making has extended NMFS's ability to require vessels fishing in the 0-5.6 km state territorial zone to carry observers.

The WCGOP and A-SHOP observe distinct sectors of the groundfish fishery. The WCGOP observes the LE hook-and-line sablefish sector, as well as a number of other fishery sectors (see Appendices). The NWFSC Fisheries Observation Science Program website provides details on how fisheries observers operate under both programs.

Albatross Bycatch in West Coast Groundfish Fisheries

The primary objective of this report is to provide estimates of bycatch of the ESA-listed short- tailed albatross in observed U.S. West Coast federally permitted groundfish fisheries since the last report in 2017, which covered the years 2016-2017. Jannot et al. (2021) summarizes seabird bycatch from 2002-2018 for all seabird species and all commercial fishing fleets on the U.S. West Coast that are observed by the WCGOP and A-SHOP. The short-tailed alabtross data and estimates presented in Jannot et al. (2021) are consistent with those presented in this report.

Groundfish Fishery Sectors with Short-tailed Albatross Bycatch

The only known short-tailed albatross take in a Pacific Coast Groundfish Fishery was reported in the Limited Entry sablefish longline fishery off the Oregon coast in 2011.

Amount and Extent of Short-tailed Albatross Take

The 2017 Biological Opinion Regarding the Effects of the Continued Operation of the Pacific Coast Groundfish Fishery (USFWS 2017) stated:

"The USFWS anticipates take of no more than one short-tailed albatrosses (*sic*) in two years or an average estimated take (calculated via the Bayesian model described in sections 6.3 and 6.4, pages 40-39) of no more than five birds per two-year period as a result of this continuing action. The incidental take is expected to be in the form of injury and mortality, due to bird injured or drowned as a result of encounters with hook and line groundfish gear, or taken by collision with trawl gear, including the third wire and warp cables. To account for interannual variability in actual take levels, a floating two-year period beginning on January 1, 2017, will be used to quantify the observed and estimated total reported take in each two-year period. Incidental take should not exceed an estimated five albatross in a two-year period or 1 observed albatross in a two-year period."

Methods

Data Sources

Data sources for analyses in this report include onboard observer data from the WCGOP and A-SHOP and landing receipt data, referred to as fish tickets, and electronic monitoring (EM) data. Fish ticket and EM data were obtained from the Pacific Fisheries Information Network (PacFIN). The Limited Entry sablefish longline fishery sector, observed by the WCGOP, is the source of the only short-tailed albatross take.

NWFSC Observer Program Data

A list of fisheries, coverage priorities and data collection methods employed by WCGOP in each observed fishery can be found in the WCGOP training manual (NWFSC 2021).

The sampling protocol employed by the WCGOP is primarily focused on the discarded portion of catch. To ensure that the recorded weights for the retained portion of the observed catch are accurate, haul-level retained catch weights recorded by observers are adjusted based on trip-level fish ticket records. This process is described in detail in the annual groundfish mortality report (Somers et al. 2020a). Data processing was applied prior to the analyses presented in this report. For a list of all of the groundfish species defined in the Pacific Coast Groundfish Fishery Management Plan see PFMC (2020).

Documenting Short-tailed Albatross Bycatch

Designation of 'take' interactions

WCGOP observers use a standardized system to record a variety of fishery interactions with seabirds. These include: killed by gear, previously dead, , lethal removal, entangled in gear (trailing gear), entangled in gear (not trailing gear), feeding on discarded catch, feeding on bait floating free, feeding on bait attached to hook, feeding on offal, feeding on catch (not yet landed on landed), vessel strike, deterrence used, boarded vessel (own volition; not captured), sighting only, and other.

Take designations for species listed under the ESA as threatened or endangered differ from those for species that are not ESA-listed. Section 3 of the ESA specifies the term 'take' to mean 'harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct' (16 USC 1532). Any interaction encompassing the ESA definition with an ESA-listed seabird species (i.e., a short-tailed albatross) was identified as a take. This designation was informed by the type of interaction recorded (below) and specific details in observer notes recorded at the time of the interaction. Observers typically detail the nature of injuries and any changes in the animal's behavior following its release. Birds documented to have exhibited bleeding, broken bones, or lost feathers were identified as takes; birds that did not fly away or return to normal behavior within a few minutes of the interaction were also considered to be takes.

Estimating Short-tailed Albatross Bycatch

Historically, for U.S. West Coast groundfish fisheries, ratio estimators were used to extrapolate seabird bycatch from observed bycatch rates using effort metrics for the fishery (e.g., the ratio of observed retained catch to total retained catch; Jannot et al. 2018). However, ratio estimators assume the unobserved fleet behaves exactly as the observed fleet. In addition, using ratio estimators is problematic when bycatch is rare or observer coverage is low (Martin et al. 2015). Attempts to use black-footed albatross bycatch as a proxy to estimate short-tailed albatross bycatch were later dropped due to problematic assumptions (NMFS 2016). The shortcomings of these approaches led to exploring probability-based methods for estimating short-tailed albatross bycatch in U.S. West Coast groundfish fisheries. Probability-based methods are particularly useful when bycatch is dominated by zeroes; there is reduced bias from rare events, the methods incorporate uncertainty, and they are less reliant on assumptions. The model-based Bayesian approach reduces volatility through its formal use of all information contained in the time series, reduces arbitrary decision-making about how many years of data to combine, and enables

probabilistic inference for bycatch and mortality within years, conditional on fishing effort. This approach has been used with other rare bycatch species such as cetaceans, delphinids, pinnipeds, sea turtles, and sharks (Martin et al. 2015).

Estimating Bycatch Using a Bayesian Modeling Approach

Only one short-tailed albatross take has been documented in a U.S. West Coast fishery during the 2002- 2019, period, specifically in the Limited Entry sablefish longline fishery in 2011. We used a Bayesian time-series model to estimate bycatch of short-tailed albatross in that fishery and to characterize the uncertainty around our estimates.

Fleet-wide bycatch of short-tailed albatross from the sablefish longline fleet was estimated using data on observer coverage obtained from the NWFSC West Coast Groundfish Observer Program (summarized in Table 2).

Table 2: Data for calculating short-tailed albatross bycatch, including year, fishing effort (number of observed sets, amount of retained catch, number of hooks), the proportion of the fleet-wide catch observed, and observed short-tailed albatross takes in the LE sablefish longline fishery 2002–2019 (data from the West Coast Groundfish Observer Program).

Year	Observed Sets (#)	Observed retained catch (MT)	Observed hooks (#)	Observed fleet-wide catch (%)	Observed STAL takes (#)
2002	391	190.79	779,624	24	0
2003	351	222.85	733,602	21	0
2004	326	180.02	492,009	14	0
2005	678	481.46	1,456,102	36	0
2006	470	295.93	939,951	21	0
2007	517	298.49	1,034,046	27	0
2008	540	338.15	1,244,141	31	0
2009	287	97.81	648,980	07	0
2010	762	345.77	1,761,173	27	0
2011	673	240.74	1,405,444	21	1
2012	532	239.32	1,580,075	22	0
2013	353	166.42	1,047,526	22	0
2014	495	203.23	1,200,615	27	0
2015	632	397.80	1,536,820	41	0
2016	671	338.12	1,743,233	33	0
2017	701	396.83	2,107,656	37	0
2018	839	467.25	2,411,652	46	0
2019	673	359.35	1,791,897	39	0

There are three parameterization choices to be made in the model. The first is the effort metric, of which there are three possible choices: the number of gear deployments (sets), the observed mass of landings (retained catch), or the number of observed gear units (hooks). The second parameter is the type of bycatch rate: a constant rate or a time-varying rate. The third parameter is the type of bycatch-generating process: a Poisson or a negative binomial. In total, there are 12 possible model combinations (3 efforts x 2 rates x 2 processes).

The base model assumes bycatch rate is constant and infers annual expected mortality, given a specified level of effort, using a simple Poisson process model, where the total number of bycatch events is assumed to follow a Poisson distribution,

$$n_{take,y} \sim \left(\lambda_y = \theta \cdot E_y\right)$$

where:

$n_{take,y}$ = number of observed bycatch events (or take events) in year y
λ_y = mean expected bycatch
θ = estimated bycatch rate
E_y = effort in year y

The estimated bycatch rate θ is assumed constant through time, but the quantity $\theta \cdot E_y$ includes uncertainty, as θ is estimated. Thus, a time series of the mean bycatch can be generated for a given species, with a given metric of effort. All uncertainty in the time series originates from fluctuating levels of effort through time (percent observer coverage only affects the expansion). We used a Bayesian model (Martin et al. 2015) to generate mean and 95% CIs of the bycatch rate parameter, θ, as well as for the expected bycatch, $\theta \cdot E_y$.

For this report, we built upon the simplified model above with the goal of finding the model that most accurately estimates bycatch and variance. To do that, we compared models to: (a) find the most suitable effort metric; (b) test the assumption that θ is constant through time; and (c) compare distributions (Poisson to negative binomial). There are a total of 12 possible models (three effort metrics, two rates, two distributions). To compare among these models, we used two model diagnostic tools (Pareto-K & p-LOO) and a model comparison method (LOOIC) from the R package *loo* (Vehtari et al. 2019a) as implemented in the *bycatch* package (Ward 2017). Details regarding model comparisons can be found in Jannot et al. (2021).

In this report, we present results from the single best model that uses the best single effort metric, bycatch rate, and bycatch process, as judged by the diagnostic statistics (see Jannot et al. 2021 for details).

Expanding Bycatch to Unobserved Portion of Fleet

Once the best model for the observed fleet has been identified, we then need to use it to expand the estimated bycatch, $\theta \cdot E_y$, to the unobserved portion of the fleet, because observer coverage in the LE sablefish fishery is less than 100% and variable through time. One approach for expansion would be to divide $\theta \cdot E_y$ by the percent observer coverage;

however, this ignores uncertainty in the expansion. We accounted for uncertainty in the expansion by treating the observer coverage and estimated bycatch ($\theta \cdot E_y$) as known and sampled from the distribution of total bycatch (N) in proportion to the binomial density function. This process was repeated for each Markov Chain Monte Carlo (MCMC) draw, to propagate uncertainty in the estimates through the uncertainty in the expansion. Details on the implementation can be found in the *bycatch* package (Ward 2017).

Non-Lethal Interactions and Sightings

In addition to lethal interactions, A-SHOP and WCGOP collect information regarding short-tailed albatross interactions that are not lethal and unlikely to cause injury. Interactions include any bird that comes into contact with the vessel, gear, catch, or vessel discharge (*e.g.*, offal, discards, vessel trash, etc.). Sightings of short-tailed albatross that do not interact with the vessel in any manner are also recorded.

Collection of data on ESA-listed species is a high priority for observers, who are instructed to document all nonlethal interactions and sightings of ESA-listed seabird species. However, because observers are not required to set aside time during every day to record sightings, these observations are opportunistic. Furthermore, nonlethal interactions and sightings reported here are limited in scope to vessel location, which is driven by fishing activity.

Statistical Software

The statistical software R (R Core Team, 2020) was used to produce the analyses, tables, and figures in this report. Specifically, we relied heavily on the R packages:

- *bycatch* (Ward, 2017) for modeling and simulation,
- *ggplot2* (Wickham, 2016) for plotting figures,
- *loo* (Vehtari et al. 2019) as implemented in *bycatch* for model comparisons,
- *knitr* (Xie, 2020) for tables and dynamic reporting, and
- *tidyverse* (Wickham et al. 2019) & *dplyr* (Wickham et al. 2020) for data wrangling.

Results

Documented Short-tailed Albatross Bycatch

For the years 2002-2019, the single documented short-tailed albatross take was observed in the Limited Entry sablefish fishery in April 2011 (USFWS 2012). There have been no recorded takes documented in U.S. West Coast groundfish fisheries in any other year from 2002-2019 (Jannot et al. 2021). There were no short-tailed albatross mortalities in the Catch Shares hook-and-line sector, nor were there any interactions with trawl gear (warps or third wires) in the at-sea hake catcher-processor sector. Non-lethal interactions and sightings recorded in these fishery sectors can be found in Tables 3 and 4.

Estimated Short-tailed Albatross Bycatch

Of the 12 models, the best model used the number of sets as the effort metric, a constant bycatch rate, and a Poisson bycatch process. Annual mean estimates from the best model ranged from 0.2 to 1.8 STAL/year, while the 95% confidence limits ranged from 0.0 to 6.6 STAL/year (Figure 1).

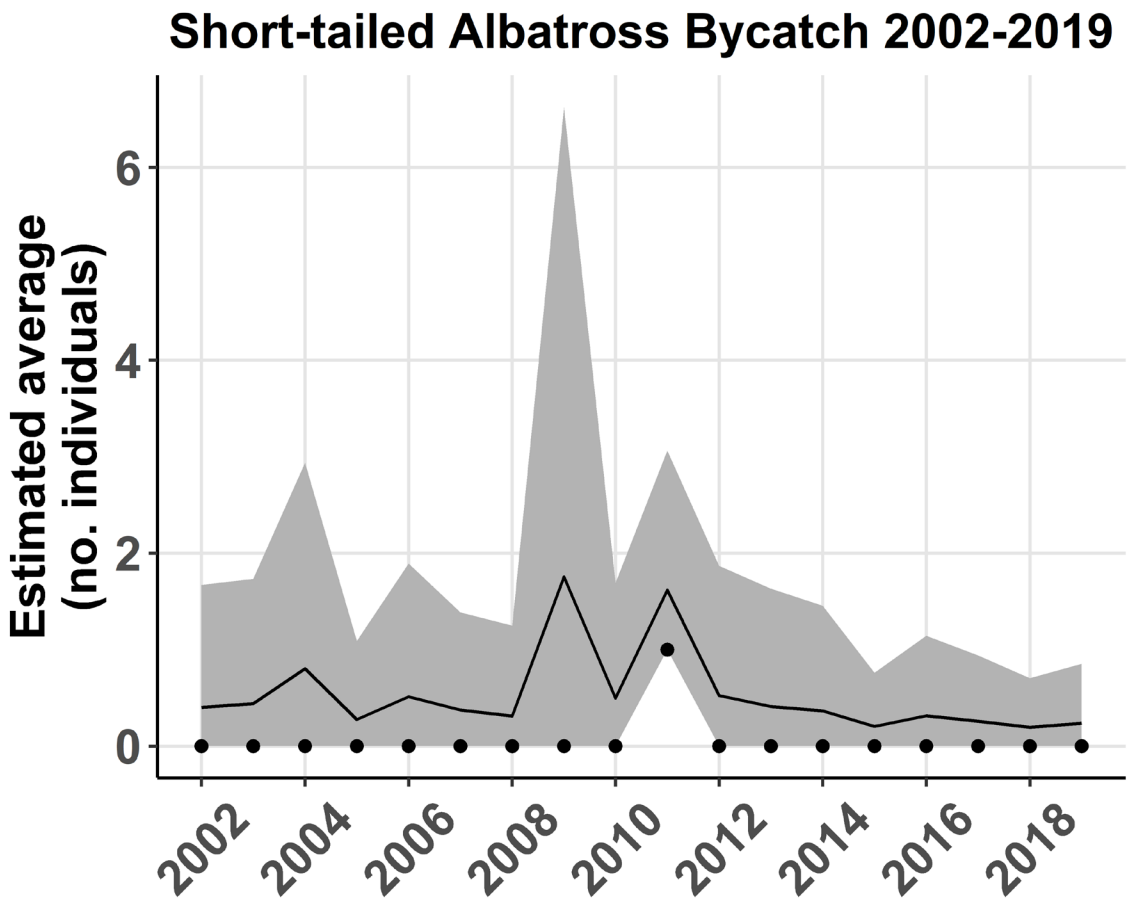

Figure 1: Fleet-wide bycatch of short-tailed albatross estimated for 2002-19. Dots represent observed bycatch, black line is the estimated mean, and the grey area represents the 95% confidence interval. The best model used the number of sets as effort, a Poisson distribution for bycatch, and a constant bycatch rate. See Jannot et al. (2021) for details.

Other Short-tailed Albatross Interactions

Other interactions of short-tailed albatross with fishing vessels have been recorded in several of the U.S. West Coast groundfish fishery sectors. In addition to the single lethal interaction in 2011, various non-lethal interactions (see Methods for list of interaction types) have been recorded (Table 3).

Table 3: Short-tailed albatross interactions with vessels recorded by fisheries observers on U.S. West Coast groundfish fishery vessels (2002-19)

Year	Sector	Fishing gear	Killed by gear	Feeding on catch	Other*
2002	Limited Entry Trawl	Bottom Trawl		2	
2009	Limited Entry Trawl	Bottom Trawl		2	
2010	Limited Entry Sablefish	Hook & Line			1
	Limited Entry Trawl	Bottom Trawl		3	
2011	Catch Shares	Bottom Trawl		4	
	Catch Shares	Hook & Line			1
	Limited Entry Sablefish	Hook & Line	1		2
	Mothership Catcher Vessel	Midwater Trawl		1	
	Shoreside Hake	Midwater Trawl		1	
2012	Catch Shares	Bottom Trawl		3	
	Catch Shares	Pot		2	
	Shoreside Hake	Midwater Trawl		2	
2013	Catch Shares	Bottom Trawl		3	
	Shoreside Hake	Midwater Trawl		1	
2014	Catch Shares	Bottom Trawl		4	
2015	Catch Shares	Bottom Trawl		2	1
2016	Catch Shares	Bottom Trawl		2	
	Catch Shares	Pot			5
	Limited Entry Sablefish	Hook & Line			1
2017	Catch Shares	Bottom Trawl		2	5
	Catch Shares EM	Pot			1
	Limited Entry Sablefish	Hook & Line			1
	OA Fixed Gear	Hook & Line			1
2018	Catch Shares	Bottom Trawl		3	
	Catch Shares	Hook & Line			3
	Catch Shares EM	Bottom Trawl		1	
	Catch Shares EM	Pot			3
	Limited Entry Sablefish	Hook & Line			4
	Limited Entry Sablefish	Pot			2
2019	Catch Shares	Hook & Line			1
	Catch Shares EM	Bottom Trawl			3
	Limited Entry Sablefish	Hook & Line			1

*Includes feeding on discarded catch, feeding on bait floating free and feeding on bait attached to hook

Observers also recorded opportunistic observations of short-tailed albatross that did not involve interaction with vessels; these "sightings" could include birds on the water or in the air nearby or at some distance from the vessel (Table 4).

Table 4: Short-tailed albatross sightings recorded opportunistically by fisheries observers on U.S. West Coast groundfish fishery vessels (2002-19). [Note: as opportunistic sightings, birds could be counted multiple times and numbers should be considered a maximum number].

Year	Sector	Fishing Gear	Sighting
2002	Limited Entry Sablefish	Hook & Line	1
	Limited Entry Trawl	Bottom Trawl	12
2003	Limited Entry Sablefish	Hook & Line	1
	Limited Entry Trawl	Bottom Trawl	4
2004	Limited Entry Trawl	Bottom Trawl	3
	Pink Shrimp	Shrimp Trawl	1
2005	Limited Entry Sablefish	Hook & Line	3
	Limited Entry Trawl	Bottom Trawl	3
2006	Limited Entry Sablefish	Hook & Line	3
	Limited Entry Trawl	Bottom Trawl	1
2007	Limited Entry Sablefish	Hook & Line	2
	Limited Entry Trawl	Bottom Trawl	1
2008	Limited Entry Sablefish	Hook & Line	1
	Limited Entry Sablefish	Pot	1
2009	Limited Entry Sablefish	Hook & Line	1
	Limited Entry Trawl	Bottom Trawl	17
2010	Limited Entry Sablefish	Hook & Line	3
	Limited Entry Sablefish	Pot	2
	Limited Entry Trawl	Bottom Trawl	5
	OA Fixed Gear	Pot	1
	Pink Shrimp	Shrimp Trawl	1
2011	Catch Shares	Bottom Trawl	21
	Catch Shares	Pot	2
	Limited Entry Sablefish	Pot	2
	Mothership Catcher Vessel	Midwater Trawl	1
	Shoreside Hake	Midwater Trawl	1
2012	Catch Shares	Bottom Trawl	8
	Catch Shares	Hook & Line	2
	Catch Shares	Pot	2
	Mothership Catcher Vessel	Midwater Trawl	1
	Shoreside Hake	Midwater Trawl	1
2013	Catch Shares	Bottom Trawl	10
	Shoreside Hake	Midwater Trawl	1
2015	Catch Shares	Bottom Trawl	1
2016	Catch Shares	Bottom Trawl	3
	Limited Entry Sablefish	Hook & Line	1
2017	Catch Shares	Bottom Trawl	10
	Limited Entry Sablefish	Hook & Line	1

Year	Sector	Fishing Gear	Sighting
2018	Catch Shares	Bottom Trawl	3
	Catch Shares	Pot	2
	Catch Shares EM	Bottom Trawl	3
	Limited Entry Sablefish	Hook & Line	1
	Limited Entry Sablefish	Pot	1
2019	Catch Shares	Bottom Trawl	3
	Catch Shares	Pot	10
	Catcher Processor	Midwater Trawl	20
	Limited Entry Sablefish	Hook & Line	2
	Pink Shrimp	Shrimp Trawl	3

There is no formal protocol for collecting short-tailed albatross sightings data in the NWFSC Observer Program. Observers are required to record any opportunistic sightings or interactions while on deck; thus, sightings data are little more than an index of presence. In 2019, opportunistic sightings include 20 sightings from seabird observers conducting research on seabird cable-strikes on hake catcher-processors (A. Gladics, unpublished data). The variability of sightings over time is likely due to the *ad hoc* nature of these data. In 2011, a single sighting of a short-tailed albatross was recorded by a fishery observer south of 36° N. latitude; no sightings south of this line have occurred since then (Figure 2).

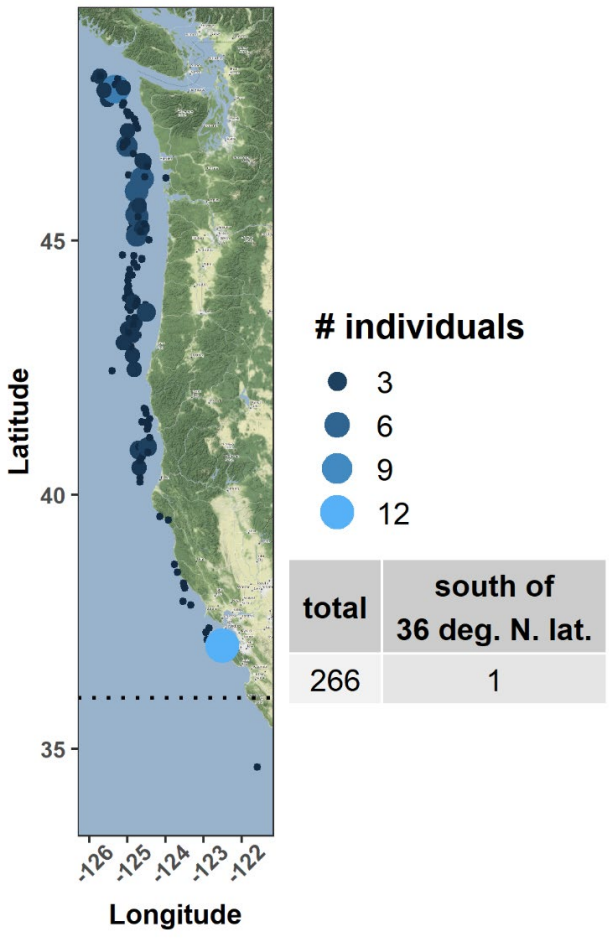

Figure 2: Sightings and non-lethal interactions of short-tailed albatross as recorded by fisheries observers on U.S. West Coast groundfish vessels, 2002-19. The table shows the total number of short-tailed albatross, and the number of those that were observed south of 36° N. latitude (denoted by dotted line). Data are not considered to be randomly sampled. For sightings, birds could be counted multiple times; thus, numbers in this figure should be considered a maximum number. Three observations were removed because the observation position turned out to be on land.

Seabird Avoidance and Mitigation Measures

NMFS has been working with fishers, Washington Sea Grant, and Oregon SeaGrant to reduce the risk that LE hook-and-line vessels present to short-tailed albatross. The take and estimates of short-tailed albatross bycatch presented here are based largely on years prior to consistent seabird bycatch mitigation measures. These efforts included:

- Pre-2009: some voluntary use of streamer lines and other seabird avoidance gear
- 2009: Washington Sea Grant initiated a NMFS-supported streamer line distribution pilot program with tribal fisheries; West Coast Groundfish Observer Program began documenting use and characteristics of seabird avoidance gear on fixed gear vessels
- 2009-2011: Washington Sea Grant extend free streamer line program to major longline ports in Oregon and Washington (Washington Sea Grant 2011)
- 2013-2016: distribution of free streamer lines and research to refine the design of streamer lines specifically for West Coast groundfish fisheries
- December 2015: use of streamer lines on vessels ≥55 feet long became mandatory (80 FR 71975), and tribal vessels use streamer lines voluntarily. Public outreach materials detailing technical requirements of streamer lines and request for vessels both ≥55 feet and <55 feet to participate in seabird bycatch
- November 2018: proposal to amend current Federal regulations to require commercial groundfish longline vessels 26 feet overall (LOA) and longer to employ streamer lines consistent with Alaska streamer line regulations or to set longlines from one hour after sunset to one hour before sunrise when fishing in Federal waters
- December 2019: use of streamer lines or night-setting on non-tribal vessels ≥26 feet long became mandatory (84 FR 67674). An exception exists when fishing in Federal waters south of 36° North latitude.

The most recent regulations, which took effect in January 2020, are an extension of the action taken in 2013 to apply streamer line requirements to vessels 55 feet LOA and longer, as described in the final EA prepared by NMFS (2013). The purpose of the proposed action was to further reduce interactions between ESA-listed seabirds and groundfish longline gear relative to current levels of take and was needed to comply with the 2017 USFWS Biological Opinion by minimizing endangered short-tailed albatross take to levels judged not to jeopardize the continued existence of the species.

Reasonable and Prudent Measures and Conservation Measures

The 2017 Biological Opinion on the continuing operation of the Pacific Coast groundfish fishery (USFWS 2017) outlined Reasonable and Prudent Measures (RPMs) and Conservation Recommendations (CRs) necessary and appropriate for NMFS to minimize take of short-tailed albatross. NMFS has outlined their actions relevant to these RPMs and CR in each report to the PFMC ESA Workgroup (Good et al. 2015, 2017, 2019). The actions have included, among other things: developing streamer line requirements for fishing vessels; facilitating outreach by collaborators; analyzing observer program data and reviewing observer program protocols; and producing a biennial bycatch report. The present status of NMFS actions are presented in Table 5.

Table 5: Reasonable and Prudent Measures (RPMs), Terms and Conditions, and NMFS' current status for the 2017 USFWS Biological Opinion for the Continued Operation of the Pacific Coast Groundfish Fishery.

RPM 1: NMFS shall minimize the risk of short-tailed albatross interacting with hooks and lines. Because short-tailed albatross are caught and killed by baited hooks in longline fisheries, minimization measures shall be employed to reduce the likelihood they will attack baited hooks.

T&C 1 for RPM 1: To ensure the effectiveness of the existing regulations (50 CFR Part 660.61; NMFS 2015a), NMFS shall: a. Amend or refine regulations to mandate vessels that use the longline gear to: i) Employ streamer lines in the commercial longline fishery of the PCGF consistent with the Alaska streamer line regulations for Federal waters, including the use of single streamer lines on boats 26-55 feet in length, OR ii) Set longlines after civil sunset[and before civil sunrise]. b. Conduct research that investigates: i) new or improved methods of reducing bycatch of short-tailed albatross that are safe and effective within the longline fishery. ii) the effect of floating gear on albatross bycatch and improved methods to minimize risk of bycatch. iii) vessel effect on seabird bycatch, and determine, if feasible, whether the use of additional minimization measures would further reduce bycatch for individual vessels. iv) If new information is revealed that determines that this T&C should be updated, the BO shall be amended, as appropriate. c. NMFS shall implement regulation amendments as soon as practical, but initiation of implementation shall not exceed a three-year period after issuance of this biological opinion. d. Continue to provide assistance to the Tribes with implementation of streamer use on tribal vessels, and shall encourage and assist with the development of Tribal regulations requiring streamer use as information and resources become available.	*NMFS mandates, as of January 2020, either the use of streamer lines or night setting (between civil sunset and civil sunrise) in the commercial longline fishery of the Pacific Coast Groundfish Fishery for non-tribal vessels 26' length or greater.* *NMFS has secured funding to conduct collaborative research with West Coast longline fleets and Oregon SeaGrant on floating gear use and seabird bycatch in FY22. Analyses into vessel effect have not revealed strong patterns based on the available data; NMFS has developed individual seabird bycatch report cards as a way to provide vessels with their seabird bycatch rate as compared to others in their port area and others in the fleet. These are planned to be piloted with the primary sablefish fishery for 2021/2022 and later expanded to all longline vessels. The objective is to encourage communication among vessels about best practices to reduce bycatch.* *NMFS implemented regulations within the 3-year period after the biological opinion was issued. (84 FR 67674; December 11, 2019)* *NMFS regularly checks in with Tribes that have longline vessels in the groundfish fishery; their voluntary streamer line programs have been well received by their vessels.*

T&C 2 for RPM 1: To ensure appropriate implementation of measures that minimize seabird take, NMFS shall: a. Distribute bulletins to permit holders covering vessel instructions for proper use of streamer lines. Additional topics to include: i) Status of short-tailed albatross population and observations of the species in the vicinity of the PCGF fishing area. ii) Short-tailed albatross notification requirements (T&C 1; RPM 5). iii) Disposition of short-tailed albatross specimens (see T&C 2; RPM 5).	*NMFS annually provides handouts to vessels with Limited Entry permits that include requirements for seabird bycatch mitigation, information on safe handling of albatross, and recommendations for bird-safe offal discharge. NMFS has provided similar handouts and education materials to vessels subject to new requirements in 2020, as noted above.*

RPM 2. NMFS shall minimize the risk of short-tailed albatross interacting with trawl cables. Because short-tailed albatross are vulnerable to striking aerial trawl cables, particularly in the catcher-processor fleet, minimization measures shall be explored and implemented to reduce the likelihood that they interact with trawl gear.

T&C 1 for RPM 2: To minimize the risk of short-tailed albatross interacting with trawl cables, NMFS shall: a. Continue to conduct research that investigates the extent of take associated with trawl gear and new or improved management actions that minimize take as a result of interactions with trawl gear in the PCGF. Management actions that should be examined include: i) The use and effectiveness of streamer lines when using trawl gear; ii) The degree to which minimizing the aerial extent of trawl cables affects the risk of bird strike; and iii) Feasible offal management techniques that decrease attraction of short-tailed albatross to the vicinity of aerial lines. b. Based on the research and findings of NMFS's investigations into trawl-associated mortality or injury, implement measures that minimize potential for short-tailed albatross interactions with trawl gear.	*NMFS collected 4 years of data on seabird-cable interactions on West Coast hake catcher-processor trawl vessels, and no short-tailed albatross cable interactions were observed. In November 2017, NMFS hosted a workshop with the trawl fishing industry, seafood associations, NGOs, and federal agencies. Participants agreed to physical mitigation measures: 1) snatch block, 2) water deterrents, 3) improved visibility of third wires, 4) combined streamer lines and warp booms, and 5) a 3rd-wire float device. Many behavioral measures were deemed unfeasible (e.g., offal batching) without major vessel changes or were already employed. Participants agreed more research was needed and interested entities should partner to fund research for data collection and to test and develop mitigation strategies for trawlers in Alaska and on the U.S. West Coast. NMFS contracted Oregon Sea Grant to study cable interactions using dedicated seabird observers. Again, no short-tailed albatross cable interactions were observed. Focused observations of seabirds following hard strikes enabled the calculation of cable-induced mortality rates for black-footed albatross and other seabird species. Based on these studies, USFWS concurs that NMFS does not need to take further steps at this time for more research or for mitigation measures for trawl interactions. NMFS intends to convene a public meeting/workshop to present trawl gear research results.*

RPM 3: NMFS shall continue to convene a multi-stakeholder, Pacific Coast Groundfish and Endangered Species Working Group as an advisory body to NMFS and USFWS for the purposes of reducing risk to short-tailed albatross. This group will work toward eliminating data gaps and facilitate adaptive management to minimize and avoid take of short-tailed albatross.

T&C 1 for RPM 3: To ensure effectiveness of the established PCGF Endangered Species Workgroup (ESA Workgroup), NMFS shall: a. At a minimum, convene formally on a biennial basis and informally annually, as needed, to consider all new information, compliance with these terms and conditions, and results of take estimation (see T&C 3 for RPM 3). b. Consider recommendations made by the ESA Workgroup regarding changes to the PCGF that are intended to reduce risk of harm to short-tailed albatross (e.g., new analyses or reports, changes to sampling protocols, additional conservation measures to implement, updating species risk assessments, recommendations regarding compliance with these terms and conditions, and advise if reinitiation is warranted). c. Make ESA Workgroup recommendations available to USFWS and PFMC.	*NMFS convenes the ESA Workgroup biennially, the most recent being held 26-28 April, 2021. NMFS considers recommendations made by the workgroup, incorporates them into a workgroup report, and makes workgroup recommendations available to the PFMC and USFWS.*
T&C 2 for RPM 3: NMFS shall update methods for the BA's risk assessment for short-tailed albatross as recommended by the ESA Workgroup or when reinitiation of consultation is required. Consider the following information when developing future estimates: a. Current available data from short-tailed albatross telemetry work. b. NMFS Groundfish observer program's data on all observed short-tailed albatross vessel and gear interactions and information on injured and killed short-tailed albatross. c. Any additional reports by other NMFS managed fisheries operating in the action area of short-tailed albatross vessel and gear interactions and information on injured and killed short-tailed albatross. d. PCGF fishing effort. e. NMFS shall report on information provided to vessel operators regarding measures minimizing seabird take.	*If necessary, NMFS will update the BA's risk assessment for short-tailed albatross if and when reinitiation of consultation is required, considering current available data on short-tailed albatross telemetry, interactions with gear observed in other NMFS-managed fisheries, and PCGF fishing effort. NMFS will report on information provided to vessel operators regarding measures minimizing seabird take.* *An updated risk assessment has not been required at this time. NMFS can continue to provide updates on telemetry data and STAL sightings data.*

T&C 3 for RPM 3: NMFS shall consult with the ESA Workgroup and USFWS to consider methods to improve the estimates of incidental take of short-tailed albatross in unobserved fisheries.	*NMFS is not aware of any reports of short-tailed albatross takes in unobserved fisheries (e.g., state fisheries not observed by the WCGOP, non-regulated fisheries, recreational fisheries, or research fisheries). NMFS will consult with the ESA Workgroup and USFWS as it develops methods to estimate incidental take of short-tailed albatross in unobserved fisheries.*

RPM 4: NMFS shall monitor and report all observed, reported and estimated take of short- tailed albatross interactions with fishing vessels and gear within the PCGF, and evaluate and report on the efficacy of avoidance and minimization measures.

T&C 1 for RPM 4: To ensure monitoring and reporting of all observed and reported interactions with fishing vessels and gear; estimate take of short-tailed albatross within the Pacific Coast Groundfish Fisheries; and evaluate and report on the efficacy of avoidance and minimization measures NMFS shall update the WCGOP to include specific guidance for endangered or threatened species, namely: a. Develop procedures to improve observers' prioritization of short-tailed albatross observations in the existing WCGOP. b. Require WCGOP to collect the following information: • Time of initiation and completion of observed set • Number of hooks deployed with each observed set • Configuration of the gear used, particularly whether using floating or sinking gear c. Maintain observer coverage in the OA Fixed Gear and Limited Entry Sablefish fisheries at or above historic levels.	*NMFS prioritizes short-tailed albatross observations by fishery observers.* *WCGOP fishery observers have recorded the initiation and completion times of observed sets and the number of hooks deployed for each observed set since 2002. WCGOP fishery observers have recorded the configuration of the gear used, particularly whether vessels were employing floating gear since 2016. NMFS is maintaining observer coverage in the OA Fixed Gear and Limited Entry Sablefish fisheries at or above historic levels.*

T&C 2 for RPM 4: To provide information that is unavailable on unobserved vessels, NMFS shall: a. Implement a logbook requirement for longline fisheries, especially for those fisheries with low observer coverage rates as recommended by the Pacific Fisheries Management Council (2015), the Pacific Coast Groundfish ESA Workgroup (2015), and GMT (2012), or at a minimum, develop methods to provide better record of gear type deployed, time of day for gear deployment, and overall effort (i.e., number of hooks). b. This information shall be utilized to improve the short-tailed albatross risk assessment for these fisheries to and reported annually with the updated risk assessment.	*NMFS is currently developing an electronic fixed gear logbook with the goal of completing the rulemaking in 2022 so the logbook can be in place for the 2023 fishery.*
T&C 3 for RPM 4: NMFS shall complete a biennial report to be submitted to State Supervisor, USFWS, 2600 SE 98th Ave. Suite 100, Portland, OR 97266, and to the Pacific Coast Groundfish and Endangered Species Workgroup. The report shall include any pertinent new information and document effects of the PCGF on endangered or threatened species.	*NMFS completed and submitted biennial reports to the USFWS and the ESA Workgroup in 2015, 2017 and 2019.*

RPM 5: NMFS shall facilitate the salvage of short-tailed albatross carcasses taken in the PCGF. Because of their rarity and unique life history traits, every effort should be made to retain short-tailed albatross carcasses for scientific and educational purposes.

T&C 1 for RPM 5: Report and continue to require observers and commercial fishers report all mortality and injury of short-tailed albatross.	*NMFS continues to require observers and commercial fishers to report all mortality and injury of short-tailed albatrosses.*

T&C 2 for RPM 5: NMFS shall disseminate the following short-tailed albatross disposition instructions to fishers and observers within the PCGF: 1. If a dead, injured, or sick short-tailed albatross individual is located, call USFWS 503-231- 6179 for handling and disposition instructions. If an observer is on board, they shall be responsible for the disposition of dead, injured, or sick birds, otherwise the boat captain shall be responsible. 2. Care should be taken in handling sick or injured specimens to ensure effective treatment and in the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured short-tailed albatross or preservation of biological materials from a dead animal, the boat captain or observer has the responsibility to carry out instructions provided by USFWS to ensure that the specimen is not unnecessarily disturbed. 3. Live birds must be retained in a safe location. Release overboard shall occur if it looks normal and exhibits all of the following traits: the bird is capable of holding its head erect, and the bird responds to noise and motion stimuli; the bird breathes without noise; the bird can flap both wings, and it can retract the wings to a normal folded position on the back; and the bird is capable of elevating itself to stand on both feet, with its toes pointed in the proper direction (forward); and it is dry. 4. Injured or sick albatross are to be retained in a safe location. 5. Dead short-tailed albatross must be frozen immediately, with identification tags attached directly to the carcass, and a duplicate identification tag attached to the bag or container holding the carcass. Ideally, the specimen should be frozen at -40 degrees Fahrenheit. Identification tags must include all of the following information: species, date of mortality, name of vessel, location (latitude and longitude) of mortality, observer or captain's name (or both), and any band numbers and colors if the specimen has any leg bands. Leg bands must remain attached to the bird.	*NMFS disseminates short-tailed albatross carcass disposition instructions to fishers and observers within the PCGF through an annual mailing to permit holders. Observers receive information through training and the WCGOP training manual (NWFSC 2021).*

6. If the bird is retained alive or dead, it must be surrendered as soon as possible as directed by the USFWS.	

Conservation Recommendations

• Calculate observer coverage level within the PCGF that will provide adequate data to predict harm to short-tailed albatross within a reasonable tolerance. • In order for the USFWS to be kept informed of actions that minimize or avoid adverse effects or benefit listed species or their habitats, the USFWS requests notification regarding the implementation of any conservation recommendation.	*The A-SHOP and the WCGOP Cacth Shares fisheries currently have 100% observer coverage and therefore provide a census of short-tailed albatross interactions with those sectors. Observer program coverage rates for other sectors are generally lower than 100% and are published on-line (Somers et al. 2020b).*

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Appendices: Fishery Descriptions

Appendix 1: Permits, gears used, target groups, vessel length range, fishing depth range, and management of catch share fishery sectors and subsectors in federally managed and monitored West Coast groundfish fisheries. Catch share sectors use individual fishing quotas (IFQ) to manage certain species. Observer coverage in these is 100%, except for vessels using electronic monitoring (EM). The IFQ program began in 2011; regulations prior to 2011 are excluded. For brevity, management descriptors are generalized and are not meant to be complete or comprehensive. Vessel lengths and fishing depths are based on observed vessels and might not represent the fleet as a whole.

Sector	Sub-sector	Permits[a]	Gears	Targets	Vessel length (m)	Depth (m)	Management
Limited Entry (LE) Trawl	LE Trawl	LE permit with trawl endorsement	Bottom Trawl, Hook & Line, Pot	Groundfish[b]	15-40	10-1600	IFQ; some vessels use EM in lieu of 100% observer coverage
Limited Entry (LE) Trawl	Midwater Rockfish	LE permit with trawl endorsement	Midwater Trawl	Midwater rockfish[c]	15-33	>70	IFQ; some vessels use EM in lieu of 100% observer coverage
Limited Entry (LE) Trawl	Midwater Hake	LE permit with trawl endorsement	Midwater Trawl	Pacific hake[d]	17-40	>70	IFQ; some vessels use EM in lieu of 100% observer coverage
At-Sea Hake	Mothership-catcher vessels (MSCV)	LE permit with MSCV endorsement	Midwater Trawl	Pacific hake[d]	8-138[e]	53-460[e]	IFQ; some vessels use EM in lieu of 100% observer coverage
At-Sea Hake	Catcher-processors (CP)	LE permit with CP endorsement	Midwater Trawl	Pacific hake[d]	82-115	60-570	IFQ
At-Sea Hake	Tribal	None	Midwater Trawl	Pacific hake[d]	<38	53-460	IFQ

[a] A.k.a. LE permit. All LE permits are issued by NOAA.

[b] Vessels with a California halibut permit, issued by the state of California, can land CA halibut under California's CA halibut fishery regulations.

[c] *Sebastes* spp.

[d] *Merluccius productus*

[e] Average values for catcher vessels

Appendix 2. Permits, gears used, target groups, vessel length range, fishing depth range, and management of non-catch share fishery sectors and subsectors in federally managed and observed U.S. West Coast groundfish fisheries. Observer coverage on these vessels is less than 100%. For brevity, management descriptors are generalized and are not meant to be complete or comprehensive. Vessel lengths and fishing depths are based on observed vessels and might not represent the fleet as a whole.

Sector	Sub-sector	Permits	Gears	Targets	Vessel Length (m)	Depth (m)	Management
Non-Nearshore Fixed Gear	Sablefish endorsed	LE permit with fixed gear endorsement and sablefish quota[a]	Longlines, Pots	Sablefish[c]	7-32	20-1300	Sablefish tier quotas; Seven-month season
Non-Nearshore Fixed Gear	Sablefish non-endorsed (a.k.a. Zero Tier)	LE permit with fixed gear endorsement w/o sablefish quota	Longlines, Pots	Sablefish, rockfish, flatfish[d, e]	7-32	20-1300	Trip limits
Non-Nearshore Fixed Gear	Open Access	None	Longlines, Pots	Sablefish, other groundfish	3-30	20-1300	Trip limits
Pacific Halibut Commercial		IPHC Pacific Halibut permit[b]	Longlines	Pacific halibut[f]	3-32	40-400	10-hr. fishing periods s. of Pt. Chehalis, WA; Legal size >82 cm; Trip limits

[a] A.k.a. LE permit. All LE permits are issued by NOAA.

[b] Issued by the International Pacific Halibut Commission (IPHC)

[c] *Anoploma fimbria*

[d] *Sebastes* spp.

[e] Pleuronectiformes

[f] *Hippoglossus stenolepis*

Appendix 3. Permits, gears used, target groups, vessel length range, fishing depth range, and management of fishery sectors and subsectors in state-managed, observed fisheries. Observer coverage on these vessels is less than 100%. For brevity, management descriptors are generalized for the given time period and are not meant to be complete or comprehensive. Vessel lengths and fishing depths are based on observed vessels and might not represent the fleet as a whole.

Sector	Permits	Gears	Targets	Vessel Length (m)	Depth (m)	Management
Open Access (OA) California Halibut	CA Halibut permit[b]	Bottom trawl	California Halibut[c]	9-22	10-200	Fishing mainly within the CA halibut trawl grounds; Minimum mesh sizes; Seven month season
Nearshore Fixed Gsear[a]	CA or OR state nearshore permits and endorsements	Variety of hand lines, pot gear, stick gear, rod and reel	Rockfish, Cabezon, Greenlings[d,e,,f]	3-15	<100	Federal and state regulations; Area closures; 2-month trip limits; Minimum mesh size
Pink Shrimp	WA, OR, or CA state pink shrimp permit	Shrimp trawl	Pink shrimp[g]	11-13	60-800	State regulations; Bycatch reduction devices; Trip limits (groundfish)
CA Ridgeback Prawn	Prawn permit[b]	Shrimp or Bottom trawl	Golden, Spot, Ridgeback or other prawn[h]	9-19	45-700	Oct-May season; Trip limits; Area restrictions; Landing requirements
CA Sea Cucumber	Sea cucumber trawl permit[b]	Bottom trawl	California sea cucumbers[i]	9-12	<100	Logbook requirement; Area and seasonal closures

[a] The state of Washington does not conduct a nearshore fishery.

[b] Issued by the state of California

[c] *Paralichthys californicus*

[d] *Sebastes* spp.

[e] *Scorpaenichthys marmoratus*

[f] Hexagrammidae

[g] *Pandalus jordani*

[h] *Crangon* spp., *Lysmata californica, Pandalus clanae, P. jordani, P. platyceros, Sicyonia ingentis*

[i] *Parastichopus californicus*