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Summary of the capture of seabirds, marine mammals, and turtles in New Zealand commercial fisheries, 2002–03 to 2012–13

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EXECUTIVE SUMMARY

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In New Zealand's Exclusive Economic Zone (EEZ), government fisheries observers on-board commercial fishing vessels record the incidental captures of protected species, including seabirds, marine mammals and turtles. For fisheries with sufficient observer coverage, these data, combined with fishing effort data, allow the development of statistical models to estimate the total number of incidental captures. The current study updates previous bycatch assessments, providing total capture estimates of seabirds, marine mammals and turtles in trawl and longline fisheries for the period between 2002–03 and 2012–13 (with some models extending back to the 1995–96 fishing year).

There was a total of 4379 (95% credible interval (c.i.): 3654–5340) estimated seabird captures in all trawl and longline fisheries within the outer boundary of New Zealand's EEZ in 2012–13. Most seabird captures occurred in trawl fisheries, with 2604 (95% c.i.: 2055–3465) estimated seabird captures, compared with bottom-longline and surface-longline fisheries that had 991 (95% c.i.: 666–1349) and 783 (95% c.i.: 567–1144) estimated seabird captures, respectively. Of the total capture estimate for 2012–13, 1658 (95% c.i.: 1355–2049) captures were of albatross, and 2721 (95% c.i.: 2079–3613) captures were of petrels and other seabirds. The estimation included captures in all trawl fisheries, and in small- and large-vessel surface-longline and bottom-longline fisheries (cut-off vessel lengths 45 and 34 m, respectively). Although small-vessel fisheries were associated with most of the seabird captures, observer coverage in these fisheries continued to be low, especially in small-vessel trawl fisheries.

Statistical models were also built to estimate total captures of seven seabird species or species groupings, including New Zealand white-capped albatross (*Thalassarche steadi*), Salvin's albatross (*Thalassarche salvini*), southern Buller's albatross (*Thalassarche bulleri bulleri*), white-chinned petrel (*Procellaria aequinoctialis*), sooty shearwater (*Puffinus griseus*), "other albatrosses", and "other birds". For New Zealand white-capped albatross, there was a total of 558 (95% c.i.: 435–724) estimated captures in 2012–13, compared with 487 (95% c.i.: 294–794) estimated captures of Salvin's albatross, 259 (95% c.i.: 200–341) estimated captures of southern Buller's albatross, 368 (95% c.i.: 242–576) estimated captures of sooty shearwater, and 586 (95% c.i.: 470–755) estimated captures of white-chinned petrel. For the two species groupings other albatrosses and other birds, capture estimates were 354 (95% c.i.: 219–598) and 1766 (95% c.i.: 1170–2654) captures, respectively.

For marine mammals, sufficient observer data allowed the estimation of captures of common dolphins, New Zealand fur seals, and New Zealand sea lions in different fisheries. Captures of common dolphins were estimated for the jack mackerel trawl fishery off the North Island's west coast, as the majority of observed common dolphin captures occurred in this fishery (139 of a total 157 observed captures in all trawl fisheries between 1995–96 and 2012–13). In 2012–13, there were an estimated 15 (95% c.i.: 15–19) common dolphin captures in the large-vessel (90 m or longer) jack mackerel trawl fishery, and the estimated capture rate was 0.87 (95% c.i.: 0.87–1.11) dolphins per 100 tows. Both estimates were higher than those in the preceding fishing year, when there were seven (95% c.i.: 5–14) estimated common dolphin captures, with a capture rate of 0.43 (95% c.i.: 0.30–0.85) dolphins per 100 tows. Of the covariates included in the model, distance of the headline below the surface best explained common dolphin captures.

New Zealand fur seals were incidentally captured in a number of different trawl fisheries, involving a range of target species and fishing areas. Across all trawl fisheries, there were an estimated 398 (95% c.i.: 236–713) captures of fur seals in 2012–13, and the estimated capture rate in 2012–13 was 0.48 (95% c.i.: 0.28–0.85) fur seals per 100 tows. Most of the estimated captures were in the hoki trawl fishery, with 242 (95% c.i.: 114–534) estimated fur seal captures and a capture rate of 2.07 (95% c.i.: 0.98–4.57) fur seals per 100 tows. For other target fisheries, capture estimates in 2012–13 included trawls targeting middle-depth species (78 estimated captures; 95% c.i.: 29–189), southern blue whiting (26 estimated captures; 95% c.i.: 26–26), ling (15 estimated captures; 95% c.i.: 5–42), and hake (11 estimated captures; 95% c.i.:

8–21). Other trawl target fisheries had less than ten mean estimated captures in 2012–13, and included squid, mackerel, and scampi fisheries). Estimated fur seal captures in deepwater fisheries were close to zero (95% c.i.: 0–1). Low observer effort in inshore trawl fisheries (0.5% coverage in 2012–13) resulted in an uncertain capture estimate of 11 fur seal captures (95% c.i.: 0–49).

In addition to trawl fisheries, New Zealand fur seals were incidentally caught in surface-longline fisheries. In 2012–13, there were 112 (95% c.i.: 72–163) estimated captures of fur seals in surface-longline fisheries, and the corresponding estimated capture rate was 0.04 (95% c.i.: 0.03–0.06) fur seals per 1000 hooks.

The number of captures of New Zealand sea lions in subantarctic trawl fisheries was estimated for five combinations of target fishery and area, including the squid, scampi, and other trawl fisheries off Auckland Islands, the southern blue whiting trawl fishery off Campbell Island, and all trawl fisheries on the Stewart-Snares shelf. The total number of estimated captures across all strata was 33 (95% c.i.: 27–40) sea lions in 2012–13. This estimate was markedly higher than in the preceding fishing year, when there were an estimated 12 (95% c.i.: 5–21) sea lion captures. Most of the estimated sea lion captures were in the southern blue whiting fishery, with 21 (95% c.i.: 21–22) estimated captures and an estimated capture rate of 2.72 (95% c.i.: 2.72–2.85) sea lions per 100 tows. High observer coverage of 99.9% in the southern blue whiting fishery meant that the estimated captures were equal to the observed captures.

High numbers of sea lion captures in the Auckland Islands squid fishery over time resulted in the use of sea lion exclusion devices (SLEDs) that are fitted to trawl nets in this fishery. The use of SLEDs means that the number of sea lion that may have escaped the net and the post-escape survival of escapees are unknown. For this reason, the estimation of sea lion captures in this fishery includes the number of interactions, which is the number of sea lions that would have been caught had no SLEDs been used. The corresponding strike rate indicates the number of interactions per 100 tows. There were an estimated 54 (95% c.i.: 7–261) interactions in this fishery in 2012–13, and the strike rate was 5.26 (95% c.i.: 0.68–25.41) interactions per 100 tows. The total number of interactions for all trawl fisheries was 83 (95% c.i.: 35–288) interactions, with a strike rate of 0.54 (95% c.i.: 0.23–1.87) interactions per 100 tows in 2012–13. The large uncertainty associated with these estimates highlights the difficulty of providing reliable estimates of the number of interactions and the strike rate. This uncertainty results from the data becoming increasingly biased towards tows that used SLEDs and a decrease in observed captures in recent years.

Observer data of incidental captures of sea turtles document 17 observed captures between 2002–03 and 2012–13. Most of these captures (15) were in surface-longline fisheries, with one observed capture each in inshore trawl fisheries and the snapper bottom-longline fishery. Based on the observer data, the capture estimate of sea turtles was 11 (95% c.i.: 5–20) individuals in 2012–13.

1. INTRODUCTION

Incidental captures of non-target species, including protected species, occur across different fisheries worldwide. In New Zealand waters, government fisheries observers monitor interactions between commercial fishing operations and protected species, including marine mammals, seabirds, and turtles. Although observer coverage can vary greatly across fisheries, these observer data provide a systematic and independent record of the number and identity of incidental captures. This information forms the basis of assessments that estimate total captures of protected species across species and fisheries, and are an integral component of management strategies.

Observers collect at-sea mortality data that allow the development of statistical models to derive total bycatch estimates based on all fishing effort in different fisheries. Previous bycatch assessments in New Zealand's Exclusive Economic Zone (EEZ) used statistical models to estimate the incidental capture of marine mammals, seabirds and turtles. This report presents an update of previous information on the incidental captures of protected species in commercial fisheries in New Zealand's Exclusive Economic Zone (EEZ). Presented here are data for fisheries that had sufficient observer coverage, including records from the 2012–13 fishing year. The impact of incidental captures on the respective populations was not considered.

Previous marine mammal bycatch assessments have focused on common dolphin (*Delphinus delphis*), New Zealand fur seal (*Arctocephalus forsteri*), and New Zealand sea lion (*Phocarctos hookeri*). For seabirds, total capture assessments have focused on species with the largest number of observed captures, New Zealand white-capped albatross (*Thalassarche steadi*), Salvin's albatross (*Thalassarche salvini*), southern Buller's albatross (*Thalassarche bulleri bulleri*), white-chinned petrel (*Procellaria aequinoctialis*), and sooty shearwater (*Puffinus griseus*). Other species observed captured less frequently were also included and grouped as either "other albatrosses" or "other birds". These same species and groupings were used in the present assessment. In addition, observer records of incidental captures of turtles were used to update the estimates of incidental turtle captures.

This report presents methods and results in separate sub-sections for the seabird species groupings, the individual marine mammal species, and turtles (details of the model datasets, estimates and diagnostics are included in Appendices A–C). As the fishing year in New Zealand spans from 1 October to 30 September the following year, data analysis and presentation follow this format, with the most recent data encompassing the 2012–13 fishing year. The only exception is the subantarctic southern blue whiting fishery, east of Campbell Island. This fishery extends past the end of the standard fishing year with most trawl effort occurring between August and November. For this reason, data from this fishery are presented by calendar year.

2. METHODS

2.1 General approach

This analysis used observer data to estimate the captures of seabirds, marine mammals, and turtles in trawl and longline fisheries. The resulting estimates are the number of captures that would have been reported by observers, if there had been an observer on every vessel. These captures are referred to as observable captures, and no attempt was made to account for mortalities that would not be recorded by observers (such as birds that are hooked during longlining, but become unhooked before the line was hauled).

Estimates of the total number of observable captures were made for the seabird species with the largest number of observed captures between the 2002–03 and 2012–13 fishing years: New Zealand white-capped albatross (*Thalassarche steadi*), Salvin's albatross (*Thalassarche salvini*), southern Buller's albatross (*Thalassarche bulleri bulleri*), white-chinned petrel (*Procellaria aequinoctialis*), and sooty shearwater (*Puffinus griseus*). Estimates were also made for other species with fewer observed captures, and these seabirds were grouped as either "other albatrosses" or "other birds".

In surface-longline fisheries, all vessels 45 m or longer in the study period were foreign charter vessels (with the exception of a single domestically registered vessel that fished with this fleet until 2003–04). These vessels primarily targeted southern bluefin tuna. In bottom-longline fisheries, larger vessels (34 m length or over) were primarily autoliners, while smaller vessels typically set their lines manually (the choice of this vessel length was based on an analysis of the number of hooks set per day, with longer vessels typically setting 20 000 or more hooks per day). In trawl fisheries, vessels longer than 28 m long are not legally able to fish within the 12-nautical miles limit, and are legally required to use warp mitigation, unlike smaller vessels. In what follows, the term "large" vessels refers to vessels 45 m, 34 m, or 28 m and longer, for surface-longline, bottom-longline, and trawl fishing respectively. Conversely, "small" vessels refers to vessels shorter than these lengths. For each of these seven seabird species groupings, captures were estimated for five fishery groups: all trawl vessels, small bottom-longline vessels ($\leq$34 m length), large bottom-longline vessels ($>$34 m length), small surface-longline vessels ($\leq$45 m length), and large surface-longline vessels ($>$45 m length). This grouping led to a total of 35 models to estimate seabird bycatch in all commercial trawl and longline fisheries (see Appendix A, Figures A-1 to A-5 for the areas included in the estimation).

The estimates were made for the period between 1998–99 and 2012–13 for surface- and bottom-longline fisheries, and from 2002–03 to 2012–13 for trawl fisheries. The earlier records of seabird captures in trawl fisheries were not considered complete.

The estimation of the number of captures of marine mammals was focused on the species, fisheries and areas where most observed captures occurred (see Appendix A, Figure A-6) for the areas included in the estimation). Captures of common dolphins were estimated for the jack mackerel trawl fishery off the North Island's west coast only, as 139 of all 157 observed captures of common dolphins between 1995–96 and 2012–13 occurred in this fishery. For New Zealand fur seals, captures were estimated for all trawl fisheries except those targeting flatfish (no fur seal captures have been observed in flatfish trawl fisheries). Fur seal captures were estimated for the period between 2002–03 and 2012–13. An estimate was also made of fur seal captures in surface-longline fisheries over the same period. New Zealand sea lion captures were estimated in southern trawl fisheries, covering the period from 1995–96 to 2012–13.

In addition to estimates of the capture of seabirds and marine mammals, an estimate was made of the capture of turtles in surface-longline fisheries, covering the 2002–03 to 2012–13 fishing years.

Generalised Linear Models (GLMs) were fitted to the observer data, and then used to estimate the observable captures on unobserved fishing effort. The models had widely varying complexity. In some cases, such as turtle captures in surface-longline fisheries, there were few covariates and a simple model structure. In other cases, such as white-capped albatross captures in trawl fisheries, the models were relatively complex, with random vessel-year effects and overdispersion.

Bayesian methods were used to fit the models. The Bayesian methods have the advantage of allowing the complex structures that are appropriate for species that have been frequently observed caught, and they also allow for samples of the estimated quantities. By using the samples, uncertainty in any derived quantities may be derived, allowing for estimates to be combined or to be reported on for different fisheries or the area breakdowns that were used for the modelling.

The models were coded in the BUGS language (Spiegelhalter et al. 2003), a domain-specific language for describing Bayesian models. Each model was fitted with the software package JAGS (Plummer 2005), using Monte Carlo Markov chains (MCMCs). Two chains were fitted to each model, with the output including samples of the posterior distribution from each chain. Model convergence was assessed with diagnostics provided by the CODA package for the R statistical system (Plummer et al. 2006) including the criteria of Heidelberger & Welch (1983) and Geweke (1992).

2.2 Data preparation

Ministry for Primary Industries (MPI, previously Ministry for Fisheries) observers on commercial fishing vessels record captures of protected species, including seabirds and marine mammals. The capture events are recorded on paper forms by the observers, and subsequently entered into a database maintained by the National Institute of Water and Atmospheric Research (NIWA) on behalf of MPI. Currently, data are housed in the Centralised Observer Database (COD), and this protected species bycatch information from COD was used in the current analysis (Table 1).

In addition to the observer data, fishing effort data were required to allow for the observed captures to be appropriately scaled. Commercial fishing vessels return a record of all fishing effort on each trip to MPI. Skippers complete either a Trawl Catch Effort Processing Return (TCEPR), Trawl Catch Effort Return (TCER), Tuna Longline Catch Effort Return (TLCER), Catch Effort Landing Return (CELR), Lining Catch Effort Return (LCER), Lining Trip Catch Effort Return (LTCER) form, or Netting Catch Effort Landing Return (NCELR) form. During the 2007–08 fishing year, inshore trawl fisheries moved from reporting fishing effort on CELR forms to TCER forms. The TCER form requires the recording of the latitude and longitude of fishing effort, instead of only the statistical area. This recording of greater spatial detail has allowed a more accurate understanding of where inshore fishing is occurring. Data from these forms are stored in databases administered by MPI (Ministry for Primary Industries 2012). In

Table 1: Protected species bycatch information from the Centralised Observer Database used in the current bycatch estimation.

Data	Description
Species	The species identification as recorded by the observer. This identification may either be at the species level or be a more general classification, depending on how precisely the observer was able to identify the animal.
Capture method	A code indicating how the animal was captured. For example, the capture may have been in the net, on the warps, or entanglement in the line. Additional information from the observer's comments were also used to identify the capture method.
Life status	Observers record whether the animal was alive, dead, killed by the crew, or decomposed (i.e., dead before capture).
Station details	Trip number, station number, date at beginning of the tow or set, and target species. This information is required for all observed stations, including stations where there were no incidental captures of protected species.

this report, information on station date, position, and effort (either number of trawls, number of hooks, or total net length) was used.

Grooming of the data was first necessary to link captures to fishing events and to minimise the number of species mis-identifications. The grooming methods followed those used previously (Abraham & Thompson 2011). One important step in the grooming was allocating a fishery to each fishing event. The fishery was allocated on the basis of the fishing method, and the fisher-declared target species (Table 2). There were some unusual codes that were targeted in fewer than 100 fishing events (these codes included mis-spelled codes for common species). The fishery of these events was set to the fishery of the closest fishing event in time, by the same vessel, that had a defined fishery. For the few events that remained without a defined fishery, the fishery was imputed by randomly sampling from fishing events by vessels of the same class in the same statistical area.

Before carrying out the estimation, the observer data were linked to the effort data reported by the fishers. The linking was carried out by searching for fishing events recorded by the fisher from the same vessel at a similar place and time as recorded by the observer, using the same fishing method and targeting the same species. The criteria for matching the records were progressively relaxed to allow most of the observed fishing events to be associated with fisher-reported effort. In each of the years used in the estimation, over 99% of observed bottom-longline fishing events, 97.5% of observed surface-longline sets, and over 98.5% of observed trawl tows were able to be linked to effort reported by the fisher. A small number of captures were during observations that could not be linked to fishing effort, and were not included in the modelling. From 2002–03 and onwards, these unlinked captures were of Salvin's albatross (6 captures), sooty shearwater (3), flesh-footed shearwater (2), New Zealand sea lion (2), Campbell black-browed albatross (1), Chatham Island albatross (1), New Zealand fur seal (1), New Zealand white-capped albatross (1), wandering albatross (1), and white-chinned petrel (1). The two unlinked sea lion captures involved trawlers in the Auckland Islands area: one sea lion capture was by a trawler targeting hoki (during the 2002–03 fishing year), while the other capture was by a trawler targeting squid (during the 2005–06 fishing year).

Non-fishing related captures (such as birds that had hit the superstructure of the vessel, or a fur seal that climbed onto the vessel) were excluded from the estimation. Before 2006–07, these captures were identified from observer comments. During the 2006–07 fishing year, the Non-Fish Bycatch form was changed to provide more information on the captures than had previously been noted, including information on where on the vessel the animals were caught. These additional data were recorded from February 2007, and were used to exclude non-fishing related captures from the reporting. Of the total 6340 repor-

Table 2: Definition of target fisheries used in the estimation of seabird captures, with common names and three-letter codes used by Ministry for Primary Industries. Only species and codes that were used on more than 100 fishing events were included. In multi-species target fisheries, species are listed in decreasing order of how frequently they were targeted.

Method	Target fishery	Target species
Trawl	Squid	Squid (SQU).
	Hoki	Hoki (HOK).
	Deepwater	Orange roughy (ORH), oreos (OEO, SSO, BOE), cardinalfish (CDL), Patagonian toothfish (PTO).
	Southern blue whiting	Southern blue whiting (SBW).
	Mackerel	Jack mackerel (JMA), blue mackerel (EMA).
	Scampi	Scampi (SCI).
	Middle depth	Barracouta (BAR), warehou (WAR, WWA, SWA), hake (HAK), alfonsino (BYX), ling (LIN), gemfish (SKI), bluenose (BNS), sea perch (SPE), ghost shark (GSH), spiny dogfish (SPD), rubyfish (RBY), frostfish (FRO).
	Inshore	Tarakihi (TAR), snapper (SNA), gurnard (GUR), red cod (RCO), trevally (TRE), John dory (JDO), giant stargazer (STA), elephantfish (ELE), queen scallop (QSC), leatherjacket (LEA), school shark (SCH), blue moki (MOK), blue cod (BCO), rig (SPO), hāpuku (HPB).
	Flatfish	Flatfish (FLA), lemon sole (LSO), sand flounder (SFL), New Zealand sole (ESO), yellow-belly flounder (YBF), flounder (FLO), greenback flounder (GFL), turbot (TUR), brill (BRI), black flounder (BFL).
Bottom longline	Ling	Ling (LIN).
	Snapper	Snapper (SNA).
	Bluenose	Bluenose (BNS).
	Other	Hāpuku & bass (HPB, HAP, BAS), school shark (SCH), gurnard (GUR), blue cod (BCO), ribaldo (RIB), Patagonian toothfish (PTO, ATO), tarakihi (TAR), trumpeter (TRU), silver warehou (SWA), red snapper (RSN), gemfish (SKI).
Surface longline	Bigeye	Bigeye tuna (BIG).
	Southern bluefin	Southern bluefin tuna (STN).
	Albacore	Albacore tuna (ALB).
	Swordfish	Swordfish (SWO).
	Other	Yellowfin tuna (YFN), Pacific bluefin tuna (TOR), snapper (SNA), Northern bluefin tuna (NTU).

ted seabird captures in trawl and longline fisheries between 2002–03 and 2012–13, 477 captures were identified as being due to collisions with the vessel, or of birds landing on the deck, and were therefore removed from the study dataset. These observed deck captures occurred predominantly in trawl fisheries (456 captures), while the remainder were in bottom-longline (18) and surface-longline (3) fisheries. They involved a range of species, including common diving petrel (80 captures), sooty shearwater (50), New Zealand white-capped albatross (45), Snares Cape petrel (28), grey petrel (26), fairy prion (24), and storm petrel species (23). In addition to the seabirds, deck captures of a fur seal have also been recorded. Between 2002–03 and 2012–13, there were 7 incidents reported where a fur seal had climbed onto the fishing vessel, or was in the "moon pool" (hauling well) of longline vessels. These incidents were not included in the estimation (or reported elsewhere in this report).

Any animals that were reported by the observer as decomposed were excluded from the estimation. In addition, captures on research fishing trips that experimentally tested the efficacy of mitigation measures were also excluded. These fishing trips required a special permit, and included bottom-longline fishing trips in 2002–03 and early 2003–04 that assessed line weighting as a mitigation measure (Robertson et al. 2006). For this assessment, special longlines were used that had weighted and unweighted sections, and many birds were caught on the unweighted line. Similarly, during 2007–08, a trial was carried out on a surface-longline trip to test the efficacy of dyeing bait blue to reduce the number of birds that were hooked. All observed captures from these trips were excluded from the analysis and treated as unobserved. In 2004–05, an experiment was conducted in the Auckland Islands squid trawl fishery, comparing the performance of different mitigation measures (Middleton & Abraham 2007). As part of this experiment, some observed tows were made without any warp mitigation. The observed captures that occurred on the unmitigated tows were not included, and the tows were treated as unobserved. In 2012–13, there were eight bottom-longline trips that were carried out in north-eastern New Zealand where the observer carried out experimental work with line-weighting, time-depth recording, or other mitigation-related activities. Data from these trips were not included in COD, and so were excluded from this report.

The diversity of seabirds in New Zealand is among the highest in the world (Karpouzi et al. 2007), with 85 seabird taxa breeding in New Zealand, and the presence of other non-breeding species in the New Zealand's Exclusive Economic Zone (EEZ). This seabird diversity represents a challenge for the identification of captured seabirds by observers. Around 60% of the seabirds observed captured between 2002–03 and 2012–13 were sent to experts for formal identification via necropsy. In recent years, observers have taken photographs of captured birds, which have then been subsequently identified by experts. This approach has allowed the additional identification of seabirds that were captured and released alive. As a consequence, in the last two years of data, over 90% of all the observed seabird captures were identified by experts. Captured fur seal and cetaceans are not routinely returned for necropsy; however they are usually photographed by the observers. Confirmation of the identification of all cetacean captures was sought from the Department of Conservation. Many captured sea lions had been returned for necropsy, and where available, photographs were used to confirm their identification. A recent review of all sea lion captures in New Zealand fisheries includes information on the identification of the reported captures (Thompson et al. 2015).

When a seabird was not identified via necropsy or from photographs, an imputation process was used to derive an identification. The imputation worked as follows. First, a key was generated for each capture event, based on observer data. On the first pass, the key was a composite of all these identifiers: trip number, fishing year, observers' names, target fishery, fishing method, area, and observed species code. For each bird that had not been necropsied, all capture events with the same key were selected. If there were matching observed captures where a necropsy had been made, then a necropsy identification was chosen at random, and this identification was the imputed identification. If no matching capture events were found, or if none of the matching captures had been necropsied, then no imputation was made at that level, and the observers' species identification was retained. The imputation process was repeated, in a total of four passes. At each pass, the key was made more general, dropping the requirement that the trip number matched, then that the fishing year matched, then that the observers' names matched, and then that the target fishery matched. On the final pass, the observed captures used for imputation were required to match on the fishing method, area, and the species code recorded by the observer. In addition to the imputation, some manual grooming of the species codes was carried out. In a small number of cases, comments made by the observer were used to groom the species code recorded by the observer.

2.3 Estimation of seabird captures

The estimation of seabird captures in unobserved fishing was carried out using GLMs that predicted the logarithm of the expected captures during a fishing event as a linear function of a number of covariates. By fitting the model to observed capture data, the coefficients of the covariates could be determined. The coefficients were then used to estimate the expected number of captures at unobserved fishing events.

The GLMs were fitted using Bayesian methods (e.g., Congdon 2003, Gelman et al. 2006), which are appropriate for data that are overdispersed, such as the current capture data that contained many events without any captures, and also a few events with multiple captures. Bayesian methods accommodate this overdispersion of captures by assuming that they are drawn from a negative binomial distribution. Furthermore, observers generally record data from all fishing on entire trips, so that observations are not a random sample of all fishing effort. This way of recording data is accounted for in Bayesian methods, as they allow the inclusion of random effects.

There are several options for representing overdispersed count data in a GLM. Common methods include using the zero-inflated Poisson distribution (applied to New Zealand seabird data by Waugh et al. 2008), the negative binomial distribution (previously used in modelling of seabird bycatch by Baird & Smith 2008) and quasi-Poisson methods (used in the analysis of warp strike data by Middleton & Abraham 2007). There is no *a priori* theoretical basis for choosing one approach over another, and the suitability of one particular model can only be justified after model fitting, by comparing the distribution of the residuals against the expected distribution.

In this study, we followed previous research (Baird & Smith 2008, Abraham & Thompson 2011) and used the negative binomial distribution, as this distribution gave an adequate representation of capture data. The negative binomial distribution is parametrised by a mean, μ, and an overdispersion, θ. The variance is given by $\mu + \mu^2/\theta$. As the overdispersion increases to infinity, the variance goes to the mean, and the negative binomial distribution converges to a Poisson distribution. As θ gets small relative to the mean, the negative binomial distribution becomes increasingly peaked at zero and develops a long right-hand tail. This characteristic allows it to represent data with many zeros, and occasional large values. The negative binomial distribution has the convenient property that the sum of n samples drawn from a negative binomial distribution is also negative-binomially distributed, with mean $n\mu$ and overdispersion $n\theta$. This characteristic of the negative binomial distribution allowed the model to be applied to grouped event level data (multiple fishing events reported as a single record).

The negative binomial may be generated by a Poisson mixture distribution, with a gamma-distributed mean. The seabird captures, y_i, during a group of n_i fishing events, were generated as

$$y_i \sim \text{Poisson}(n_i \mu_i \delta_i), \tag{1}$$

$$\delta_i \sim \text{Gamma}(n_i \theta, n_i \theta), \tag{2}$$

where the Gamma distribution had shape $n_i\theta$ and a mean of 1. In this sense, the negative binomial distribution was an obvious choice for modelling the captures, as the overdispersion represented the effect of unknown processes on the variation of the mean capture rate. In some of the models, overdispersion was not included as there were insufficient numbers of observed captures to allow it to be estimated. In these models, the captures were assumed to be Poisson distributed.

The log of the mean catch rate for a single fishing event, μ_i, was assumed to be a linear function of N covariates, x_{ij}, with

$$\log(\mu_i) = \sum_{j=1}^{N} \beta_j x_{ij} + \log(\lambda_{y_i}), \tag{3}$$

where β_j are the coefficients of the covariates, x_{ij}, and λ_{y_i} are year effects. The covariates were all normalised before the model fitting, by subtracting the mean value and dividing by the standard deviation. After fitting, the regression coefficients, β_j, were converted back into standard units for presentation purposes.

The year effects, λ_{y_i}, were indexed by the fishing year of each group of events, y_i. They allowed for variation in the catch rate between years that was not explained by the covariates. They were modelled as log-normally distributed random effects,

$$\log(\lambda_y) \sim \text{Normal}(\log(\mu_\lambda), \sigma_\lambda), \tag{4}$$

where the mean and standard deviation of the year effects, μ_λ and σ_λ, were estimated by the model.

Not only were the observed captures overdispersed at an individual tow level, but there was also vessel-level variation in the capture rate. This variation was represented by including vessel effects, ν_v. The vessel effects were a multiplicative correction to the mean rate, μ_i, that could be different for each vessel within each fishing year. They were indexed by the vessel, v_i, and fishing year, y_i, of each group of events. When vessel effects were included, the equation for catch on a tow (Equation 1) was modified to be

$$y_i \sim \text{Poisson}(n_i \nu_{v_i} \mu_i \delta_i). \tag{5}$$

The vessel effects were assumed to be gamma distributed, with mean 1 and shape θ_ν,

$$\nu_v \sim \text{Gamma}(\theta_\nu, \theta_\nu). \tag{6}$$

The use of a gamma distribution allowed for a skewed distribution in the vessel effects, depending on the value of the shape, θ_ν.

The models used in the present analysis were the same as the statistical models used previously for estimating total seabird captures (Abraham et al. 2013). A vessel effect was included in the models as a parameter taking a different value for each vessel, allowing for capture rates to vary between vessels. This approach meant that the model will tend to extrapolate from high (or low) observed captures in one year by a vessel, to infer relatively high (or low) captures by the same vessel in other years. Being able to infer catch rates between years makes the model fitting more stable, especially in fisheries where vessels are only sporadically observed, and it reduces identifiability issues caused by fitting both vessel-year and year effects. The models were coded in the BUGS modelling language (Spiegelhalter et al. 2003), and model fitting was carried out using the software JAGS (Plummer 2005).

During model fitting, estimates were made for the parameters β_j, λ_1, μ_λ, σ_λ, θ, and θ_ν. Prior distributions were required for all these parameters, and were identical to those in Abraham et al. (2013). Diffuse normal priors were used for the mean year effect, μ_λ, the regression coefficients, β_j, and the initial year effect $\log(\lambda_1)$. A half-Cauchy prior (Gelman 2006) was used for the variation between years, σ_λ, and uniform-shrinkage priors were used for the overdispersion parameters (Gelman 2006):

$$\begin{aligned}
\beta_0 &\sim \text{Normal}(\mu = 0, \sigma = 10), && (7)\\
\beta_j &\sim \text{Normal}(\mu = 0, \sigma = 10), && (8)\\
\log(\lambda_1) &\sim \text{Normal}(\mu = \log(\bar{y_i}), \sigma = 100), && (9)\\
\delta_\lambda &\sim \text{Normal}(\mu = \log(\bar{y_i}), \sigma = 100), && (10)\\
\sigma_\lambda &\sim \text{Half-Cauchy}(\sigma = \sigma_y), && (11)\\
\theta &\sim \text{Uniform-shrinkage}(\mu = \bar{y_i}), && (12)\\
\theta_\nu &\sim \text{Uniform-shrinkage}(\mu = \bar{y_v}), && (13)
\end{aligned}$$

where $\bar{y_i}$ was the mean count per event, σ_y was the standard deviation in the captures per year, and $\bar{y_v}$ was the mean number of captures per vessel. The prior for the regression coefficients had a relatively small standard deviation, reflecting the consideration that larger absolute values of these coefficients would be unrealistic.

The models were run for 4000 updates during burn-in, and then run for up to a further 40 000 updates, with every 20th sample being retained for analysis.

The Bayesian model fitting was computationally intensive, and the trawl data were grouped to reduce the data volume. Data from consecutive tows by the same vessel were aggregated, following similar methods to those used by Manly et al. (2002b). All tows by the same vessel, fishing in the same fishery, statistical area, calendar month, and either observed or not observed, were grouped together. The values of the other covariates were then aggregated, to provide group level covariates. The average number of tows in a group was 8.9, with the size of the effort dataset being reduced from 839 054 tows to 93 964 tow groups.

2.3.1 Seabird model selection

The model structure allowed for the seabird capture probability to depend on covariates (see Tables 3-8 for the covariates and configurations used in the models for the different fisheries).

A step analysis was used to select the covariates that had explanatory power (Venables & Ripley 2002). Maximum likelihood methods were used to fit the negative binomial GLM to the observed captures. The logarithm of the number of fishing events associated with each observation was included in the linear predictor as an offset term. The models used for the step analysis differed from the full Bayesian models in the following ways: the overdispersion did not depend on the number of events in each observation; no random-year or vessel effects were included; and the fishing year was presented to the step analysis as a fixed-effect. At each stage of the step analysis, the model was fitted repeatedly, with each of the potential covariates included (or removed) in turn. The covariate was selected that produced the greatest reduction in the Akaike information criterion (AIC)(Akaike 1974). Steps continued until the deviance was not reduced by more than 1%. Placing a requirement on the deviance reduction prevented the inclusion of covariates that had little explanatory power. In some cases, the Bayesian models did not converge when the full set of covariates was used. In this case, covariates with low explanatory power were progressively omitted until convergence was achieved. In addition to selecting a set of covariates, further modelling choices were made. The most complex models had fishing-year random effects, vessel random effects, and overdispersion. These factors could be omitted to simplify the model, so that the simplest models had no random effects and no overdispersion. Model simplification was necessary to ensure model convergence for those species group and fishing method combinations that had few observed captures.

The configuration of the models and the covariates included in the models closely followed those in Richard & Abraham (2013a). Nevertheless, due to the addition of an additional year of data on observed fishing effort and captures, the step procedure for the selection of variables led to some differences. For trawl models (Table 4), fishing duration was added to the model for New Zealand white-capped albatross; area was added to the model for southern Buller's albatross; catch weight was added to the model for Salvin's albatross; the fraction of fishing at night was added to the model for other albatrosses; area and the fraction of fishing at night were added to the model for white-chinned petrel; the annual sine component, catch weight, moon phase, and a six-month sine component were added to the model for sooty shearwater; an annual cosine component was added to the model for other birds. For large-vessel bottom-longline models (Table 6), the half year to May was changed to September for New Zealand white-capped albatross, the half year to July was added to the model for southern Buller's albatross, the moon phase was added to the model for white-chinned petrel, and the half year to May was added to the model for sooty shearwater. For small-vessel bottom-longline models, a simple model equivalent to a ratio estimate was run without covariates for New Zealand white-capped albatross, whereas the number of observed captures was previously insufficient. Additionally, an area effect was added to the model for other birds. For the large-vessel surface-longline models (Table 8), the half year to July was changed to June for the model for other birds. No change was made to the small-vessel surface-longline models.

Table 3: Capture of seabirds in trawl fisheries. Covariates used in estimating seabird captures in trawl fisheries.

Covariate	Definition
Vessel size	Four groups, vessels $\leq$ 28 m, 29 m to 45 m, 46 m to 85 m, and $\geq$86 m length.
Area	Groups of statistical areas, based on the observed capture rates. Different area groupings were used for each species group (see Figure A-1).
Fishery	Classification of each group of tows based on target species. Includes deepwater species, hoki, mackerel, southern blue whiting, scampi, squid, and other middle-depth species (see Table 2). When grouping tows, the fishery was taken as the most frequent fishery of all the tows in a group.
Day of year	First and second harmonics of the day of the year (sin$(2d\pi/366)$, cos$(2d\pi/366)$, sin$(4d\pi/366)$, cos$(4d\pi/366)$, where d is the day of the year) included as continuous variables, allowing for smooth variation in the seabird bycatch rates with the season. Averaged over all trawls within a group.
Gear type	Midwater or bottom trawl.
Processing type	Freezer, freezer with meal plant, or neither. Derived from the meal plant and freezer indicators from the vessels database. Vessels for which this information was missing were assigned to the "neither" class.
Duration	The logarithm of the average duration of the trawls within a group.
Moon phase	Fractional illumination of the moon's disk (between 0 and 1). Averaged over all trawls within a group.
Mandatory mitigation	This factor is true for all fishing by trawlers over 28 m length after January 2006, and is false otherwise. This factor reflects the introduction of mandatory warp mitigation for large trawlers fishing within the Exclusive Economic Zone (Department of Internal Affairs 2006).

Table 4: Capture of seabirds in trawl fisheries. Summary of the configuration of the trawl fisheries models, with a list of the covariates that were included in each model. The bullets indicate the inclusion of different effects in the model (Years: random year effects; Vessel: random vessel effects; Over.: overdispersion).

Species group	Years	Vessels	Over.	Covariates
White-capped albatross	●	●	●	Annual sine exponent; area; fishery; log(fishing duration); mandatory mitigation
Southern Buller's albatross	●	●	●	Annual cosine exponent; annual sine exponent; area; fishery; mandatory mitigation; net type; processing type; six month sine exponent
Salvin's albatross	●	●	●	Annual cosine exponent; annual sine exponent; area; fishery; log(catch weight); mandatory mitigation; processing type
Other albatrosses	●	●	●	Fraction of fishing at night; inshore; mandatory mitigation; moon phase; processing type
White-chinned petrel	●	●	●	Annual cosine exponent; annual sine exponent; area; fishery; fraction of fishing at night; log(fishing duration); mandatory mitigation; processing type
Sooty shearwater	●	●	●	Annual cosine exponent; annual sine exponent; fishery-area; inshore; log(catch weight); mandatory mitigation; moon phase; net type; processing type; six month cosine exponent; six month sine exponent
Other birds	●	●	●	Annual cosine exponent; area; fishery; inshore; mandatory mitigation; processing type

Table 5: Capture of seabirds in bottom-longline fisheries. Covariates used to estimate seabird captures in bottom-longline fisheries.

Covariate	Definition
Target species	Target species fishery, either ling, snapper, bluenose, or other target species.
Area	Areas were defined by grouping statistical areas with similar observed capture rates, for each seabird species group.
Season	Either a two-level factor (summer and winter), with summer defined as being between the beginning of October and the end of March, or a three-level factor with the breeding season of the bird species. Breeding season was used for sooty shearwater and white-chinned petrel. For sooty shearwater, the levels were breeding (November to March), shoulder (April to June, October), and off-season (July to September). For white-chinned petrel, the levels were breeding (October to April), shoulder (May and September), and off-season (June to August). For both sooty shearwater and white-chinned petrel, no captures have been observed in bottom-longline fisheries during the off season, and so the catch rate was assumed to be zero during these months.
Integrated weight line	Whether or not the vessel was using an integrated weight line at the time of the fishing.
Moon phase	A value between 0 and 1 defined as the fractional illumination of the moon's disk. Calculated following algorithms by Meeus (1991).
Hook number	The logarithm of the total number of hooks set, obtained from the fisher data. This covariate allows for a bycatch that is a power law of the number of hooks.

Table 6: Capture of seabirds in bottom-longline fisheries. Summary of the configuration of the bottom-longline fisheries models, with a list of the covariates that were included in each model. The bullets indicate the inclusion of different effects in the model (Year: random year effects; Vessel: random vessel effects; Over.: overdispersion). The cut-off length for small and large vessel sizes classes was 34 m.

(a) Large vessels ($\geq$ 35 m)

Species group	Years	Vessels	Over.	Covariates
White-capped albatross	-	-	-	Half year to September; integrated weight line; log(hooks); moon phase
Southern Buller's albatross	-	-	●	Half year to July; integrated weight line
Salvin's albatross	-	-	-	Half year to April; integrated weight line; log(hooks)
Other albatrosses	-	●	●	Integrated weight line
White-chinned petrel	●	●	●	Area; breeding season; integrated weight line; log(hooks); moon phase
Sooty shearwater	●	●	●	Area; breeding season; half year to May; integrated weight line
Other birds	●	●	●	Area; half year to May; integrated weight line; log(hooks)

(b) Small vessels ($<$ 35 m)

Species group	Years	Vessels	Over.	Covariates
White-capped albatross	-	-	-	
Southern Buller's albatross	-	-	●	Half year to June
Salvin's albatross	-	-	●	Half year to August
Other albatrosses	-	-	●	Half year to August
White-chinned petrel	-	-	●	Half year to September
Sooty shearwater	-	-	-	
Other birds	-	-	●	Half year to May

Table 7: Capture of seabirds in surface-longline fisheries. Covariates used in estimating seabird captures in surface-longline fisheries.

Covariate	Definition
Target species	Southern bluefin tuna, bigeye tuna, albacore and swordfish. A number of other species were targeted relatively infrequently, such as yellowfin tuna (*Thunnus albacares*). For the modelling, these other target species were included with bigeye tuna. Other species were primarily targeted on trips that also targeted bigeye tuna, and sets targeting other species were only infrequently observed.
Area	Northern, southern and Kermadec Islands areas. The northern area includes Area 1 and Area 4, with the exception of Fishery Management Area (FMA) 10 surrounding Kermadec Islands. The southern area includes Area 2 and Area 3. The Kermadec Islands area, FMA 10, was treated separately.
Day of year	The sine and cosine of the day of year (sin$(2d\pi/366)$, cos$(2d\pi/366)$) were included as continuous variables, allowing for smooth variation in the seabird bycatch rates with the season.
Set time	Night, day, full moon. The start and end times of the set, and vessel position, used to calculate whether the set was entirely in the night, or was partly in the day. Astronomical algorithms were used to calculate the sun's angle relative to the horizon, with night being defined by when the sun was below the horizon at both the start and the end of the set (Meeus 1991). For night sets, the fractional illumination of the moon's disc was used to define a full moon, with an illumination of more than 90% being defined as full. Other categorisations were also tried, including using separate categories for dawn and dusk sets, using continuous functions of the set time, and using haul times rather than set times.
Hook number	The logarithm of the total number of hooks set. The log transformation allowed for a bycatch that is proportional to the number of hooks.
Duration	The logarithm of the duration (hours) of the setting. The log transformation allowed for a bycatch that is proportional to the duration. The duration was of the set time only, as it was assumed that the highest risk to birds is during line setting.

Table 8: Capture of seabirds in surface-longline fisheries. Summary of the configuration of the surface-longline fisheries models, with a list of the covariates that were included in each model. The bullets indicate the inclusion of different effects in the model (Year: random year effects; Vessel: random vessel effects; Over.: overdispersion). The cut-off length for small and large vessel sizes classes was 45 m.

(a) Large vessels (≥ 45 m)

Species group	Years	Vessels	Over.	Covariates
White-capped albatross	●	●	●	Half year to April; set time (day, night, full moon)
Southern Buller's albatross	●	●	●	Half year to May; set time (day, night, full moon); log.set.duration
Salvin's albatross	●	●	●	Half year to June; set time (day, night, full moon)
Other albatrosses	●	●	●	Area; half year to April; set time (day, night, full moon)
White-chinned petrel	-	-	-	Half year to April
Sooty shearwater	-	-	-	Half year to April; log(fishing duration); set time (day, night, full moon)
Other birds	●	●	●	Area; half year to June; set time (day, night, full moon)

(b) Small vessels (< 45 m)

Species group	Years	Vessels	Over.	Covariates
White-capped albatross	-	-	-	Area; half year to April; set time (day, night, full moon)
Southern Buller's albatross	-	-	-	Half year to June; set time (day, night, full moon)
Salvin's albatross	-	-	-	Half year to August
Other albatrosses	-	●	●	Fishery; half year to August; set time (day, night, full moon)
White-chinned petrel	-	-	-	Fishery
Sooty shearwater	-	-	-	
Other birds	-	●	●	Area; half year to April; set time (day, night, full moon)

2.3.2 Seabird model diagnostics

The first diagnostic was to assess that the MCMCs appeared to have converged. The Heidelberger & Welch (1983) criterion, applied to the model parameters and hyper-parameters, was used as a guide. This diagnostic assessed that the chains were stationary. Two independent chains were run, with similar posterior distributions from the two chains being consistent with model convergence. In making this comparison, the key measure of interest, the total estimated number of captures during the 2012–13 fishing year, was used.

Also assessed was whether there was evidence that the assumptions underlying the model were not being met. The captures were estimated on observed groups of fishing events, and this assessment examined whether randomised quantile residuals (derived from the difference between the modelled and the observed captures) had the expected distribution (Dunn & Smyth 1996). In the case of the most general model (Equation 5), the captures on a group of fishing events, i, were drawn from a negative binomial distribution, with mean $n_i \nu_{v_i y_i} \mu_i$ and overdispersion $n_i \theta$. The randomised quantile residuals were calculated from the beta distribution (Murray Smith, NIWA, pers. comm.),

$$b(c_i) \sim \text{Beta}(\theta/(\nu_{v_i y_i} \mu_i + \theta);\ n_i \theta,\ c_i), \tag{14}$$

where c_i were the observed captures, by drawing from the uniform distribution.

$$u_i \sim \text{Uniform}(b(c_i),\ b(c_i + 1)). \tag{15}$$

If the data were represented by a negative binomial model, then the quantile residuals, u_i, would have been normally distributed with zero mean and unit standard deviation. Normal quantile-quantile plots were used to inspect whether this held. Credible intervals, the Bayesian analog of confidence intervals, were obtained by calculating the quantile residuals for 1000 randomly drawn samples from the MCMC, and taking the 2.5% and 97.5% percentiles.

2.3.3 Predicted seabird captures

To make predictions of observable seabird captures, the number of captures that occurred during each group of fishing events was estimated. For observed fishing events, the number of captures was the number of observed captures. For unobserved fishing events, an estimate was made by sampling from the Poisson distribution (following Equation 1 or Equation 5), where the parameters of these equations were derived from the covariates and from the posterior distributions of the parameters. The event-group estimates were then summed within strata to obtain an estimate of total captures by year, by fishery, or in other aggregates. A consistent set of areas and fisheries was used for reporting on the data, following those used by Abraham et al. (2013). In many cases, the areas and fisheries used as covariates during the modelling differed from those used during model fitting.

By repeating the estimate for all samples from the MCMCs, a posterior distribution of estimated captures was obtained. The posterior distributions are summarised by their mean, median, and 95% credible interval (determined from the 2.5% and 97.5% quantiles).

For each of the 35 models, a summary is provided in Appendices B and C. A consistent set of the following tables and plots is included for each model:

- Estimated captures and capture rate for each fishery. For trawl fisheries, estimated captures and capture rates are listed for the fisheries that had the highest number of captures.
- The number of estimated captures within each fishery-area combination. The areas used in this summary are the areas that were used by Abraham et al. (2010), rather than the areas used as model covariates. Use of the former areas allowed comparison between the model estimates, and with the early ratio estimates.
- A summary of the step-analysis that presents the deviance explained by the sequential addition of covariates to the maximum likelihood model.

- Time-series plots showing the captures estimated by applying the model to observed fishing effort, and to all fishing effort. The number of observed captures is indicated for comparison. As a simple diagnostic, it is expected that the observed captures should generally be within the range of estimates made by applying the model to the observed effort.
- A summary of the Bayesian model parameters (the median, mean, 2.5% and 97.5% percentiles). The base rates and model covariates are presented in exponentiated form, so that they can be interpreted as multiplicative effects.
- Diagnostic plots of total estimated captures during the 2012–13 fishing year, calculated for each sample from the MCMCs. The MCMCs and the density of the posterior distribution are shown for each chain.
- A plot of the randomised quantile residuals, comparing observed captures, with the mean expected captures for each observed fishing event.

2.4 Estimation of common dolphin captures

The statistical model built to estimate the total number of common dolphin captures was a two-stage Bayesian model that separately predicted the probability of capture events occurring and the number of captures on each capture event (see Appendices B.9 and C.36). Models of this kind are called hurdle models (Mullahy 1986, Ridout et al. 1998), and are appropriate when different processes are influencing the occurrence of captures and the number of animals caught on each capture event. In the first stage, a logistic generalised linear model estimated the probability of capturing common dolphin on a given tow as a linear function of a number of covariates. Given that there was a capture event, the number of captures was then estimated in the second stage by sampling from a zero-truncated Poisson distribution. In addition to estimating total captures, the model explored which covariates are related to dolphin captures in the examined fishery. This modelling approach was previously applied to the jack mackerel fishery on North Island's west coast between 1995–96 and 2010–11, as common dolphin captures were observed sufficiently frequently in this fishery to allow development of the model (Thompson & Abraham 2009, Thompson et al. 2010a, Thompson et al. 2011, Thompson et al. 2013). The present study updated the model to include data from the mackerel fishery up to the 2012–13 fishing year, encompassing the 17-year period between 1 October 1995 and 30 September 2013.

Data for modelling and analysis were from an area on the North Island west coast that included the region where common dolphin captures have been observed in the mackerel fishery. This area was enclosed by a line extending north along longitude 173°2.8′ E, a line across Cook Strait at latitude 41° S, boundary at 171° E, and the boundary of New Zealand's EEZ (Figure A-6). For higher spatial resolution, the area was divided into northern and southern sub-areas by a line at latitude 39°18′ S.

The statistical model estimated the probability, π_i, of capturing dolphins on a tow, i. A year effect, λ_j was estimated for each year, j, allowing for annual variation in the capture event rates that was unrelated to the covariates, x_{ic}. The contribution of each covariate, indexed by c, was governed by a regression coefficient, β_c, that was estimated by the model. The logit transform of the capture event probability was defined as the sum of the year effect, $\lambda_{j[i]}$, and the covariates:

$$\text{logit}(\pi_i) = \lambda_{j[i]} + \sum_c \beta_c x_{ic}. \tag{16}$$

Diffuse normal priors were given to the regression coefficients, β_c, and to the mean of the year effects, λ_j. A half-Cauchy prior, with a scale of 25, was given to the variance of the year effects.

On tows where common dolphin captures occurred, the captures were assumed to follow a zero-truncated Poisson distribution with size μ. The use of a zero-truncated distribution reflected the structure of the hurdle model (if a capture event occurred the number of dolphins caught must have been one or more).

The probability that y_i dolphins were captured on tow i was given by

$$\Pr(y_i = y) = \begin{cases} (1-\pi_i) & \text{if} \quad y = 0 \\ \pi_i \frac{e^{-\mu}\mu^y}{(1-e^{-\mu})y!} & \text{if} \quad y > 0. \end{cases}$$

The size, μ, was given a prior that was uniform between 0.5 and 30. It would be possible for the size of the truncated Poisson distribution, μ, to vary with the value of covariates on each tow. However, an initial exploration suggested that there was no consistent variation of the size μ with any available covariates.

Estimates were prepared for groups of trawls, grouped by fishing year, y, and vessel, v. The estimated total number of dolphins captured in a group, D^t_{yv}, was calculated as the sum of actual reported captures on observed tows, d^o_{yv}, and estimated captures on the unobserved tows, D^e_{yv},

$$D^t_{yv} = d^o_{yv} + D^e_{yv}. \tag{17}$$

Total captures in a year were obtained by summing the captures over all vessels fishing in that year, $D^t_y = \sum_v D^t_{yv}$.

The model structure allowed for the dolphin capture event probability to depend on covariates. The same covariates used previously (see Thompson & Abraham 2009, Thompson et al. 2010a, Thompson et al. 2011, Thompson et al. 2013) were used in this report, and included trawl duration, headline depth, sub-area, and light condition (see definitions in Table 9).

2.5 Estimation of fur seal captures in trawl fisheries

A Bayesian capture model was developed to predict fur seal captures in commercial trawl fisheries (see Appendices B.10.1 to B.10.11, Appendix C.37) The same modelling approach was previously used to estimate the total number of incidental fur seal captures per fishing year for the periods from 2002–03 to 2007–08, 2008–09, 2009–10, and 2010–11, respectively (Thompson & Abraham 2010, Thompson et al. 2010b, Thompson et al. 2011, Thompson et al. 2013). In this report, parameters from the fitted model were used to update fur seal capture estimates across commercial trawl effort, including vessels targeting inshore fish species (excluding flatfish), for the 10-year period from 1 October 2002 to 30 September 2013.

As the number of observed tows greatly exceeded the number of tows that could be easily fitted by the model, trawl events were aggregated to reduce the computational load. The grouping was similar to methods used by Manly et al. (2002a). Tow groups were defined as trawls by the same vessel, in the same statistical area, fishing for species in the same target fishery, observed or unobserved, and in the same calendar month. The aggregation of trawl events into groups reduced the accuracy of representation of some covariates, but allowed the simultaneous fitting of all trawl data from New Zealand's EEZ between 2002–03 and 2012–13 by the model using Bayesian methods.

In the model, captures, y_i, in a trawl group, i, were modelled as samples from a negative-binomial distribution:

$$y_i \sim \text{NegativeBinomial}(\text{mean} = \mu_i n_i, \text{ shape} = \theta n_i), \tag{18}$$

where n_i is the number of tows in a trawl group. The shape parameter, θ, allows for extra dispersion in the number of captures, relative to a Poisson distribution. The shape was assumed to be the same for all trawl groups. The negative-binomial distribution has the property that the mean of n samples from a negative-binomial distribution (NegativeBinomial(μ, θ)) is itself negative-binomially distributed, with mean μn and shape θn. For this reason, while y_i is the number of captures per group, μ_i should be interpreted as the mean capture rate per tow.

The mean capture rate within each group was estimated as the product of a random year effect λ_{y_i}, a

Table 9: Covariates included in the common dolphin capture model.

Covariate	Description
Trawl duration	Duration of trawls in hours from start and end times recorded on Trawl Catch Effort Processing Return (TCEPR) forms.
Headline depth	Depth in metres of the top of the net, derived by subtracting the headline height from the ground line depth (both recorded on TCEPR forms). Indicates the depth of the top of the net.
Sub-area	The west coast North Island region, divided into two sub-areas (north and south of $39°18'$ S) that were included as a factor variable.
Light condition	Three-level factor characterising the time of the haul and the phase of the moon: light (net hauled between dawn and dusk, or between dusk and midnight on a moonlit night), dark (net hauled between dusk and midnight on a dark night, or between midnight and dawn on a moonlit night), and black (net hauled between midnight and dawn on a dark night). The illumination of the moon and time of dawn and dusk were calculated using algorithms from Meeus (1991). Night was classified as moonlit if more than 17% of the moon's disc was illuminated. Dawn and dusk were defined as when the centre of the sun's disk was 6° below the horizon (civil dawn and dusk).

random vessel-year effect $\nu_{v_i y_i}$, and the exponential of a sum over covariates,

$$\mu_i = \lambda_{y_i} \nu_{v_i y_i} \exp\left(\sum_c \beta_c x_i^c\right), \tag{19}$$

$$\log(\lambda_{y_i}) \sim \text{Normal}(\mu = \mu_\lambda,\ \sigma = \sigma_\lambda), \tag{20}$$

$$\nu_{v_i y_i} \sim \text{Gamma}(\text{shape} = \theta_\nu,\ \text{rate} = \theta_\nu). \tag{21}$$

The random year effect λ_{y_i} on each tow was drawn from a log normal distribution with mean μ_λ, and standard deviation σ_λ. The random vessel-year effect $\nu_{v_i y_i}$ for each observed vessel v_i and year y_i was included to account for the variation between vessels, and was drawn from a gamma distribution with shape and rate θ_ν. With this parameterisation, the gamma distribution has unit mean. The coefficient of a covariate c was denoted β_c, while the value of the covariate at tow i was denoted x_i^c.

Standard priors were used for the model (hyper-)parameters (e.g., Gelman et al. 2006). Diffuse normal priors were used for the covariate coefficients and for the logarithm of the mean year effect, μ_λ. The shape hyper-parameters were given uniform shrinkage priors, with the size parameter for the overdispersion equal to the mean number of captures, and the size parameter for the vessel-year effect equal to the mean number of captures per vessel:

$$\log(\mu_\lambda) \sim \text{Mean}(\mu = \bar{y_i}, \sigma = 100), \tag{22}$$

$$\sigma_\lambda \sim \text{Half-Cauchy}(25), \tag{23}$$

$$\theta \sim \text{Uniform-shrinkage}(\bar{y_i}), \tag{24}$$

$$\theta_\nu \sim \text{Uniform-shrinkage}(\bar{y_{v_i}}), \tag{25}$$

$$\beta_c \sim \text{Normal}(\mu = 0, \sigma = 100). \tag{26}$$

The same covariates selected in previous modelling of fur seal captures (Thompson & Abraham 2010, Thompson et al. 2010b, Thompson et al. 2011, Thompson et al. 2013) were used in the current report, and included fishing area, target fishery, day of year, and distance from shore (see definitions in Table 10). Fishing area was used to provide higher spatial resolution within New Zealand's entire EEZ. The latter was divided into 13 fishing areas, using the same areas as those defined by Thompson & Abraham (2010). Fur seal captures were observed in ten of the fishing areas, which were included in the analysis (see

Figure A-6). Tows in the three fishing areas in which no fur seal captures were observed, north and east of North Island, and around Chatham Islands were excluded from the model, based on the assumption that there were no captures by the unobserved effort in these fishing areas.

The definition of target fishery was the same as those applied previously (Thompson & Abraham 2010, Thompson et al. 2011, Thompson et al. 2013), with tows targeting hoki, hake, and ling combined into one group during the modelling (estimated captures are reported separately for each of these target species). Included in the modelling were tows targeting inshore species, excluding flatfish targets. Low observer effort in the past prevented the inclusion of inshore target fisheries in previous assessments of incidental captures. An increase in observer effort in recent years allowed for the inshore trawl fisheries (excluding flatfish targets) to be included in the present estimation.

The covariate distance from shore was correlated with fur seal captures in some areas in previous analyses (Mormede et al. 2008, Smith & Baird 2009), and was included in the present model. The New Zealand coastline was obtained from GSHHS (Global Self-consistent, Hierarchical, High-resolution Shoreline Database) (Wessel & Smith 1996), and distance from shore was calculated using functions from PostGIS (http://postgis.refractions.net/). Islands with an area of less than 0.25 km^2 were excluded from the calculations of distance from shore. To account for seasonal variation, day of year was included as a covariate in the model.

A single area–target interaction term was included in the model, following Thompson & Abraham (2010), for the subantarctic area and the deepwater target group. The inclusion of this single interaction term allowed the model to accurately fit the observed captures within each area and by each target fishery.

2.6 Estimation of fur seal captures in surface-longline fisheries

New Zealand fur seal captures in surface-longline fisheries were estimated using a Bayesian Poisson GLM with random-year effects, and with fixed strata as covariates (see Appendix B.10.12). The model structure was similar to the structure used for estimating fur seal captures in trawl fisheries, but with simpler covariates. The strata were fisheries-area combinations that reflect variation in the observed fur seal capture rates. The New Zealand region was divided into Kermadec, "North Island" (Northland-Hauraki, Taranaki, and North Island west coast areas), "Eastern North Island" (Cook Strait, North Island east coast, and Bay of Plenty areas), West Coast South Island, and Southern (Fiordland, Stewart Island, Chatham Rise, South Island east coast, and sub-antarctic areas). Surface-longline fisheries were grouped into fisheries targeting southern bluefin tuna, bigeye tuna, and all other species. The strata included in the model were surface-longline fishing in the South Island, West Coast South Island, and Kermadec regions, and fisheries-area strata for fishing in the North Island and Eastern North Island regions.

Table 10: Covariates included in the step analysis of the fur seal capture model.

Fishing area	New Zealand's Exclusive Economic Zone was divided into 13 fishing areas. Ten areas in which fur seal captures had been observed were included in the model data set.
Target fishery	Defined by individual target species and species groups: hoki, hake, ling; southern blue whiting; squid; jack (and blue) mackerel; scampi; middle-depth species (barracouta, ribaldo, rubyfish, alfonsino, bluenose, frostfish, ghost shark, gemfish, spiny dogfish, sea perch, and warehou); deepwater species (orange roughy, oreos, and cardinalfish); inshore species (tarakihi, snapper, gurnard, red cod, trevally, John dory, giant stargazer, elephantfish, leatherjacket, school shark, blue moki, blue cod, rig, hāpuku).
Day of year	Calculated from the mean day of the year of the tows in a group, and used to account for any seasonal variation. Harmonic functions were used to ensure that the seasonal effects were truly periodic.
Distance from shore	Four-level factor calculated using the distance from shore: coastal ($\leq$ 25 km), near (between 25 km and 90 km), far (between 90 km and 180 km), and ocean ($>$ 180 km)(see map in Thompson & Abraham 2010).

2.7 Estimation of sea lion captures and interactions

New Zealand sea lion captures in subantarctic trawl fisheries were estimated using Bayesian generalised linear models and ratio estimation, closely following methods applied previously to estimate sea lion captures in the 1995–96 to 2007–08, 2008–09, 2009–10, and 2010–11 fishing years, respectively (Thompson & Abraham 2011, Thompson et al. 2010c, Thompson et al. 2011, Thompson et al. 2013). The previous estimates were updated by including data from the 2012–13 fishing year, presenting capture estimates over the 18-year period between 1 October 1995 and 30 September 2013 (see Appendices B.11 and C.38).

Data from the subantarctic trawl fisheries were organised into five separate strata: the squid fishery near Auckland Islands, the southern blue whiting fishery near Campbell Island, the scampi fishery near Auckland Islands, other fisheries near Auckland Islands, and all trawl fisheries on the southern end of the Stewart-Snares shelf (Figure A-6(c)). This data organisation was necessitated by differences in observer coverage and number of observed captures, which required independent estimation methods for each stratum (Table 11).

Table 11: Strata used for estimating sea lion captures.

Stratum		Estimation method
Area	Fisheries	
Auckland Islands	Squid trawl	Bayesian model
Campbell Island	Southern blue whiting trawl	Bayesian model
Auckland Islands	Scampi trawl	Ratio estimate
Auckland Islands	Other (non-squid) trawl	Ratio estimate
Stewart Snares shelf	Squid trawl	Ratio estimate

For the Auckland Islands squid fishery, observer and capture data supported the development of a generalised linear Bayesian model, with a simpler model applied to data from the Campbell Island southern blue whiting fishery. The other three strata involved fisheries with lower observer coverage and sporadic records of sea lion captures, so that capture estimates for the non-squid Auckland Islands fisheries (scampi, other non-squid targets) and the Stewart-Snares shelf fishery were derived using ratio estimation. The latter estimation method was based on the assumptions that observer effort was representative and that strata were homogeneous. A single total estimate was calculated by combining the output from all strata.

2.7.1 Terminology for sea lion captures in the Auckland Islands squid fishery

Owing to the number of sea lions that was incidentally taken by trawlers targeting squid near Auckland Islands, management of this fishery has included usage of sea lion exclusion devices (SLEDs) as a mitigation method for incidental captures, and the application of a fisheries-related mortality limit (FRML) (Breen et al. 2003). As a consequence, sea lion capture estimates for this fishery involve terms that do not apply to other subantarctic trawl fisheries (see full terminology in Table 12, Figure 1).

SLEDs were first introduced in 2001, and since 2004–05, the majority of tows in the Auckland Islands squid fishery have used SLEDs that have been audited and approved by Ministry for Primary Industries. Since their introduction, the design of SLEDs has undergone some modifications, including the narrowing of the bar spacing on the angled grid that guides sea lions to the exit (in 2005–06), and standardisation of the kite material used to hold the SLED hood above the exit open. A detailed audit of SLEDs before the start of the 2006–07 fishing year included alterations to SLEDs that deviated from the standard specifications, ensuring consistency across the squid trawl fishery (Clement & Associates 2007).

On tows using SLEDs, the exact number of sea lions killed (or injured) is unknown, as some sea lions may escape from the net. Because of this uncertainty, the number of sea lions that would have been caught without SLEDs, on both observed and non-observed tows was estimated as the number of interactions. This term denotes the maximum direct fishing-related mortality. Another estimate, exclusions, accounts for sea lions that interact with the net on tows using SLEDs, but are not brought on-board the vessel. Exclusions are calculated as the number of sea lion captures (the sum of observed and estimated captures) subtracted from the number of interactions. To account for sea lion captures in relation to fishing effort, interactions are converted to a strike rate, the number of interactions per 100 tows. This conversion also allows comparisons between fishing years and fisheries.

Another management tool specifically applied to the Auckland Islands squid fishery is the FRML, a maximum number of permitted sea lion mortalities. The FRML is converted into a permitted number of tows by dividing it by an assumed strike rate. The fishery is closed once this number of tows is exceeded (or the season is finished). The setting of the FRML involves the fixing of a discount rate, a percentage reduction in the assumed strike rate for tows made using approved SLEDs (see Figure 1). For the 2012–13 fishing year, the FRML was 68 sea lions, and the strike rate was set at 5.89%, based on the assumption that 5.89 sea lions are killed per 100 tows that did not use SLEDs. The discount rate for the 2012–13 fishing year was set at 82%, so that for every 100 tows using SLEDs, the strike rate was reduced to 1.06% (Ministry for Primary Industries 2013). To incorporate vessels that operate with SLEDs not audited and approved by Ministry for Primary Industries, the metric “attributed mortality” is calculated as the sum of interactions on tows with unapproved SLEDs and a percentage (100% less the discount rate) of interactions on tows with approved SLEDs.

2.7.2 Sea lion capture model for the Auckland Islands squid fishery

The current modelling approach followed the modelling used to estimate captures in the Auckland Islands squid fishery during the 2010–11 fishing year (Thompson et al. 2013). Specifically, it involved one model with a split SLED retention probability, in addition to a model with a single SLED retention probability.

The split SLED retention model allowed the SLED retention probability to vary before and after a cut-off date, based on the prior knowledge that the SLED design had changed sometime in the three years 2004–05, 2005–06, and 2006–07. To allow for this change in SLED design, the model chose the cut-off date from these three fishing years, with early and late sled retention probabilities for the periods up to and including the cut-off year (i.e., 2004–05, 2005–06, or 2006–07) and subsequently. Results from the split and the single SLED retention models were combined with equal weight.

Table 12: Terminology used in this report for sea lion captures in the Auckland Islands squid fishery (following the definitions used by Thompson et al. 2015).

Term	Definition
Auckland Islands squid fishery	Trawlers targeting squid in the Auckland Islands part of the SQU6T fishing area.
SLED	Sea lion exclusion device, a mitigation method used in the Auckland Islands squid fishery. SLEDs are fitted mid-section in the trawl net that allow sea lions inside the net to escape.
Approved SLED	A SLED that has been audited and approved by Ministry for Primary Industries as meeting specifications.
Closed SLED	A trawl net that either does not have a SLED fitted, or that has a SLED fitted with the SLED exit covered so that sea lions are unable to escape.
Open SLED	A trawl net that has a SLED fitted with the SLED's exit being open.
Observed captures	The number of sea lions brought on deck both dead and alive, during observed tows (Figure 1(a)). Decomposed animals and any sea lions that climb on board the vessel, are excluded.
Captures	An estimate of the total number of sea lion captures, calculated as the sum of observed captures and the estimated captures that would have been recorded on unobserved tows, had observers been present (Figure 1(b)).
Interactions	An estimate of the number of sea lions that would have been caught if no SLEDs were used in the Auckland Islands squid fishery (Figure 1(f)).
Strike rate	Sea lion interactions per 100 tows.
Exclusions	An estimate of the number of sea lions interacting with a net but not being brought on board the vessel (Figure 1(c)). This number is calculated as sea lion captures subtracted from interactions.
FRML (Fishing Related Mortality Limit)	The maximum number of sea lion mortalities permitted in the Auckland Islands Squid Fishery. This number is converted into a permitted number of tows by dividing by an assumed strike rate.
Discount rate	The discount rate is an incentive to vessel operators to use SLEDs. It is a percentage reduction in the assumed strike rate for tows that use approved SLEDs, used when determining the amount of fishing effort permitted in the Auckland Islands squid fishery under the FRML. In the 2010–11 fishing year, a discount rate of 35% was applied to tows that used approved SLEDs.
Attributed mortality	The attributed mortality is the sum of interactions on tows with unapproved SLEDs, and a percentage (100% less the discount rate) of interactions on tows with approved SLEDs (Figure 1(d, e)). If the discount rate was 0%, the attributed mortalities would be the same as the interactions. Attributed mortality also includes any sea lions released alive.

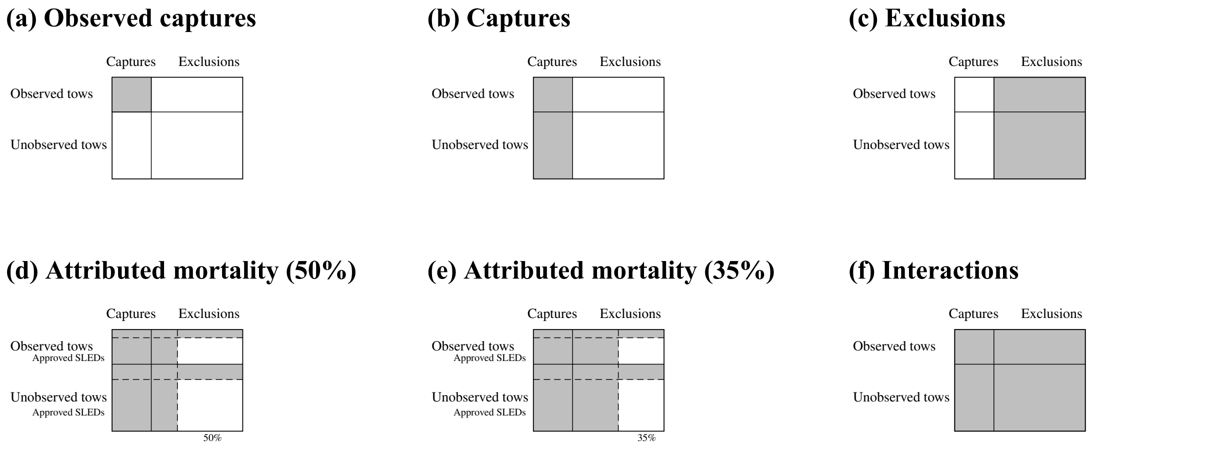


Figure 1: Quantities estimated for tows in the Auckland Islands squid fishery that used SLEDs. The box represents the total captures that would have occurred if no SLEDs were used, with the shading indicating the portion of the total that was included in each quantity. Tows are either observed or unobserved, and sea lions are either captured or are excluded (escaped through the SLED and would have been captured had a SLED not been used). The shaded grey areas are (a) Observed captures; (b) Captures, the sum of observed captures and estimated captures on unobserved tows; (c) Exclusions, sea lions that escaped being captured because SLEDs were used; (d) attributed mortality at a 50% discount rate; (e) attributed mortality at a 35% discount rate; (f) Interactions. In (d) and (e) the horizontal line is used to indicate that not all SLEDs were approved, and the vertical line indicates the portion of interactions that were ignored because of the discount factor.

The basic unit of effort used in the models was a single trawl event. Observers recorded the number of sea lions caught per tow, and the objective of the estimation was to predict the expected number of captured sea lion on the unobserved tows. Tows in fishing year y were indexed by vessel key, j, and number, k, and the number of sea lion captured on tow jk in year y was denoted c^y_{jk}. The captures, c^y_{jk}, were assumed to follow a negative-binomial distribution with a mean, μ^y_{jk}, that varied from tow to tow, and with an over-dispersion, θ, that was the same for all tows. The negative-binomial distribution was implemented using a Poisson distribution with a gamma distributed mean, which was achieved by multiplying the mean strike rate by a value randomly sampled from a gamma distribution with shape θ and unit mean. As $1/\theta$ decreases the model becomes less dispersed, with the limiting case, when $1/\theta = 0$, being a Poisson model. The model parameter θ was given the uniform shrinkage prior (Natarajan & Kass 2000, Gelman 2006) with mean equal to the mean number of sea lion captures per tow, μ_θ:

$$\begin{aligned} c^y_{jk} &\sim \text{Poisson}(\mu^y_{jk} g_\theta), && (27)\\ g_\theta &\sim \text{Gamma}(\theta, \theta), && (28)\\ \theta &\sim \text{Uniform-shrinkage}(\mu_\theta). && (29) \end{aligned}$$

The mean strike rate μ^y_{jk} was composed of three components multiplied together: a random year effect λ_i, a random vessel-year effect ν^y_j, and a linear regression component that depended on the value of covariates x^{yb}_{jk} and the regression coefficients β_b,

$$\mu^y_{jk} = \lambda^y \nu^y_j \exp\left(\sum_b x^{yb}_{jk}\beta_b\right) \quad . \tag{30}$$

The random year effects, λ^y, carried the mean strike rate for each year, and were drawn from a single log-normal distribution with mean μ_λ and standard deviation σ_λ. These hyper-parameters were given fixed prior distributions:

$$\begin{aligned}\log \lambda^y &\sim \text{Normal}(\mu_\lambda, \sigma_\lambda), &(31)\\ \mu_\lambda &\sim \text{Normal}(-4, 100), &(32)\\ \sigma_\lambda &\sim \text{Half-Cauchy}(0, 25). &(33)\end{aligned}$$

For each vessel and year combination, there was a vessel-year random effect, ν_j^y, that was drawn from a gamma distribution with a mean value of 1. This selection allowed the strike rate for each vessel in each year to have a mean value different from the year effect λ^y. The shape of the gamma distribution was defined by the hyper-parameter, θ_ν. The shape parameter was given the uniform shrinkage prior, with a mean value equal to the mean number of sea lions caught per vessel, μ_{vs}. For vessels that were not observed in a given year, a value of the random effect ν_j^y was drawn from the gamma distribution:

$$\begin{aligned}\nu_j^y &\sim \text{Gamma}(\theta_\nu, \theta_\nu), &(34)\\ \theta_\nu &\sim \text{Uniform-shrinkage}(\mu_{vs}). &(35)\end{aligned}$$

The model was also used to investigate factors that may have contributed to sea lion captures, including distance to colony, tow duration, sub-area and open SLED (i.e., SLED present with the cover net open; see covariate definitions in Table 13). The covariates included in the model were those selected previously by Smith & Baird (2007), based on earlier research specifically aimed at identifying the factors associated with sea lion captures (Smith & Baird 2005). To improve model convergence, the covariates were normalised before model fitting by subtracting the mean value and dividing by the standard deviation. This normalisation was removed before presenting results from the model. The regression coefficients, β_b, were assumed to be the same for all years. The priors for the regression coefficients of the three covariates distance to colony, tow duration, and sub-area were non-informative normal distributions,

$$\beta_b \sim \text{Normal}(0, 100). \quad (36)$$

The presence or absence of a SLED with the cover net open (open SLED) was treated as a covariate. The regression coefficients were $\beta_{\textit{open SLED}_{1,2}}$, where the index 1 or 2 refers to the two periods (up to and including the cut-off year, and after the cut-off year). These coefficients were transformed into the SLED retention probabilities, $\pi_{1,2} = \exp\left(\beta_{\textit{open SLED}_{1,2}}\right)$, and were given uniform priors,

$$\pi_{1,2} \sim \text{Uniform}(0, 1). \quad (37)$$

The choice to allow the SLED retention probability to vary before and after a cut-off date was made to reflect the known changes that have been made to the SLED design. Two models were fitted, including a model with a single SLED retention probability in addition to a split-retention model.

A significant limitation to this modelling approach, however, was that the model data set was greatly unbalanced, as there have been few observed captures in recent years. This imbalance means that recent changes in SLED retention were unable to greatly improve the overall fit of the model, while adding to model complexity.

From the fitted model, posterior distributions were calculated for the captures, interactions, strike rate, attributed mortalities, and exclusions (see definitions in Table 12 and Figure 1). For each sample from the MCMC, the estimated number of sea lion interactions i_{jk} was calculated for each tow (here, and in the following, the year index y was assumed). The mean interaction rate was given by the linear predictor, μ_{jk} (Equation 30), but with the net assumed to be closed, irrespective of whether or not a SLED was used. This approach was enforced by setting the open-SLED covariate to the value corresponding with a closed SLED. The number of interactions on a tow can be interpreted as the number of sea lions that would have been caught if a SLED had not been used. They were obtained from the mean interaction rate by sampling from a negative-binomial distribution (following Equations 27, 28, and 29). From

Table 13: Covariates used in the sea lion capture model of the Auckland Islands squid fishery.

Covariate	Definition
Distance to colony	A continuous variable, the logarithm of distance to nearest sea lion breeding colony.
Tow duration	A continuous variable, the logarithm of tow duration.
Sub-area	A two-level factor variable, indicating in which sub-area the start of the tow was located. The Auckland Islands part of squid fishing area SQU6T was divided into two sub-areas, NW (Northwest, north of $50.45\,^\circ$ S and west of $166.95\,^\circ$ E), and S&E (South and East: the remainder of the Auckland Islands part of SQU6T).
Open SLED	A factor variable, indicating that the net had a sea lion exclusion device (SLED) attached and that the cover net was open. In the model with a split SLED retention probability, the open-SLED factor depended on whether or not the tow was after the cut-off fishing year of 2004–05, 2005–06, or 2006–07.

the interactions, the captures were then calculated by sampling from a binomial distribution with the probability given by the SLED retention probability and the size given by the number of interactions,

$$c_{jk} \sim \begin{cases} \text{Binomial}(\pi_{1,2},\, i_{jk}) & \text{(open SLED)}, \\ i_{jk} & \text{(no SLED or closed SLED)}. \end{cases} \tag{38}$$

This procedure simulated the independent random capture of interacting sea lion, with probability $\pi_{1,2}$. It ensured that, on any tow, the number of captures was less than or equal to the number of interactions. The number of sea lion exclusions on a tow was calculated as the difference between the interactions and the captures, $e_{jk} = i_{jk} - c_{jk}$.

Tow level attributed captures, a_{jk}, were calculated from the interactions in a similar way, by sampling from a binomial distribution,

$$a_{jk} \sim \begin{cases} \text{Binomial}((1 - DR/100) - \pi_{1,2},\, i_{jk}) & \text{(open SLED, approved SLED)}, \\ \text{Binomial}(1 - \pi_{1,2},\, i_{jk}) & \text{(open SLED, unapproved SLED)}, \\ 0 & \text{(closed net)}, \end{cases} \tag{39}$$

where DR is the percentage discount rate. With this definition, the attributed captures on a tow are always less than the number of interactions. The SLED retention probability was subtracted from the probability in Equation 39, so that the captures were not included in a_{jk}.

The estimated quantities were calculated as follows:

$$\text{Captures} \quad C = \sum_u c_{jk} + C_o, \tag{40}$$

$$\text{Interactions} \quad I = \sum_u i_{jk} + \sum_o e_{jk} + C_o, \tag{41}$$

$$\text{Strike rate} \quad \mu = I/n, \tag{42}$$

$$\text{Exclusions} \quad E = I - C, \tag{43}$$

$$\text{Attributed captures} \quad A = C + \sum_a a_{jk}, \tag{44}$$

where C_o is the number of observed captures in the fishery, $\sum_u$ denotes a sum over unobserved tows, $\sum_o$ denotes a sum over observed tows, $\sum_a$ denotes a sum over all tows, and n denotes the total number of tows in the fishery. The attributed captures were calculated for discount rates of 20%, 35%, 50%, and 82%.

Posterior distributions of these quantities were obtained by calculating them for every sample from the MCMC. The posterior distributions were summarised by the median, mean, and 95% credible interval (calculated from the 2.5% and 97.5% quantiles).

2.7.3 Sea lion captures in the Campbell Island southern blue whiting fishery

A simple Bayesian model was used to estimate sea lion captures in the southern blue whiting fishery east of Campbell Island. Data for this fishery were organised by calendar rather than fishing year as this fishery extends beyond the end of the standard fishing year (30 September). All fishing effort in the Campbell Island southern blue whiting fishery occurs between August and November. This trawl fishery has had observer coverage since 1996, with the first observed sea lion capture in 2002.

The southern blue whiting fishery operates on Pukaki Rise, and to the east of Campbell Island, while all sea lion captures have been observed on the shelf to the east and south of Campbell Island. As a consequence, the data set was restricted to fishing effort near Campbell Island (see Figure A-6).

The model used for the southern blue whiting trawl fishery was a variation of the Auckland Islands squid model described above. Simplifications were necessary, mostly because of the small number of observed captures. The inclusion of vessel-year random effects was not feasible due to the small number of vessels that had observed captures. The model used a Poisson error model, and included only random year effects and a SLED effect. The year effects allowed for a varying strike rate, without assuming any trend over the years. The same model was used by Thompson et al. (2013), except that the date range was extended to include all data from 1996 to 2013, and because SLEDs were used in the fishery from part-way through the 2012–13 fishing season.

2.7.4 Sea lion captures in other strata

Ratio estimates of sea lion captures were calculated for the three remaining strata: the Auckland Islands scampi fishery, other Auckland Islands non-squid trawl fisheries, and all trawl fisheries at the south end of the Stewart-Snares shelf. In addition to the Auckland Islands trawl fishery targeting scampi, other Auckland Islands non-squid trawl fisheries were distinguished as all other trawl operations not targeting squid in the Auckland Islands part of the SQU6T fishing area. The area for the Stewart-Snares trawl fishery was defined as the southern end of the Stewart-Snares shelf, south of 48.02 °, north of 49.5 ° latitude, west of 168 °, and east of 166 ° longitude.

The ratio estimates were made using a simple Poisson GLM, with a single fixed-effect for each stratum, estimated using Bayesian methods. The sea lion capture rate was estimated as a constant rate over all years, from 1995–96 to 2012–13.

2.7.5 Sea lion captures and interactions in combined trawl fisheries

Estimates from the five strata were combined to provide an estimate of total sea lion captures (and interactions) in each year. The posterior distribution of estimated captures in each of the five strata was described by a set of 4000 samples, from the MCMC in the relevant Bayesian models. The samples were added to obtain 4000 samples from the combined posterior distribution of total estimated captures in each year. Annual interactions were calculated as the sum of estimated interactions in the Auckland Islands squid fishery and estimated captures in the other four strata. The mean and 95% credible intervals were calculated for each year from the samples.

2.8 Estimation of turtle captures in surface-longline fisheries

Turtle captures in surface-longline fisheries were estimated using a Bayesian Poisson GLM with fixed strata as covariates (see Appendix B.12). The model structure was similar to the structure used for estimating fur seal captures in surface-longline fisheries, but without random-year effects. The strata used were the regions defined for estimating fur seal captures in surface-longline fisheries: Kermadec, “North Island” (Northland-Hauraki, Taranaki, and North Island west coast areas), “Eastern North island” (Cook Strait, North Island east coast, and Bay of Plenty areas), West Coast South Island, and Southern (Fiordland, Stewart Island, Chatham Rise, South Island east coast, and sub-antarctic areas). There were no strata related to target species.

3. RESULTS

3.1 Observed fishing effort

In the 2012–13 fishing year, observed fishing effort included 12 360 tows in trawl fisheries (14.8% of total effort), 148 bottom-longline sets (1% of total effort), 229 surface-longline sets (8.7% of total effort), 1093 set-net sets (0.8% of total effort), and 67 purse-seine sets (5.6% of total effort).

There were marked differences in observer coverage between small and large vessels (for example, see Figure 2). For large trawl vessels (28 m or longer), observer coverage increased from 32.2% of tows in 2011–12 to 49.2% of all tows in 2012–13, the highest observer coverage in any of the years. In contrast, observer coverage of fishing by small trawl vessels in 2012–13, which mainly targeted flatfish and inshore species, was only 0.96% of the total fishing effort. In bottom-longline fisheries, 19.1% of the sets made by large vessels (34 m or longer) were observed in 2011–12, and this observer coverage decreased to 9.8% in 2012–13. Observer coverage of small vessel bottom-longline fisheries was less than 1% of sets in 2010–11, 2011–12, and 2012–13 (with 0.59% of sets being observed in 2012–13). In surface-longline fisheries, 100% of the fishing by large vessels (45 m or longer) was observed in 2012–13, while only 3.4% of surface-longline sets by small surface-longline vessels were observed.

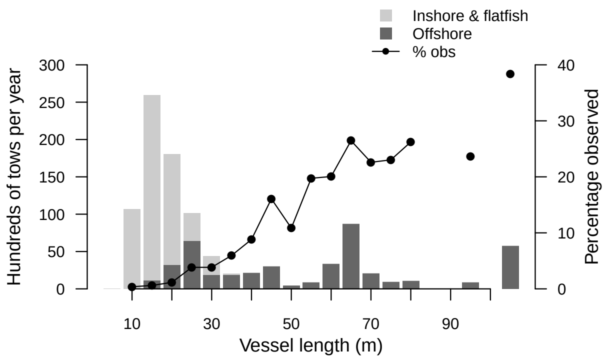


Figure 2: Capture of seabirds in trawl fisheries. Average number of trawls per year by vessels of different lengths for the period between 2002–03 and 2012–13. Vessels were divided into 5-m length classes. The percentage of tows observed was calculated for length classes with a total of more than 100 tows per year. Inshore and flatfish fisheries are shown separate to fisheries targeting other species.

3.2 Observed captures during 2012–13

3.2.1 Observed seabird captures during 2012–13

During 2012–13, observers documented a total of 740 seabird captures from a wide range of taxa (Table 14). Of the seabirds that were observed caught in 2012–13, 403 were necropsied, and a further 248 were identified by experts from photographs. In total, 91.8% of the seabirds caught in 2012–13 were identified by experts. Of the 58 seabirds caught during 2012–13 whose identification was not confirmed by experts, there were only 15 whose identification was changed by the imputation process (and of these birds, 14 birds were released alive). The changes included two birds identified by the observer as "white-capped albatross", whose identity was changed to Salvin's albatross; one bird given the generic observer identification of "albatrosses" whose identity was changed to sooty shearwater; one bird given the generic observer identification of "common diving petrel", whose identity was changed to sooty shearwater; one bird with the observer identification of "black-browed albatrosses" whose identification was changed to white-capped albatross; one bird given the identification of "black-browed albatrosses" whose identification was changed to Campbell black-browed albatross; one bird whose identification was changed from "white-capped albatross" to Campbell black-browed albatross; and one bird whose identification was changed from "fulmars, petrels, prions and shearwaters" to Westland petrel. The most frequently observed captured seabird species were white-chinned petrel (277 captures), New Zealand white-capped albatross (131), sooty shearwater (111), southern Buller's albatross (67), Salvin's albatross (47), fulmars, petrels, prions and shearwaters (27), petrels, prions, and shearwaters (19), and grey petrel (10). All other seabird species had five captures or less.

Most of the observed seabird captures occurred in trawl fisheries (709 captures, 95.8% of all observed captures), a marked increase from 2011–12 during which 248 captures of seabirds were observed. The increase in observed captures occurred mainly in trawl fisheries targeting squid (from 106 to 450 observed captures), hoki (from 59 to 96 observed captures), midwater-trawl fisheries (from 41 to 92 observed captures), and mackerel trawl fisheries (from 5 to 34 observed captures). This increase corresponded with an increase in the number of observed fishing events, in particular in trawl fisheries targeting squid (from 1378 to 2271 tows observed), hoki (from 2577 to 4496 tows observed), midwater trawl fisheries (from 761 to 1241 tows observed), and mackerel (from 1548 to 1932 tows observed).

Observed seabird captures in trawl fisheries were mostly of white-chinned petrel, with 276 observed captures in 2012–13, an increase from 58 observed captures of this species in 2011–12. The observed captures were also of New Zealand white-capped albatross (119 captures, increased from 67 captures in 2011–12), sooty shearwater (110 captures, increased from 31 captures), southern Buller's albatross (57 captures, increased from 36 captures), Salvin's albatross (47 captures, increased from 24 captures), and grey petrel (10 captures, increased from 1 capture). For species with over five captures in either 2011–12 or 2012–13, there was no decrease in the number of observed captures in 2012–13 compared with 2011–12.

In contrast to trawl fisheries, the number of observed seabird captures decreased in surface-longline fisheries, from 64 captures in 2011–12 to 27 captures in 2012–13, with most of the decrease being in fisheries targeting southern bluefin tuna (from 50 observed captures in 2011–12 to 23 captures in 2012–13). This decrease was associated with a decrease in observed effort (from 645 530 hooks observed in 2011–12 to 491 903 hooks in 2012–13), and also in the observed capture rate (from 0.077 to 0.047 captures per thousand hooks). Observed seabird captures in surface-longline fisheries in 2012–13 were mostly of New Zealand white-capped albatross (12 captures, up from 8 captures in 2011–12) and southern Buller's albatross (10 captures, decreased from 31 captures in 2011–12), with a single capture observed each of Gibson's, Antipodean, southern royal, and Campbell black-browed albatrosses, and of white-chinned petrel.

In bottom-longline fisheries, there were only two observed seabird captures in 2012–13, down from 10 captures in 2011–12: one capture of black-backed gull, and one of flesh-footed shearwater (both captures occurred while targeting gurnard off the Taranaki coast). This decrease followed a large decrease in the effort observed, from 2 100 831 hooks observed in 2011–12 to 387 238 hooks in 2012–13.

In 2012–13, all but two observed captures were in trawl and longline fisheries. The two other captures were of one sooty shearwater and one flesh-footed shearwater in set-net fisheries. There were no observed captures in purse-seine fisheries.

Among all fishing methods, white-chinned petrel was the most frequently captured seabird species in 2012–13, with 277 observed captures, an increase from 63 captures in 2011–12. Most observed captures of white-chinned petrel occurred in the squid trawl fisheries at the southern end of the Stewart-Snares shelf and off Auckland Islands.

Table 14: Captures of seabirds, marine mammals, and turtles in New Zealand commercial fisheries during the fishing year 2012–13. Summary of the number of observed captures ("Captures"), the number of fishing events during which these captures occurred ("Events"), the number of live captures ("Alive"), the number of fatal captures that were necropsied ("Necr.") or not ("Not necr."), and the distribution of all observed captures by fishing method, in trawl, surface-longline (SLL), bottom-longline (BLL) and set-net (SN) fisheries.

Common name	Captures	Events	Alive	Dead		Method			
				Necr.	Not necr.	Trawl	SLL	BLL	SN
White-chinned petrel	277	179	103	169	5	276	1	-	-
New Zealand white-capped albatross	131	96	42	82	7	119	12	-	-
Sooty shearwater	111	86	31	80	-	110	-	-	1
Southern Buller's albatross	67	57	20	44	3	57	10	-	-
Salvin's albatross	47	39	18	28	1	47	-	-	-
Fulmars, petrels, prions and shearwaters	27	20	26	1	-	27	-	-	-
Petrels, prions, and shearwaters	19	11	19	-	-	19	-	-	-
Grey petrel	10	7	-	9	1	10	-	-	-
Shearwaters	5	2	5	-	-	5	-	-	-
Albatrosses	5	5	2	-	3	5	-	-	-
Common diving petrel	4	3	3	1	-	4	-	-	-
Great albatrosses	4	4	3	-	1	4	-	-	-
Southern royal albatross	4	4	1	3	-	3	1	-	-
Fairy prion	4	3	3	1	-	4	-	-	-
Campbell black-browed albatross	4	4	2	2	-	3	1	-	-
Cape petrel	4	3	3	-	1	4	-	-	-
Westland petrel	3	3	1	1	1	3	-	-	-
Cape petrels	2	2	2	-	-	2	-	-	-
Flesh-footed shearwater	2	2	-	2	-	-	-	1	1
Smaller albatrosses	2	2	2	-	-	2	-	-	-
Procellaria petrels	2	1	2	-	-	2	-	-	-
Gibson's albatross	1	1	-	1	-	-	1	-	-
Light-mantled sooty albatross	1	1	1	-	-	1	-	-	-
Antipodean albatross	1	1	-	1	-	-	1	-	-
Southern black-backed gull	1	1	-	1	-	-	-	1	-
Prions	1	1	1	-	-	1	-	-	-
Northern giant petrel	1	1	1	-	-	1	-	-	-
New Zealand fur seal	135	106	38	-	97	114	21	-	-
New Zealand sea lion	25	16	5	-	20	25	-	-	-
Common dolphin	17	9	2	-	15	17	-	-	-
Pilot whale long-finned	5	2	-	-	5	5	-	-	-
Dusky dolphin	1	1	-	-	1	1	-	-	-
Hectors dolphin	1	1	1	-	-	-	-	-	1
Turtle	2	2	2	-	-	-	2	-	-
Total	926	676	339	426	161	871	50	2	3

New Zealand white-capped albatross had the second highest number of observed captures in 2012–13, with 131 captures; an increase from 77 captures in 2011–12. The captures occurred mostly in the squid trawl fisheries (74 observed captures), midwater trawl fisheries (24), hoki trawl fisheries (11), and surface-longline fisheries targeting southern bluefin tuna (11), with most observed captures on the Stewart-Snares shelf.

The species with the third highest number of observed captures in 2012–13 was sooty shearwater, with 111 captures, up from 31 captures in 2011–12. All but one of the captures occurred in trawl fisheries, including 68 captures while targeting squid and 18 while targeting hoki, 12 captures in midwater trawl fisheries, and 10 captures while targeting mackerel species. One sooty shearwater capture was observed in set-net fisheries.

Southern Buller's albatross was the species with the fourth highest number of observed captures in 2012–13, with 67 captures, similar to the 70 captures observed in 2011–12. The captures occurred mostly in the squid and hoki trawl fisheries.

There were 47 observed captures of Salvin's albatross in 2012–13, the highest number since 2000–01. This increase corresponded with an increase in observer coverage in the hoki, squid, and southern blue whiting trawl fisheries. Most captures occurred on Chatham Rise and off the South Island east coast.

Observers recorded the capture of 10 grey petrels in 2012–13, an increase from 3 captures of this species in 2011–12. All of these captures occurred during a single trawl trip, targeting southern blue whiting.

All other species had less than 10 observed captures in 2012–13, although a number of observed captures were recorded using generic codes. These unidentified birds included 46 captures of "petrels, prions, or shearwaters" (and 41 of these captures were in the squid trawl fishery).

There were two large seabird capture events (when 10 birds or more were caught in a single event) during the 2012–13 fishing year, with ten white-chinned petrels captured on two separate occasions, during a single trawl fishing trip while targeting squid off Auckland Islands. The same fishing trip had the highest number of observed captures of any species, with 30 white-chinned petrels observed caught. Large, multiple capture events of white-chinned petrels have previously been observed, with 56 white-chinned petrels recorded caught during a trawl fishing trip in 2010–11.

There were marked differences in the characteristics of the fisheries, and in the seabird captures, in relation to vessel size (Figure 3). Overall, in recent years, around three-quarters of all estimated seabird captures were associated with small vessels, and this fraction was much higher in longline fisheries (Figure 3)

Over all methods, small vessels were responsible for most of the fishing effort, and were poorly observed. Over the period covered by the modelling, only 1.2% of the fishing effort carried out by small trawl vessels was observed, despite being associated with around 55% of estimated captures (63% in 2012–13). In surface-longline fisheries, 2.9% of the sets made by small vessels since 1998–99 were observed, but around 94% of all estimated seabird captures over that period were by the small-vessel fleet (99% in 2012–13). Similarly, in bottom-longline fisheries, 0.7% of the sets made by small vessels since 1998–99 were observed, but 64% of the estimated seabird captures in bottom-longline fisheries over the study period were associated with small vessels. This ratio has increased in recent years: in 2012–13, small-vessel bottom-longline fisheries were associated with 90% of all bottom-longline estimated captures.

3.2.2 Observed cetacean captures during 2012–13

In the 2012–13 fishing year, there were 17 observed captures of common dolphins, including 15 captures in the jack mackerel trawl fishery, one capture in midwater trawl fisheries while targeting barracouta, and one capture in the hoki trawl fishery (the first record of a common dolphin capture in the hoki fishery). These captures occurred during nine separate fishing events, with two multiple capture events. The largest capture event in 2012–13 was of six common dolphins during a single fishing event in the

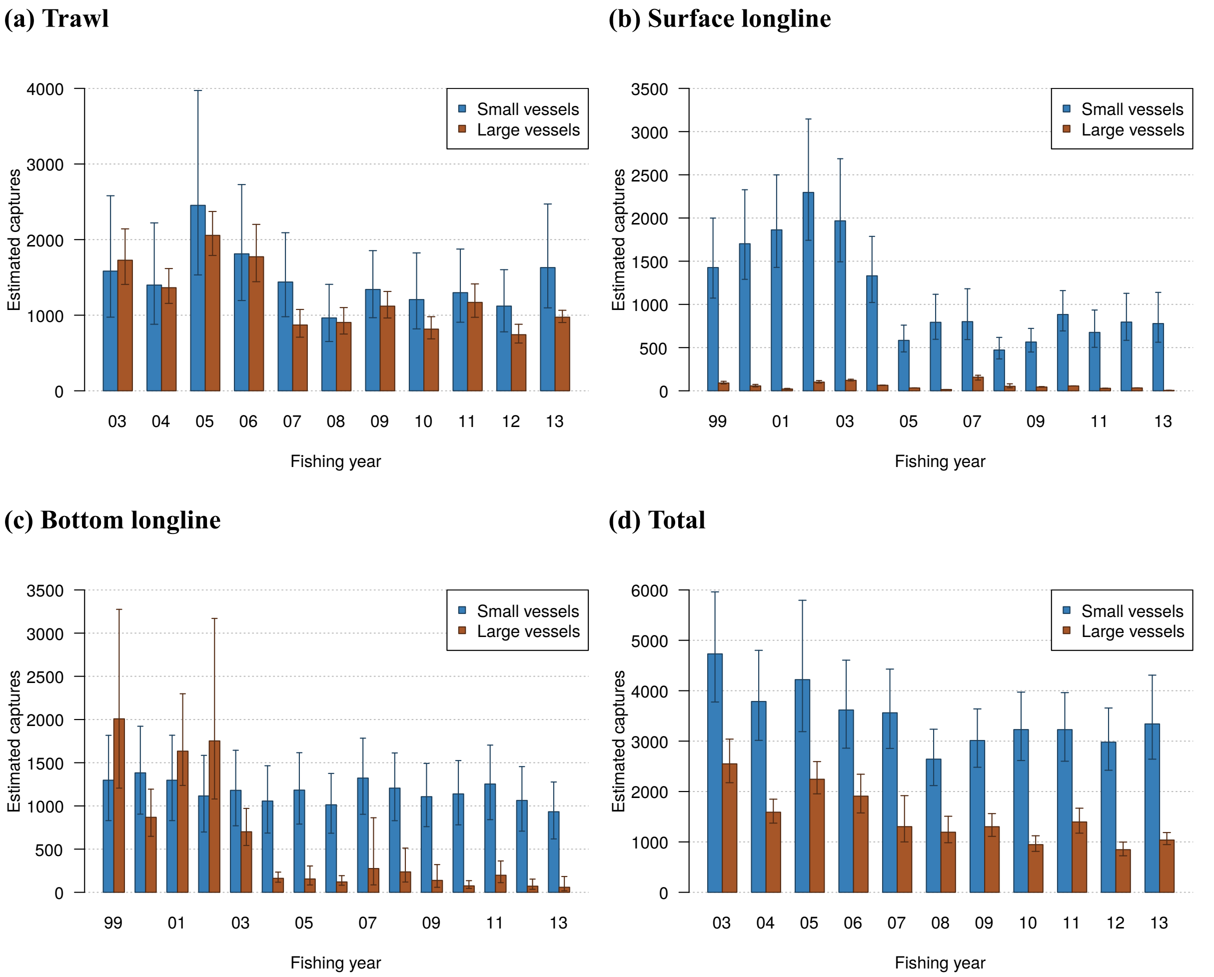


Figure 3: Comparison of estimated annual captures of all seabirds between large and small vessels over the study period, in (a) trawl, (b) surface longline, (c) bottom longline, and (d) all fisheries combined. The cut-off length between small and large vessels was 28 m in trawl fisheries, 34 m in bottom-longline fisheries, and 45 m in surface-longline fisheries. The bars show the mean of the posterior distributions with error bars indicating the 95% credible intervals.

mackerel trawl fishery off the North Island west coast. The other observed multiple capture event in 2012–13 involved the capture of four common dolphins in the mackerel trawl fishery, off the Taranaki coast.

The 17 observed captures of common dolphins in 2012–13 were the highest number of observed captures of this species since 2008–09; it was a marked increase from the five common dolphin captures observed in 2011–12. This increase reflected the high observer coverage in the mackerel fishery (85.7% of tows observed).

Observed captures of cetaceans in 2012–13 also included five captures of pilot whales, one dusky dolphin, and one Hector's dolphin. All the captures of pilot whales occurred in the jack mackerel trawl fishery off the Taranaki coast, and four of the five captures were during a single fishing event in December 2012. The capture of the dusky dolphin occurred off the East Coast South Island, in the hoki trawl fishery in May 2013. The pilot whales and the dusky dolphin were all dead. The Hector's dolphin was captured in a set net off the South Island east coast while targeting rig in October 2012, and was recorded as uninjured and released alive.

3.2.3 Observed pinniped captures during 2012–13

During the 2012–13 fishing year, there were 135 observed captures of New Zealand fur seals. Of these fur seal captures, 114 captures were in trawl fisheries, particularly hoki fisheries (58 observed captures) and southern blue whiting fisheries (26 observed captures). The observed capture rate in trawl fisheries has been relatively constant since 2008–09, at less than 1 fur seal per 100 tows, after an overall decrease since 2004–05, when it peaked at 2.59 fur seals per 100 tows. There was no clear trend over time apparent in the observed capture rate in surface-longline fisheries, which has fluctuated around 0.25 fur seals per 10 000 hooks (see Appendix B.10.12). Nevertheless, over the reporting period, the observed capture rate had the highest recorded values in 2011–12 and 2012–13, at 0.55 and 0.37 fur seals per 10 000 hooks, respectively.

The remaining 21 observed fur seal captures in 2012–13 were in surface-longline fisheries (all while targeting southern bluefin tuna). Between 2002–03 and 2012–13, there was a total of 267 observed fur seal captures in surface-longline fisheries. Of these observed captures, 263 captures occurred while targeting southern bluefin tuna, corresponding with a capture rate of 0.03 fur seals per 1000 hooks. Over the same reporting period, there were also 12 observed captures of fur seals in set nets, two captures in bottom-longline fisheries, and one capture in purse-seine fisheries.

A total of 25 observed captures of New Zealand sea lions were recorded during the 2012–13 fishing year (Table 14), and all of these captures occurred in trawl fisheries. There were 21 sea lions observed captured during fishing targeting southern blue whiting near Campbell Island (the highest number of observed sea lion captures recorded in any year in the southern blue whiting fishery to date), 3 observed sea lion captures were recorded while targeting squid in the Auckland Islands area, and 1 capture was observed while targeting hoki on the Stewart-Snares shelf. All fishing in the Auckland Islands squid fishery used SLEDs.

The first tow in the Campbell Island southern blue whiting fishery was on 15 August 2013, with the multiple capture of 5 sea lions occurring three days later, on 18 August 2013. Following these early-season captures, SLEDs were used, with most fishing in the Campbell Island southern blue whiting fishery between 31 August 2013 and the end of the season on 5 October 2013 using SLEDs. In total, there were 772 observed tows in the 2013 southern blue whiting fishery, including 394 tows without SLEDs and 379 tows using SLEDs. No sea lions were captured on tows using SLEDs, while on tows without SLEDs, the sea lion capture rate was 5.5 sea lions per 100 tows. Two of the sea lions caught in the Campbell Island southern blue whiting fishery had flipper tags. One sea lion (yellow coffin tag 3314) was recorded as tagged at Tiama colony, Campbell Island, on 3 February 2008, while the other tagged sea lion (yellow coffin tag 3019) was recorded as tagged at Davis Point, Campbell Island, on 6 January

2008[*].

The three sea lions caught in the squid fishery were all female, and were all dead. One animal was recorded in comments by the observer as “dead in the pounds”, and one as “found at the top of the SLED still in the net”. All of the 21 sea lions caught in the southern blue whiting fishery were male, aside from one sea lion whose sex was not determined by the observer. Of these captured sea lions, 17 sea lions were dead and 4 sea lions were released alive. The sea lion caught in the hoki fishery was a male, which was recorded as released alive.

No pinnipeds other than New Zealand fur seals and New Zealand sea lions were observed caught in New Zealand commercial fisheries in 2012–13.

3.2.4 Observed turtle captures during 2012–13

Two turtles (no further identification) were observed caught in 2012–13, both in the bigeye tuna surface-longline fishery to the north of New Zealand, in June and September 2013. One turtle was recorded as hooked in the flipper, and one as hooked in the mouth. Both were released alive.

3.3 Estimated captures

3.3.1 Estimated captures of seabirds

Seabird captures were estimated in trawl and longline fisheries (see a summary of data used for the estimation in Table 15). Model areas and fisheries in which there were not any observed captures were excluded from the estimation, on the assumption that there are no captures of those species in those areas (see Appendix A, Figures A-1 to A-5, for the areas used in each of the seabird models). This approach led to variation in the effort that was included in the modelling (Table 15). (Detailed estimates of the capture of the seven groupings of seabird species in trawl, bottom and surface-longline fisheries are presented in Appendix B, for fisheries in which the mean estimated annual captures exceeded 50 birds. Summaries of the models, including estimated values of the covariates, and comparisons between the observed and estimated captures, are presented in Appendix C.)

During the 2012–13 fishing year, there was a total of 4379 (95% c.i.: 3654–5340) estimated seabird captures in all trawl and longline fisheries within the outer boundary of New Zealand’s EEZ (Table 16). The total number of seabird captures has decreased since the start of the period, 2002–03, when there were an estimated 7280 (95% c.i.: 6204–8647) seabirds caught in trawl and longline fisheries (Figure 4, Table 17). The decrease in captures has occurred for both albatrosses and other seabirds, and has occurred in trawl surface- and bottom-longline fisheries. Following an initial decrease, the estimated number of seabird captures appears to have been stable since around 2006–07, with estimated captures of seabirds in trawl, surface- and bottom-longline fisheries not being significantly different from the number of captures in 2006–07.

Of the estimated captures during 2012–13, 1658 (95% c.i.: 1355–2049) captures were of albatross, and 2721 (95% c.i.: 2079–3613) captures were of petrels and other seabirds (Table 16). In 2012–13, most seabird captures occurred in trawl fisheries, with 2604 (95% c.i.: 2055–3465) estimated seabird captures, compared with 783 (95% c.i.: 567–1144) estimated seabird captures in bottom-longline fisheries, and 991 (95% c.i.: 666–1349) estimated seabird captures in surface-longline fisheries.

The number of estimated captures in 2012–13 was higher in trawl fisheries than in bottom- or surface-longline fisheries for all modelled species groupings (Table 16), except for the other albatrosses group, for which the mean estimated number of captures in surface-longline fisheries (184 captures, 95% c.i.: 84–406) was estimated to be twice as high as in trawl (94 captures, 95% c.i.: 48–172) or bottom-longline fisheries (76 captures, 95% c.i.: 32–155). In 2011–12, the estimated number of captures for the other birds grouping was higher in bottom-longline than in trawl fisheries (Richard & Abraham 2013a), but

[*] Sea lion tag records from the sea lion demographic database: http://data.dragonfly.co.nz/nzsl-demographics/

Table 15: Summary of the model datasets for each model, showing total effort (tows for trawl, sets for longline), observed effort and observer coverage, observed bird captures and capture rate (birds per 100 tows or sets). Data cover the period between the fishing years 2002–03 and 2012–13 for trawl, and between 1998–99 and 2012–13 for longline fisheries. The cut-off length between small and large vessels was 34 m in bottom-longline fisheries (BLL), and 45 m in surface-longline fisheries (SLL).

Species group	Fishery	Total effort	Observed effort		Captures	
			Effort	Coverage (%)	Birds	Rate
White-capped albatross	Trawl	1 108 823	92 279	8.3	1 015	1.10
	Large BLL	39 126	7 179	18.3	7	0.10
	Small BLL	45 233	506	1.1	3	0.59
	Large SLL	3 779	3 303	87.4	105	3.18
	Small SLL	62 693	1 699	2.7	38	2.24
Salvin's albatross	Trawl	1 081 996	83 248	7.7	271	0.33
	Large BLL	39 126	7 179	18.3	153	2.13
	Small BLL	45 233	506	1.1	26	5.14
	Large SLL	4 223	3 667	86.8	5	0.14
	Small SLL	59 607	1 596	2.7	11	0.69
Southern Buller's albatross	Trawl	398 590	74 996	18.8	213	0.28
	Large BLL	39 126	7 179	18.3	4	0.06
	Small BLL	45 233	506	1.1	7	1.38
	Large SLL	4 223	3 667	86.8	423	11.54
	Small SLL	62 693	1 699	2.7	58	3.41
Other albatrosses	Trawl	847 998	81 789	9.6	87	0.11
	Large BLL	39 126	7 179	18.3	38	0.53
	Small BLL	275 455	2 017	0.7	20	0.99
	Large SLL	4 223	3 667	86.8	76	2.07
	Small SLL	63 495	1 774	2.8	134	7.55
Sooty shearwater	Trawl	1 108 823	92 279	8.3	1 025	1.11
	Large BLL	39 126	7 179	18.3	102	1.42
	Small BLL	28 692	65	0.2	1	1.54
	Large SLL	4 223	3 667	86.8	13	0.35
	Small SLL	48 516	1 057	2.2	1	0.09
White-chinned petrel	Trawl	336 126	61 717	18.4	885	1.43
	Large BLL	39 126	7 179	18.3	838	11.67
	Small BLL	86 701	813	0.9	23	2.83
	Large SLL	4 223	3 667	86.8	36	0.98
	Small SLL	63 495	1 774	2.8	18	1.01
Other birds	Trawl	1 108 823	92 279	8.3	358	0.39
	Large BLL	39 347	7 196	18.3	520	7.23
	Small BLL	275 455	2 017	0.7	170	8.43
	Large SLL	4 359	3 798	87.1	64	1.69
	Small SLL	63 495	1 774	2.8	209	11.78

Table 16: Summary of estimated seabird captures, showing the estimated total seabird captures by fishing method during 2012–13. The mean and 95% credible intervals of the posterior distribution of the totals are given.

Group	Trawl		BLL		SLL		Total	
	Mean	c.i.	Mean	c.i.	Mean	c.i.	Mean	c.i.
White-capped alb.	454	337–611	21	4–48	83	54–121	558	435–724
S. Buller's alb.	112	80–174	49	16–101	97	70–130	259	200–341
Salvin's alb.	387	212–685	88	33–190	11	3–23	487	294–794
Other albatross	94	48–172	76	32–155	184	84–406	354	219–598
Total albatross	1 048	809–1 376	235	141–368	376	259–604	1 658	1 355–2 049
Sooty shearwater	321	212–518	46	5–145	1	0–6	368	242–576
White-chinned petr.	372	328–437	190	88–347	24	12–40	586	470–755
Other birds	863	429–1 706	521	267–824	382	218–676	1 766	1 170–2 654
Total small birds	1 556	1 090–2 386	757	461–1 098	407	243–705	2 721	2 079–3 613
Total birds	2 604	2 055–3 465	991	666–1 349	783	567–1 144	4 379	3 654–5 340

this was not the case in 2012–13.

Among trawl fisheries, target fisheries for flatfish, inshore fish species, and squid were estimated to capture the most seabirds in 2012–13, with a mean of 597 (95% c.i.: 225–1365), 574 (95% c.i.: 363–888), and 505 (95% c.i.: 477–553) captures, respectively. The flatfish trawl fishery was not among the target fisheries with the highest estimated captures in 2011–12, and the increase of the mean estimated captures in 2012–13 followed a decrease in the observed fishing effort (only 0.3% of the total flatfish trawl effort was observed in 2012–13), resulting in an increase in the uncertainty in the capture estimate.

The estimated captures of New Zealand white-capped albatross, Salvin's albatross, southern Buller's albatross, sooty shearwater, and white-chinned petrel in trawl fisheries were similar to previous years, with a respective mean of 454 (95% c.i.: 337–611), 387 (95% c.i.: 212–685), 112 (95% c.i.: 80–174), and 372 (95% c.i.: 328–437) captures in trawl fisheries in 2012–13 (Table 16, see also Appendices B.1.1, B.2.1, B.3.1, B.5.1, and B.6.1). The estimated number of captures of seabirds in the other albatrosses grouping in 2012–13 was also similar to the estimate in 2011–12 (see Appendix B.4.1), with a mean estimate of 94 (95% c.i.: 48–172) captures in 2012–13 compared with 99 captures (95% c.i.: 50–190) the previous year. In contrast, the estimated number of captures of seabirds in the other birds grouping in 2012–13 was higher than in 2011–12 (see Appendix B.7.1), with a mean estimate of 863 (95% c.i.: 429–1706) captures in 2012–13 compared with 413 captures (95% c.i.: 189–821) the previous year. Most of these estimated captures were associated with the flatfish trawl fishery (see Appendix B.7.2). There were no observed captures of other birds in flatfish trawl fisheries in either 2011–12 or 2012–13, and fishing effort was similar between the two years. This increase was uncertain and was associated with the model structure, which estimated a single year effect for captures of each bird grouping across all target fisheries, within each method. Increases in the capture rate in well observed fisheries caused increases in the estimated captures in poorly-observed fisheries.

Among the trawl fisheries capturing at least 50 birds annually, the lowest capture rate was in inshore trawl fisheries at 1.73 (95% c.i.: 1.09–2.67) captures per 100 tows (see Appendix B.8.3), whereas the highest capture rate was in the squid target fisheries, at 19.09 (95% c.i.: 18.03–20.90) captures per 100 tows (see Appendix B.8.2). The capture rate in squid fisheries was the highest value over the reporting period. This high estimate was due to a large increase in the capture rate of white-chinned petrel, at 9.07 (95% c.i.: 8.50–10.39) captures per 100 tows, a 10-fold increase from the estimate in 2002–03 (mean 0.86 captures per 100 tows; 95% c.i.: 0.43–1.51) (see Appendix B.6.2). Trawl fisheries targeting middle-depth species also had a relatively high capture rate, at 5.19 (95% c.i.: 3.53–8.08) seabird captures per 100 tows (Appendix B.8.5).

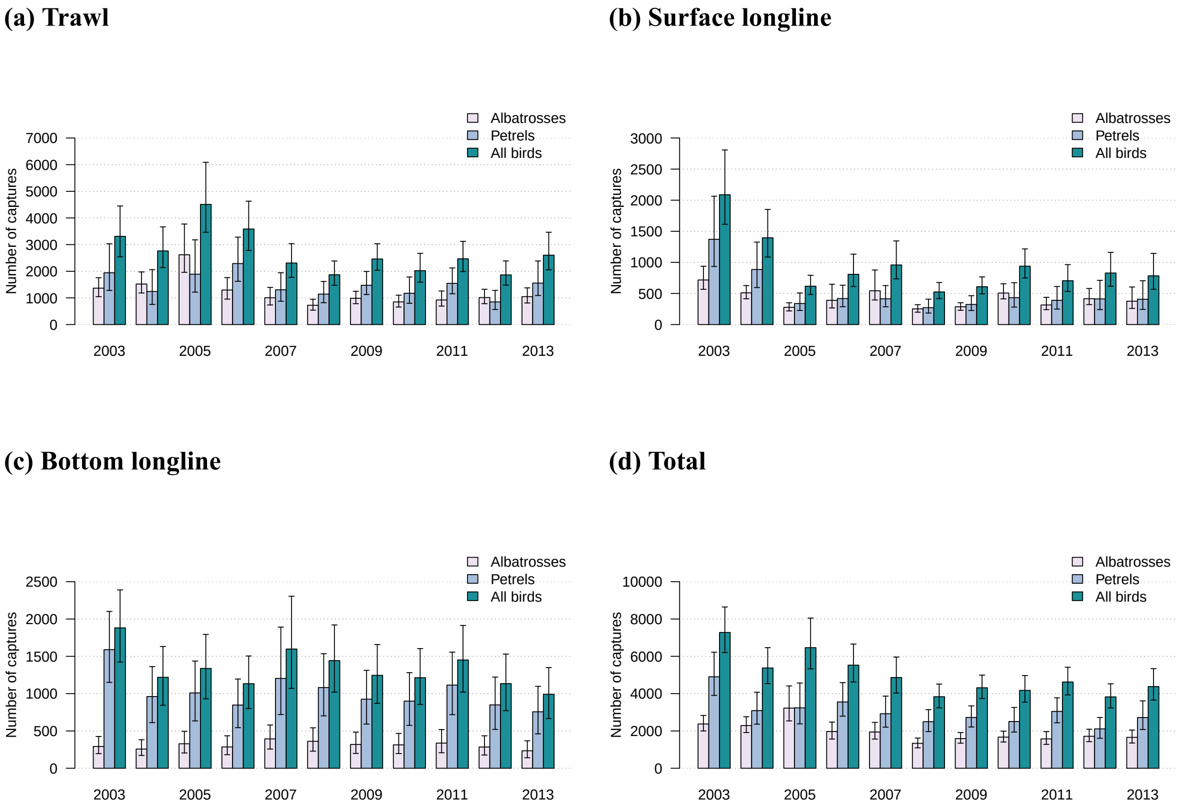


Figure 4: Time series of estimated seabird captures for each of the three fishing methods (a) trawl, (b) surface longline, and (c) bottom longline, and (d) for all fisheries combined. The bars show the mean of the posterior distributions with error bars indicating the 95% credible intervals.

Table 17: Summary of estimated total seabird captures in modelled trawl, surface-longline (SLL), and bottom-longline (BLL) fisheries for the period from 2002–03 to 2012–13. Presented are the mean and 95% credible intervals of the posterior distribution of the totals. Data include albatrosses (Alb. – white-capped albatross and other albatrosses), the remaining species groups (Petr. – white-chinned petrel, sooty shearwater and other birds), and all birds combined.

Birds	Year	Trawl		SLL		BLL		All	
		Mean	c.i.	Mean	c.i.	Mean	c.i.	Mean	c.i.
Alb.	2002–03	1 367	1 047–1 758	717	567–938	292	196–426	2 375	2 001–2 832
	2003–04	1 521	1 184–1 974	510	415–627	257	172–382	2 288	1 913–2 761
	2004–05	2 619	1 961–3 772	278	219–350	328	205–495	3 225	2 539–4 414
	2005–06	1 296	955–1 763	389	267–649	286	182–435	1 972	1 565–2 477
	2006–07	1 005	735–1 393	544	395–877	394	257–580	1 943	1 564–2 459
	2007–08	725	541–950	252	199–320	361	229–542	1 338	1 096–1 620
	2008–09	986	783–1 249	285	230–351	319	199–484	1 590	1 344–1 913
	2009–10	849	657–1 103	507	413–656	314	197–467	1 669	1 408–1 988
	2010–11	923	694–1 259	315	240–438	337	208–519	1 575	1 281–1 964
	2011–12	1 014	783–1 325	416	321–580	285	178–435	1 715	1 424–2 092
	2012–13	1 048	809–1 376	376	259–604	235	141–368	1 658	1 355–2 049
Petr.	2002–03	1 944	1 281–3 032	1 371	934–2 064	1 589	1 151–2 102	4 905	3 906–6 220
	2003–04	1 242	754–2 062	885	595–1 326	961	611–1 362	3 088	2 364–4 075
	2004–05	1 891	1 217–3 178	339	227–508	1 010	635–1 437	3 239	2 382–4 571
	2005–06	2 289	1 623–3 281	418	287–633	847	544–1 196	3 555	2 792–4 591
	2006–07	1 304	877–1 945	414	286–627	1 204	720–1 892	2 923	2 203–3 867
	2007–08	1 143	820–1 616	272	185–409	1 081	702–1 535	2 497	1 966–3 142
	2008–09	1 475	1 127–1 992	323	226–464	926	592–1 312	2 724	2 213–3 345
	2009–10	1 174	799–1 785	433	281–673	900	575–1 281	2 506	1 939–3 262
	2010–11	1 545	1 156–2 123	390	249–612	1 114	718–1 556	3 049	2 438–3 776
	2011–12	850	565–1 281	413	241–711	850	521–1 222	2 112	1 607–2 724
	2012–13	1 556	1 090–2 386	407	243–705	757	461–1 098	2 721	2 079–3 613
All birds	2002–03	3 311	2 540–4 449	2 088	1 613–2 807	1 881	1 423–2 390	7 280	6 204–8 647
	2003–04	2 763	2 138–3 664	1 395	1 086–1 851	1 219	844–1 632	5 376	4 537–6 465
	2004–05	4 509	3 466–6 089	617	483–793	1 338	931–1 794	6 464	5 331–8 052
	2005–06	3 585	2 779–4 630	808	611–1 132	1 133	800–1 505	5 526	4 628–6 657
	2006–07	2 310	1 774–3 035	958	736–1 345	1 598	1 071–2 305	4 866	4 030–5 962
	2007–08	1 868	1 476–2 385	524	417–676	1 443	1 020–1 921	3 836	3 239–4 512
	2008–09	2 460	2 039–3 033	609	493–766	1 245	870–1 658	4 314	3 739–4 992
	2009–10	2 023	1 592–2 674	939	749–1 216	1 214	856–1 604	4 176	3 543–4 970
	2010–11	2 468	1 990–3 121	705	532–964	1 451	1 021–1 914	4 624	3 932–5 415
	2011–12	1 863	1 480–2 387	829	617–1 161	1 135	772–1 530	3 826	3 233–4 526
	2012–13	2 604	2 055–3 465	783	567–1 144	991	666–1 349	4 379	3 654–5 340

In bottom-longline fisheries, there were 235 (95% c.i.: 141–368) estimated captures of albatrosses, and 757 (95% c.i.: 461–1098) estimated captures of other birds in 2012–13 (Table 16). The total estimate of 991 seabird captures (95% c.i.: 666–1349) was the lowest value over the reporting period, and half the value of 2002–03, when there was an estimated 1881 captures (95% c.i.: 1423–2390). Among the albatross groupings, Salvin's albatross had the highest estimated number of captures, with a mean of 88 (95% c.i.: 33–190) captures, and the other birds grouping had the highest number of estimated captures overall, at 521 (95% c.i.: 267–824) captures (Table 16).

In surface-longline fisheries in 2012–13, there were an estimated 376 (95% c.i.: 259–604) and 407 (95% c.i.: 243–705) captures of albatross and other seabirds, respectively. The other birds and other albatrosses groupings had the highest estimated number of captures in surface-longline fisheries, with 382 (95% c.i.: 218–676) and 184 (95% c.i.: 84–406) captures, respectively.

Among albatross groupings, New Zealand white-capped albatross had the highest number of estimated total captures in 2012–13, at 558 captures (95% c.i.: 435–724). Around eighty percent of these captures occurred in trawl fisheries (mean 454 captures; 95% c.i. 337–611), and the numbers of estimated captures in surface- and bottom-longline fisheries were relatively low, at 83 captures (95% c.i.: 54–121) and 21 captures (95% c.i.: 4–48), respectively. Among albatross, Salvin's albatross had the second highest number of estimated captures across the three considered fishing methods, with an estimated 487 captures (95% c.i.: 294–794) in 2012–13. Similar to New Zealand white-capped albatross, around 80% of these captures occurred in trawl fisheries (mean 387 captures; 95% c.i.: 212–685), with relatively low numbers in longline fisheries. Captures of southern Buller's albatross were more distributed among different fishing methods. Of the 259 (95% c.i.: 200–341) total estimated captures, 112 (95% c.i.: 80–174) captures were in trawl, 97 (95% c.i.: 70–130) captures were in surface-longline, and 49 (95% c.i.: 16–101) captures were in bottom-longline fisheries. The captures of other albatrosses occurred predominantly in surface-longline fisheries (mean 184 captures; 95% c.i.: 84–406), but also in trawl (mean 94 captures; 95% c.i.: 48–172) and bottom-longline fisheries (mean 76 captures, 95% c.i.: 32–155).

Among the species and groupings of other seabirds, the estimated number of captures of the other birds group was the highest across the three fishing methods, with an estimated 1766 (95% c.i.: 1170–2654) captures in 2012–13. Half of these captures occurred in trawl fisheries (mean 863 captures, 95% c.i.: 429–1706), with the other captures occurring in bottom-longline (mean 521 captures, 95% c.i.: 267–824) and surface-longline fisheries (mean 382 captures, 95% c.i.: 218–676). Of the 586 (95% c.i.: 470–755) total captures of white-chinned petrels, 372 (95% c.i.: 328–437) captures were in trawl fisheries, 190 (95% c.i.: 88–347) captures were in bottom-longline, and 24 (95% c.i.: 12–40) captures were in surface-longline fisheries. Almost 90% of the 368 (95% c.i.: 242–576) captures of sooty shearwater occurred in trawl fisheries (mean 321 captures; 95% c.i.: 212–518), and 46 (95% c.i.: 5–145) captures occurred in bottom-longline fisheries; sooty shearwaters were not frequently caught in surface-longline fisheries.

3.3.2 Estimated captures of common dolphins in jack mackerel trawl fisheries

Between the 1995–96 and 2012–13 fishing years, a total of 151 common dolphin captures were observed in all trawl fisheries (Table 18). Most (139) of the captures occurred while targeting jack mackerel, and these captures all occurred off the North Island west coast, in the fleet of vessels longer than 90 m. This fishery had the highest observer coverage among the trawl fisheries that caught dolphins: over the 18-year reporting period, almost 30% of the tows in this fishery were observed; in 2012–13 over 85% of the tows were observed.

Other common dolphin captures observed in trawl fisheries included six captures while targeting barracouta, four captures while targeting warehou, two captures while targeting flatfish, two captures while targeting trevally, and one capture each while targeting gurnard and targeting hoki, respectively. In longline fisheries, there were two observed common dolphin captures over the same period, both in the 1996–97 fishing year, with one capture each in the bigeye tuna surface-longline fishery and in the southern bluefin tuna surface-longline fishery.

The estimation of the number of common dolphin captures was carried out on fishing trips made by the large-vessel (90 m or over) trawl fleet on the North Island west coast, where the trips had some fishing effort that targeted jack mackerel (see Appendix B.9.2).

Most of the fishing effort in the jack mackerel trawl fishery off the North Island's west coast was associated with seven vessels. These vessels operated as a coherent fleet between 1997–98 and 2012–13 (Figure 5). Over this period, the seven vessels associated with most of the fishing effort were generally consistent in their trawl effort, headline depth, trawl duration, location, and the proportion of tows hauled under different light conditions. Changes in the main fishing characteristics were generally uniform across the different vessels.

In recent years, there has been a decrease in overall trawl effort, with one vessel leaving this fishery after 2009–10, while the remaining vessels fished less. Headline depth has remained relatively consistent over time, with median depths below 50 m since 2001–02. Trawl duration showed an overall increase across all vessels over time, and was at median values just over 4 hours in 2012–13. Similarly, fishing effort was concentrated in the same sub-area across the different vessels each year, with a similar proportion of fishing effort between the northern and southern sub-areas since 2007–08. The proportion of tows hauled under different light conditions has also remained constant for most of the reporting period. Since 2001–02, about 20% of tows were hauled in dark light conditions (between dusk and midnight on a dark night), compared with about 5% of tows that were hauled in black light conditions (between midnight and dawn on a dark night).

Table 18: Observed captures of common dolphins in New Zealand's commercial trawl fisheries between the fishing years 1995–96 and 2012–13, in the west coast of North Island and Taranaki areas. Summary of the model dataset by target species of total effort, observed effort and observer coverage, observed captures of common dolphins and capture rate (dolphins per 100 tows).

Target species	Total tows	Observed effort		Captures	
		Tows	Coverage (%)	Dolphins	Rate
Jack mackerel	28 997	8 200	28.3	139	1.70
Barracouta	16 484	235	1.4	4	1.70
Warehou	2 245	14	0.6	4	28.57
Flatfish	84 194	172	0.2	2	1.16
Trevally	35 066	181	0.5	2	1.10

From the observed captures, it was estimated that 15 common dolphins (95% c.i.: 15–19) were captured in 2012–13 in the large-vessel jack-mackerel target fisheries (see Appendix B-66), an increase from 7 (95% c.i.: 5–14) estimated captures in 2011–12. This estimate was low in comparison with 2002–03, when there were an estimated 142 (95% c.i.: 58–270) captures of common dolphins in the same fishery.

The estimated capture rate in 2012–13 was 0.87 (95% c.i.: 0.87–1.11) dolphins per 100 tows, which was higher than the estimated capture rate of the previous year of 0.43 (95% c.i.: 0.30–0.85) dolphins per 100 tows. Nevertheless, the estimated 2012–13 capture rate was within the range of values estimated since 2005–06.

Common dolphin captures in this trawl fishery frequently involve the capture of several individuals per capture event. The model estimated a median number of dolphins per capture event of 1.9 (95% c.i.: 1.6–2.3) individuals (see Appendix C.36), but up to nine common dolphin captures in a single capture event have been observed.

3.3.3 Estimated captures of New Zealand fur seals in trawl fisheries

A total of 1122 captures of New Zealand fur seals were included in the model dataset (Table 19). These captures mostly occurred in the fishery targeting hoki (545 captures), the southern blue whiting fishery

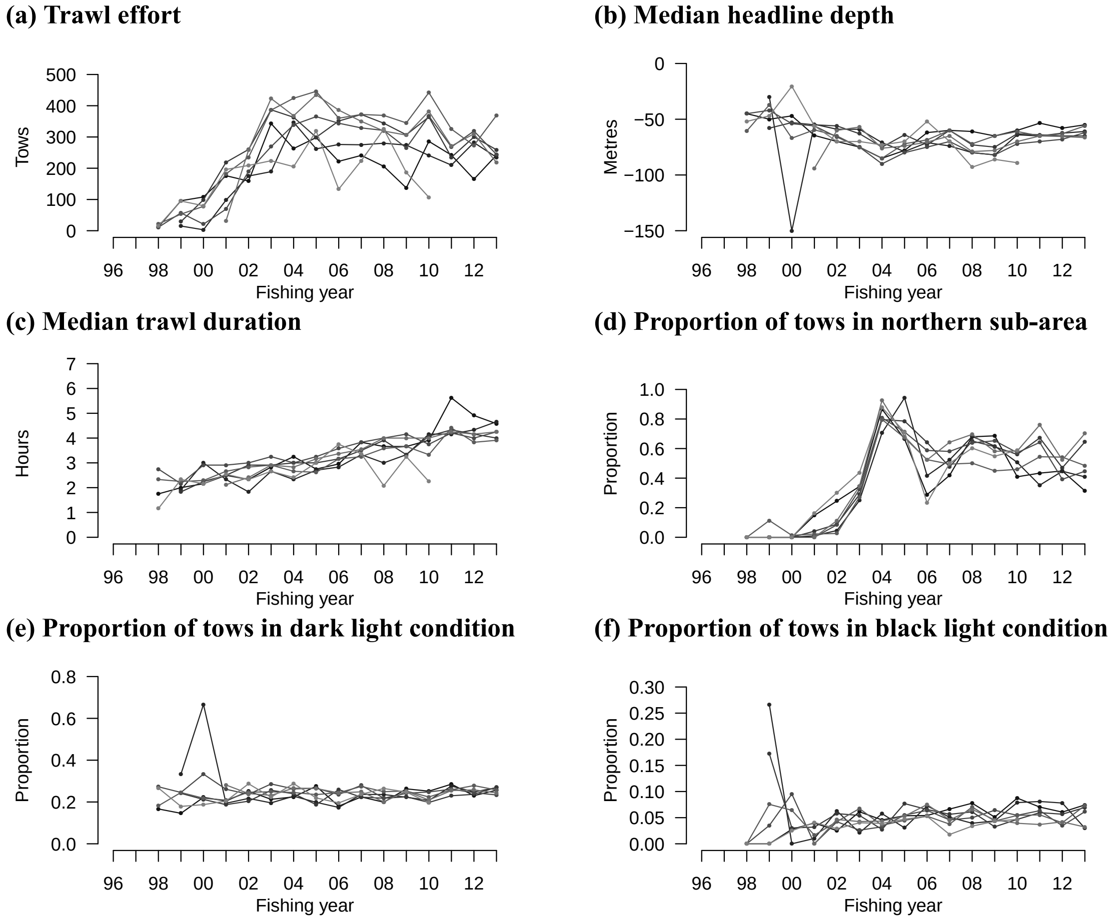


Figure 5: Captures of common dolphins in New Zealand's commercial trawl fisheries. Annual trends of (a) trawl effort, (b) median headline depth, (c) trawl duration, (d) proportion of tows in the north, (e) proportion of tows in dark light conditions, and (f) proportion of tows in black light conditions, for each of the seven vessels responsible for most of the mackerel trawl effort between 1997–98 and 2012–13.

(263), and the squid fishery (90). The observed capture rate varied greatly between target fisheries. Inshore trawl fisheries, and fisheries targeting squid, middle-depth species, jack mackerel, deep-water species, or scampi had a low observed capture rate of between 0.05 and 1.03 fur seals per 100 tows. Medium capture rates of between 2 and 3 fur seals per 100 tows were in trawl fisheries targeting hake, hoki, and ling. The trawl fishery targeting southern blue whiting had the highest observed capture rate, at 6.26 fur seals per 100 tows. Across areas, the highest observed capture rate of 14.12 fur seals per 100 tows was in trawl fisheries off the Bounty Islands (Table 20), where one of the largest fur seal colonies is present, and where some of the southern blue whiting trawl fishery operates. The Cook Strait area, mostly utilised by the inshore, flatfish, and hoki trawl fisheries, had the second highest capture rate, at 9.16 fur seals per 100 tows.

In 2012–13, there were 114 observed captures of New Zealand fur seals in trawl fisheries. From these observed captures, it was estimated that 398 (95% c.i.: 236–713) fur seals were captured in all trawl fisheries in this fishing year (Appendix B.10.1; the posterior distribution of model parameters is summarised in Appendix C.37). Although this value was the lowest mean estimate over the reporting period, it was not significantly different from the values estimated since 2008–09. The number of estimated captures peaked at 1443 (95% c.i.: 904–2341) fur seals in 2004–05, and has decreased since then. The estimated capture rate in 2012–13 was 0.48 (95% c.i.: 0.28–0.85) fur seals per 100 tows, and the estimated capture rate has been relatively stable since 2006–07.

Most captures of New Zealand fur seals were in the hoki trawl fishery, in which 242 (95% c.i.: 114–534) fur seals were estimated captured in 2012–13, with a capture rate of 2.07 (95% c.i.: 0.98–4.57) fur seals per 100 tows. The fishing effort in this fishery decreased from almost 28 000 tows in 2002–03 to 8174 tows in 2008–09, followed by an increase to 11 682 tows in 2012–13. Estimated captures followed a similar pattern to the fishing effort, peaking in 2004–05 at 797 (95% c.i.: 422–1504) captures, decreasing to a minimum in 2009–10 at 179 (95% c.i.: 88–366) captures, and then increasing again.

Captures of fur seals also occurred in trawl fisheries targeting other species. Trawl target fisheries of middle-depth species had 78 (95% c.i.: 29–189) estimated captures in 2012–13, followed by 26 (95% c.i. 26–26) estimated captures in southern blue whiting trawl fisheries. Ling target fisheries had 15 (95% c.i.: 5–42) estimated captures, hake fisheries had 11 (95% c.i.: 8–21), squid fisheries had 8 (95% c.i.: 6–17), mackerel species had 4 (95% c.i.: 3–8), and scampi fisheries had 4 (95% c.i.: 0–17) estimated captures. The number of captures and fishing effort in these fisheries have been stable since 2009–10, and were at lower levels than previously.

In deepwater trawl fisheries, no fur seal captures have been observed since 2008–09, with observer coverage of around 30%. The estimated number of captures in these fisheries was estimated to be almost zero in 2012–13. Due to the very low observer coverage in inshore trawl fisheries (0.5% in 2012–13), and the observation of a single capture in 2008–09, the capture estimate in 2012–13 was uncertain, with a mean of 11 fur seal captures, but a 95% c.i. of 0–49.

In the southern blue whiting trawl fishery, capture estimates prior to 2012–13 were imprecise, with a 95% c.i. of 25–237 in 2011–12, due to the combination of low observer coverage and a high capture rate in the proximity of the Bounty Islands. In 2012–13, almost all (99.9%) fishing effort was observed, and the number of estimated captures was the same as the number of observed captures (26 fur seals).

3.3.4 Estimated captures of New Zealand fur seals in surface-longline fisheries

In 2012–13, there were 112 (95% c.i.: 72–163) estimated captures of fur seals in surface-longline fisheries (see Appendix B.10.12). The corresponding estimated capture rate was 0.04 (95% c.i.: 0.03–0.06) fur seals per 1000 hooks. Both estimates reflect a slight decrease from the estimates in the preceding fishing year, when there were a total of 143 (95% c.i.:104–190) estimated captures with an estimated capture rate of 0.05 (95% c.i.: 0.03–0.06) fur seals per 1000 hooks. Nevertheless, these two most recent estimates were relatively high compared with values in the preceding period, i.e., since 2004–05. At that time, fishing effort declined markedly and remained at similar low levels of about about 2 to 3 million hooks

Table 19: Observed captures of fur seals in New Zealand's commercial trawl fisheries between the fishing years 2002–03 and 2012–13. Summary of the model dataset by target species of total effort, observed effort and observer coverage, observed captures of fur seals and capture rate (fur seals per 100 tows).

Target species	Total tows	Observed effort		Captures	
		Tows	Coverage (%)	Fur seal	Rate
Hoki	141 416	24 325	17.2	545	2.24
Southern blue whiting	9 533	4 198	44.0	263	6.26
Squid	63 890	16 920	26.5	90	0.53
Hake	12 650	3 029	23.9	67	2.21
Middle depth species	69 700	5 145	7.4	53	1.03
Jack mackerel	26 737	8 987	33.6	41	0.46
Ling	11 639	1 432	12.3	41	2.86
Deepwater species	35 318	9 381	26.6	14	0.15
Scampi	31 199	2 786	8.9	7	0.25
Inshore (excluding flat fish)	198 442	1 976	1.0	1	0.05

Table 20: Observed captures of fur seals in New Zealand's commercial trawl fisheries between the fishing years 2002–03 and 2012–13. Summary of the model dataset by fishing area of total effort, observed effort and observer coverage, observed captures of fur seals and capture rate (fur seals per 100 tows).

Fishing area	Total tows	Observed effort		Captures	
		Tows	Coverage (%)	Fur seal	Rate
West Coast South Island	97 064	13 913	14.3	304	2.19
Cook Strait	56 432	2 184	3.9	200	9.16
Bounty Islands	4 134	1 402	33.9	198	14.12
Stewart-Snares	85 502	17 689	20.7	132	0.75
East Coast South Island	181 478	15 119	8.3	124	0.82
Campbell Island	7 677	3 321	43.3	60	1.81
Puysegur	8 612	1 182	13.7	31	2.62
Subantarctic islands	15 298	4 648	30.4	28	0.60
West Coast North Island	106 959	9 739	9.1	25	0.26
Auckland Islands	37 368	8 982	24.0	20	0.22

per year. The decrease in estimated fur seal captures since 2004–05 corresponded with this decrease in fishing effort.

3.3.5 Estimated captures of New Zealand sea lions in trawl fisheries

Between the fishing years 1995–96 and 2012–13, there were 294 observed captures of New Zealand sea lions in the trawl fisheries that were included in the model dataset (Table 21). There were seven observed captures that were not included in the estimation. These captures included five observed captures where the observed fishing could not be linked to the fishing effort. These five captures were all in the Auckland Islands area, with three recorded by the observer as targeting squid, one target scampi, and one targeting hoki). In addition, there was a sea lion observed caught in a hoki trawl on the east coast of the South Island in 1996, and a sea lion observed caught in a hoki trawl in the subantarctic in 2001. Neither of these observed captures were included in areas that were included in the estimation.

In 2012–13, there were 25 observed captures of New Zealand sea lions (see Appendix B.11.1), a marked increase from the single sea lion capture observed in the previous year. The observed capture rate was variable between 1995–96 and 2012–13, but showed an overall decrease, with a maximum of 1.30 sea lions per hundred tows in 1996–97, and a minimum of 0.03 sea lions per hundred tows in 2011–12. In 2012–13, the observed capture rate was 0.48 sea lions per 100 tows.

The number of captures of New Zealand sea lions was estimated for five combinations of target fishery and area: the squid, scampi, and other trawl fisheries off Auckland Islands, the southern blue whiting trawl fishery off Campbell Island, and all trawl fisheries on the Stewart-Snares shelf.

Combining the five strata, it was estimated that 33 (95% c.i.: 27–40) sea lions were captured in 2012–13. The number of interactions, i.e., the number of sea lions that would have been caught if SLEDs were not used in the Auckland Islands fishery, was estimated as 83 (95% c.i.: 35–288) interactions (Table 22). The estimates of the number of captures and interactions, were higher than for 2011–12, when there were an estimated 12 (95% c.i.: 5–21) sea lion captures and 55 (95% c.i.: 11–127) interactions. Nevertheless, the estimates for 2012–13 were within the range obtained from the period since 2002–03 (see Appendix B.11.1).

Most captures in 2012–13 were estimated to occur in the Campbell Island southern blue whiting trawl fishery, in which 21 (95% c.i.: 21–22) sea lions were estimated to have been captured, with a capture rate of 2.72 (95% c.i.: 2.72–2.85) captures per 100 tows (see Appendix B.11.4). The uncertainty was low because of the very high observer coverage (99.9% of tows observed in the model dataset for 2012–13). Between zero and three sea lions were estimated to have been captured in 2011–12 in this fishery. Nevertheless, the number of captures have been very variable since 2006–07, and the number of captures in 2012–13 was within the range of variation over that period. It is possible that the number of captures would have been higher if SLEDs had not been introduced into the fishery part-way through the season.

Table 21: Observed captures of sea lions in New Zealand's commercial trawl fisheries between the fishing years 1995–96 and 2012–13. Summary of the model datasets by model of total effort, observed effort and observer coverage, observed captures of sea lions and capture rate (sea lions per 100 tows).

Model	Total tows	Observed effort		Captures	
		Tows	Coverage (%)	Sea lion	Rate
Auckland Islands squid fishery	32 288	10 213	31.6	209	2.05
Campbell Island southern blue whiting fishery	15 627	6 329	40.5	53	0.84
Auckland Islands scampi fishery	23 382	1 924	8.2	12	0.62
Other Auckland Islands trawl fisheries	5 500	780	14.2	3	0.38
All trawl fisheries on the Stewart-Snares shelf	78 035	19 174	24.6	17	0.09
Total	154 832	38 420	24.8	294	0.77

Table 22: Estimated sea lion captures and interactions, in 2011–12 and 2012–13, in the five trawl fishing strata used in the estimation (see Appendix B.11 for a longer time series of estimates). The number of interactions may be interpreted as the number of sea lions that would have been caught if no sea lion exclusion devices had been used in the Auckland Islands squid fishery.

	Est. captures		Est. interactions	
	Mean	95% c.i.	Mean	95% c.i.
2011–12				
Auckland Islands squid trawl	2	0–6	43	2–208
Campbell Island southern blue whiting trawl	1	0–3	1	0–3
Auckland Islands scampi trawl	7	2–15	7	2–15
Stewart Snares shelf trawl	2	1 – 4	2	1 – 4
Other Auckland Islands trawl	0	0–1	0	0–1
All trawl	12	5–21	55	11–227
2012–13				
Auckland Islands squid trawl	4	3–6	53	7–244
Campbell Island southern blue whiting trawl	21	21–22	21	21–22
Auckland Islands scampi trawl	6	1–13	6	1–13
Stewart Snares shelf trawl	2	1 – 4	2	1 – 4
Other Auckland Islands trawl	0	0–1	0	0–1
All trawl	33	27–40	83	35–288

It was estimated that 6 (95% c.i.: 1–13) sea lions were captured in the Auckland Islands scampi fishery in 2012–13, at a rate of 0.55 (95% c.i.: 0.09–1.19) captures per 100 tows, comparable to previous years (see Appendix B.11.3). In the Auckland Islands squid fishery, 4 (95% c.i.: 3–6) sea lions were estimated to have been captured, with a highly uncertain strike rate of 5.26 (95% c.i.: 0.68–25.41) interactions per 100 tows (see Appendix B.11.2). No sea lions were estimated to have been captured in the Auckland Islands trawl fisheries not targeting squid or scampi. In all trawl fisheries on the Stewart-Snares shelf, 2 (95% c.i.: 1–4) sea lions were estimated to have been captured (see Appendix B.11.5).

3.3.6 Estimated captures of sea turtles in surface-longline fisheries

Between 2002–03 and 2012–13, a total of 17 captures of sea turtles were observed, including 15 captures in surface-longline fisheries, one capture in inshore trawl fisheries, and one capture in the snapper bottom-longline fishery. Of the 15 observed captures in surface-longline fisheries, 10 captures occurred while targeting bigeye tuna, three captures while targeting southern bluefin tuna, and two captures while targeting swordfish. The 17 observed captures included 11 leatherback sea turtles, three green sea turtles, and three unidentified sea turtles. All the turtles were released alive, and all captures occurred in northern waters. There was no apparent trend in the observed capture rate over the reporting period (see Appendix B.12.1).

It was estimated that 11 (95% c.i.: 5–20) sea turtles were captured in 2012–13. The fishing effort in surface-longline fisheries has been relatively constant since 2004–05, at about 3 million hooks per year, after a decrease from 2002–03 onwards, when fishing effort was over 10 million hooks; the estimated number of captures followed this variation. The estimated number of sea turtles captured annually has varied between 9 (95% c.i.: 3–16) captures in 2007–08 and 16 (95% c.i.: 7–29) captures in 2004–05, but was higher in the first two years of the reporting period. In 2002–03 and 2003–04, when fishing effort was high, 43 (95% c.i.: 20–74) and 28 (95% c.i.: 13–48) turtles were estimated caught.

4. DISCUSSION

4.1 Modelling approach

In this report, we used GLMs to estimate captures in trawl and longline fishing from observed captures. The models ranged in complexity from models with single, multi-level covariates, to relatively complex models with multiple hierarchical effects. The models were fitted using a Bayesian method, with the advantage that the variety of model structures were able to be fitted using the same framework. For each fishing event (or group of events), the output from a model was a set of samples of the estimated number of captures. These samples may be combined, with the uncertainty being carried through the calculation. By aggregating all the seabird models, for example, it is possible to estimate the total number of seabird captures, and the associated uncertainty. (Summaries of the estimates similar to those found in Appendix B, but separated by area, fishery, and vessel-size, are available online*.)

This report continues a series of similar annual reports estimating protected species captures (recent reports include estimates of seabird captures (Richard & Abraham 2013a) and marine mammal captures (Thompson et al. 2016)). When the models were re-run with new data, i.e., including data from the most recent fishing year, the estimates were recalculated for the whole series of years (rather than just for the most recent fishing year). To assess the estimation, the estimated captures for the 2011–12 fishing year from the models reported here were compared with earlier estimates by Richard & Abraham (2013a) and Thompson et al. (2016) (Figure 6). For most species and fisheries, the estimate of captures in 2011–12 was similar between the two analyses. There was only one case where the estimates differed by more than the 95% c.i., which was for white-capped albatross in bottom-longline fisheries. In the current report, estimates were included of white-capped albatross captures in small-vessel bottom-longline fisheries, whereas it was assumed by Richard & Abraham (2013a) that there were no captures of white-capped albatross in these fisheries. In addition, there was a decrease in estimated captures of fur seals in inshore trawl fisheries between the two analyses. Nevertheless, there has only been a single observed capture of fur seals in inshore trawl fisheries, and so the estimates are sensitive to new data and to any changes in the other model parameters.

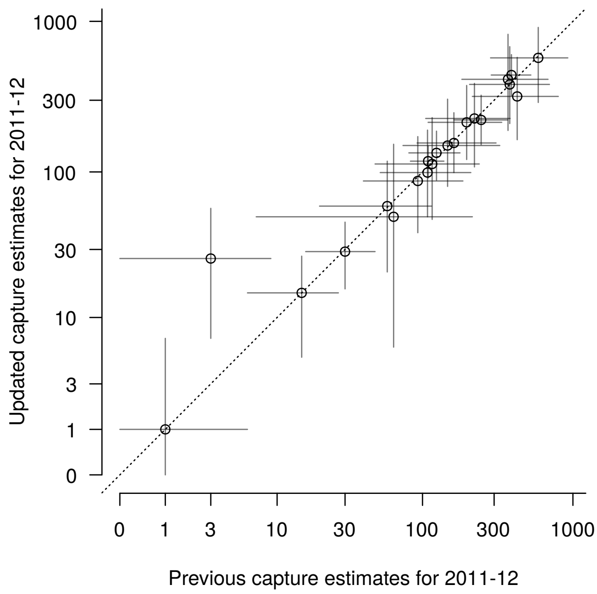
4.2 Observer coverage

The foundation for the estimation was the observations collected by government observers, supported by expert identification of captured animals. In 2012–13, observer coverage increased markedly in large-vessel trawl fisheries. This increase meant that close to 100% observer coverage was achieved in southern blue whiting trawl fisheries, and there was 87.6% and 85.9% coverage in jack mackerel and squid trawl fisheries, respectively. Where observer coverage was high, the estimated captures were largely in agreement with estimates made in previous years, when observer coverage was lower.

For seabirds, a risk assessment process identified small-vessel fisheries as contributing highly to the overall risk (Richard & Abraham 2013b). In this analysis, these small-vessel fisheries were also associated with most of the seabird captures (see Figure 2). These small-vessel fisheries remain poorly observed. For example, inshore and flatfish trawl fisheries combined accounted for 60% of trawl effort, but only had 0.5% and 0.3% observer coverage in 2012–13, respectively. With this continued low coverage, it is unlikely that the range of impacts of these fisheries on protected species are understood. In flatfish trawl fisheries, there have only been eleven observed seabird capture events. These capture events have mostly involved one or two birds; however, one event involved the capture of 31 shags. Because of the low observer coverage, this single event accounted for 73.8% of all observed seabird captures in flatfish trawl fisheries. With coverage at this low level, the observations cannot be considered representative, and so there is a risk that the estimates of captures in these fisheries are biased. Although the snapper bottom-longline fishery has been identified as a fishery that is associated with captures of very high risk seabirds, there was only 0.3% observer coverage in this fishery in 2012–13 (see Appendix B.7.5), with no coverage in either 2010–11 or 2011–12. While the estimates make use of the available information, this low observer coverage means that they may be biased.

* Currently available at https://data.dragonfly.co.nz/psc/

(a) Seabirds



(b) Marine mammals

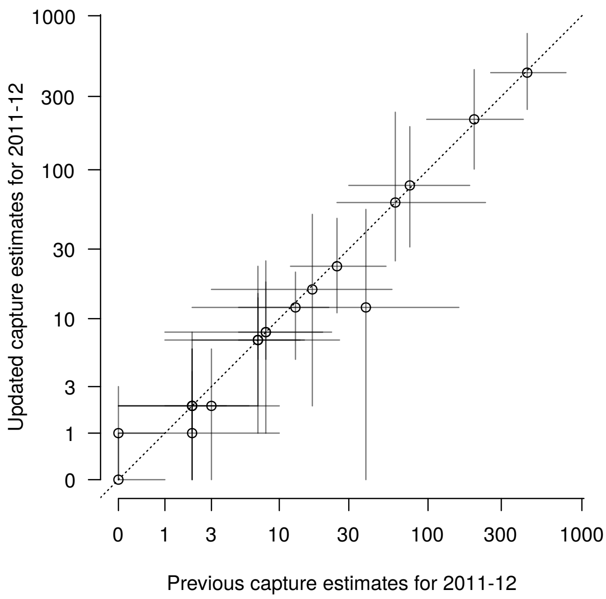


Figure 6: Comparison of estimated captures for the 2011–12 fishing year between the previous estimates (Richard & Abraham 2013a, Thompson et al. 2016) and the current study, showing the estimated means and 95% credible intervals for (a) seabirds for each of the seven modelled species or species groupings and each of the three fishing methods considered (trawl, bottom longline, and surface longline), and for (b) marine mammals (for the combinations of species and fisheries/areas presented in Appendix B). The furthest point from the diagonal line in (a) is of white-capped albatross in bottom-longline fisheries, and the furthest point in (b) is of fur seals in inshore trawl fisheries.

There has been some development of electronic video monitoring of inshore longline and trawl fisheries (McElderry et al. 2008, 2011). During a trial deployment in east coast South Island set-net fisheries during 2012–13, electronic monitoring recorded the capture of one Hector's dolphin and two seabirds (Geytenbeek et al. 2014). Electronic monitoring promises to provide a comparatively cheap way to extend the coverage of small-vessel fisheries, which tend to be difficult fisheries for deploying observers. These methods are not yet in widespread use in New Zealand fisheries, and no data from electronic monitoring were included here. With further validation, an expansion of electronic monitoring may improve observer coverage in poorly observed small-vessel fisheries.

4.3 Sea lion captures and interactions

The analysis of New Zealand sea lion captures is used to provide information for managing interactions between trawl fisheries and New Zealand sea lions (e.g., Ministry for Primary Industries 2013). A key measure has been setting of a fisheries-related mortality limit (FRML) for the Auckland Islands squid fishery (Breen et al. 2003), which is a limit on the annual number of estimated sea lion fatalities, calculated from an assumed strike rate. The strike rate is discounted for tows that use SLEDs. In 2012–13, the FRML was 68 sea lions, and the strike rate was 5.89, with a discount for SLED use of 82% (Ministry for Primary Industries 2013). With these settings, the Auckland Islands squid fishery fishery was able to carry out 6415 tows without exceeding the FRML (assuming that all tows used approved SLEDs). In 2012–13, there were 1027 tows in this fishery, well within the limit of the FRML, and this effort was the lowest number of tows since 2000–01 (see Appendix B.11.2).

Estimation of an annually varying strike rate within the model has become increasingly difficult. The design of SLEDs has changed since they were first introduced, with standardisation and refinement of the design (Clement & Associates 2007). Now, few sea lions are caught on tows that use SLEDs, and estimation of the strike relies on the model comparing captures between recent tows and tows during the period when no SLEDs were used. In 2012–13, the strike rate was estimated as 5.26 (95% c.i.: 0.68–25.41) sea lions per 100 tows. While the mean value is close to the assumed strike rate, the high uncertainty means that the current approach does not provide a guide for setting the FRML. In recent years, the mean estimated strike rate has ranged between 3.51 sea lions per 100 tows (2011–12) and 10.77 sea lions per 100 tows (2009–10).

In 2012–13, 21 sea lions were observed caught in the southern blue whiting trawl fishery near Campbell Island. Following a multiple capture event of 5 sea lions early in the season, SLEDs were introduced into the fishery. While the fishery had close to 100% observer coverage (so the estimated captures are equal to the observed captures), SLEDs were used on around half of all the observed tows. If SLEDs had not been used, the number of sea lion captures in this fishery may have been higher, however interactions were not calculated for this fishery. If SLEDs continue to be used in the southern blue whiting fishery, then there will be little ongoing information about sea lion captures.

5. ACKNOWLEDGMENTS

The data for this project were collected by government fisheries observers. We are grateful for their ongoing work to collect the independent information that underpins our understanding of interactions between New Zealand fisheries and protected species. We also appreciate the assistance of the Ministry for Primary Industries Database team; Dave Fisher of the National Institute of Water and Atmospheric Research for help with the Centralised Observer Database; Conservation Services Programme staff at the Department of Conservation, primarily Igor Debski and Kris Ramm, for help resolving species identifications; Biz Bell of Wildlife Management International for seabird identification data; and Richard Wells of Deepwater Group for many valuable points of clarification.

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APPENDIX A Areas used for estimation

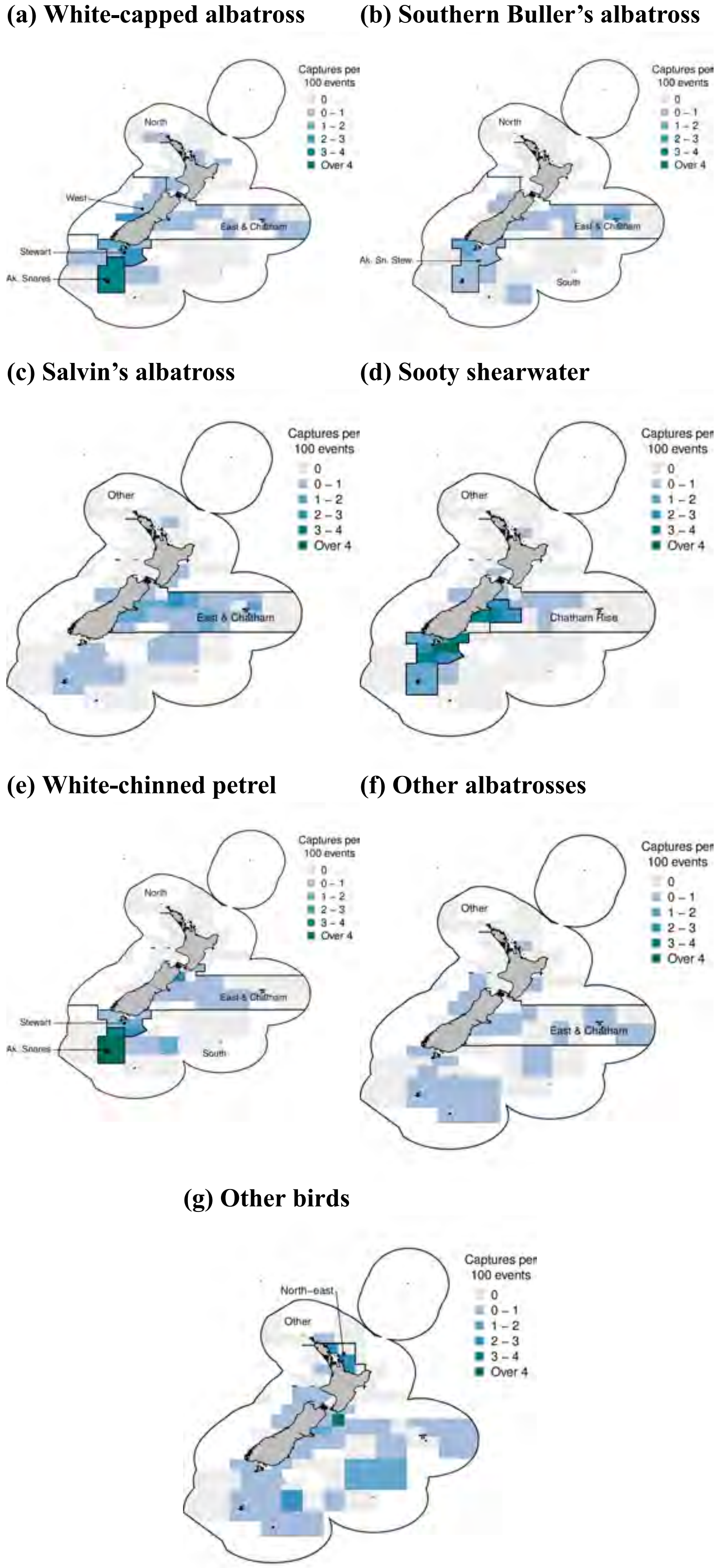


Figure A-1: Areas used as covariates in the trawl fisheries models. The colours give the capture rate (birds per 100 tows) for each of the species groups within each statistical area. Capture rates are only shown if more than 100 observed tows were in a statistical area.

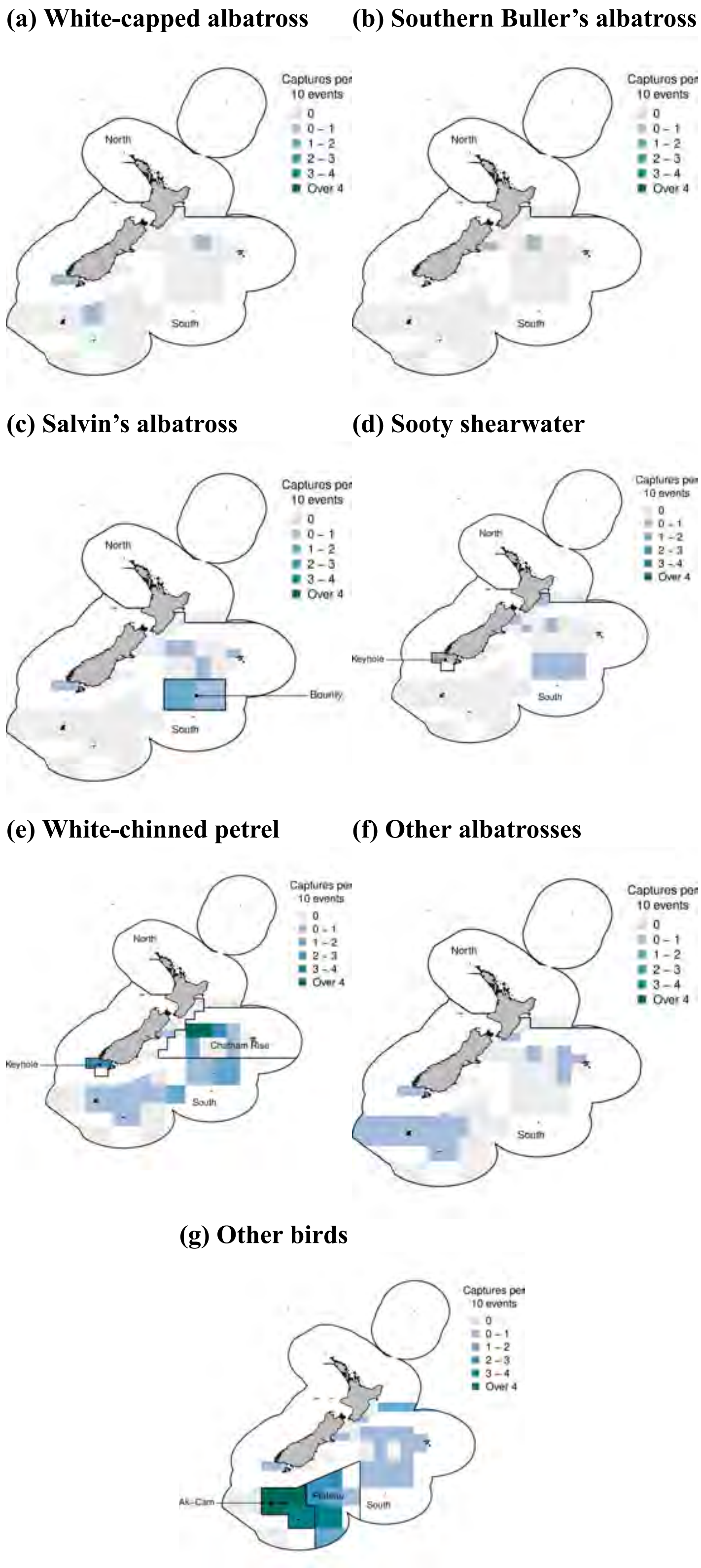
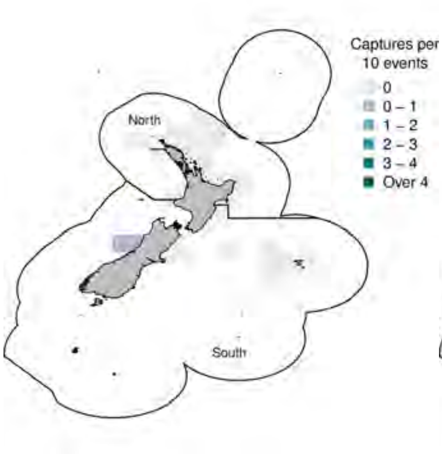
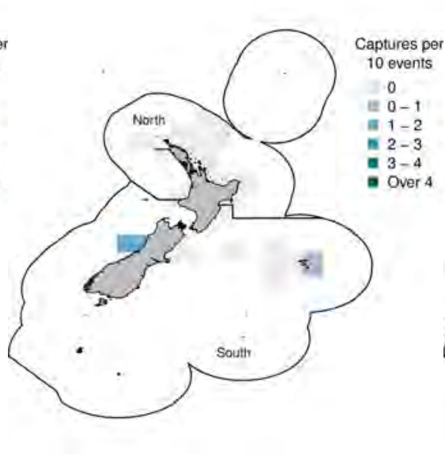


Figure A-2: Areas used as covariates in the large-vessel (≥34 m length) bottom-longline fisheries models. The colours give the capture rate (birds per 100 sets) for each of the species groups within each statistical area.

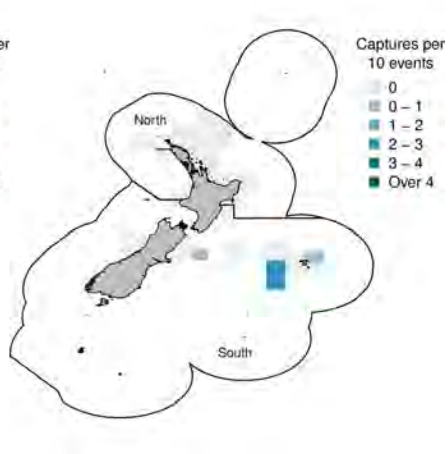
(a) White-capped albatross



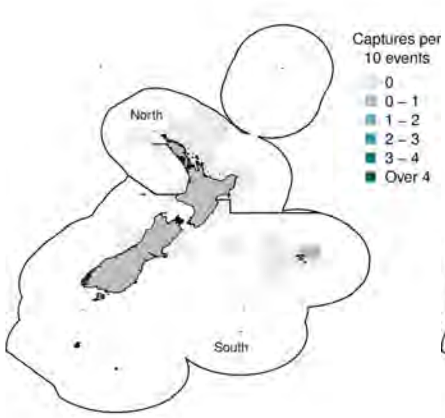
(b) Southern Buller's albatross



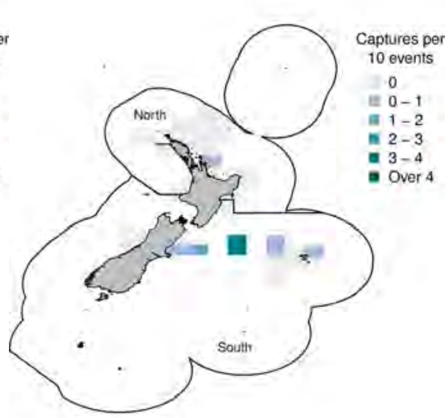
(c) Salvin's albatross



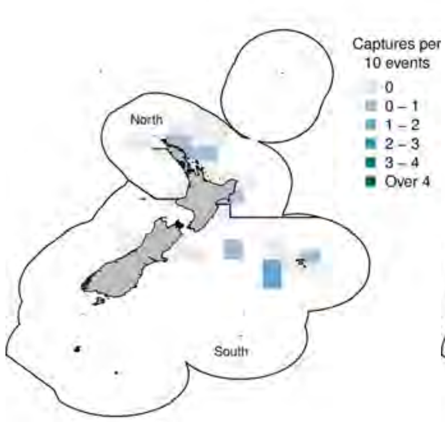
(d) Sooty shearwater



(e) White-chinned petrel



(f) Other albatrosses



(g) Other birds

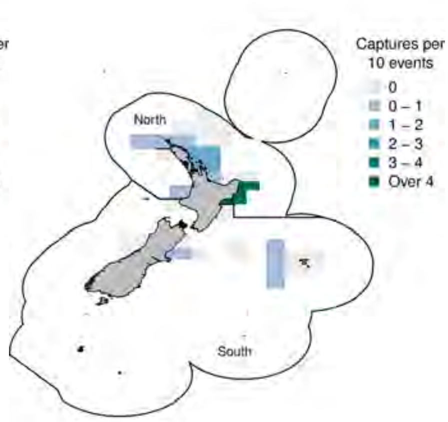


Figure A-3: Areas used as covariates in the small-vessel (<34 m length) bottom-longline fisheries models. The colours give the capture rate (birds per 100 sets) for each of the species groups within each statistical area.

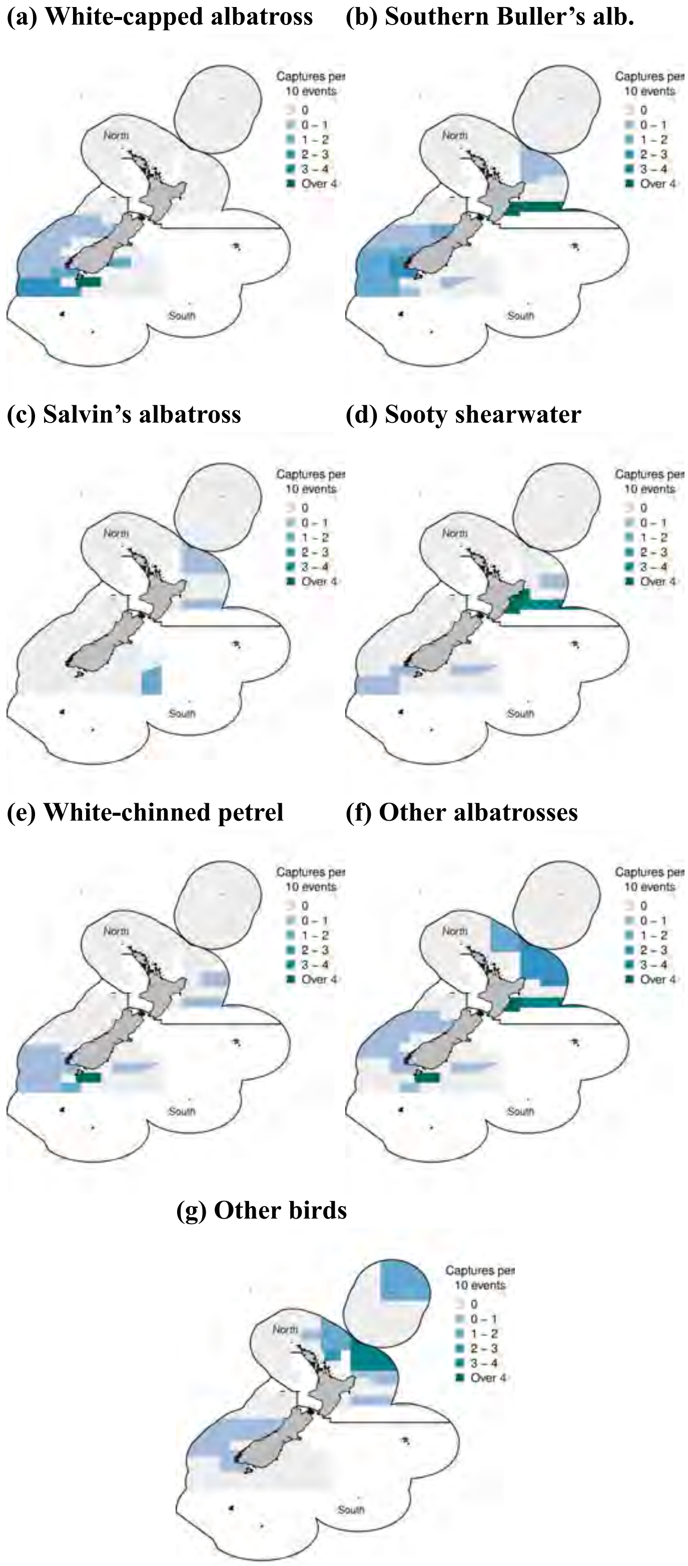
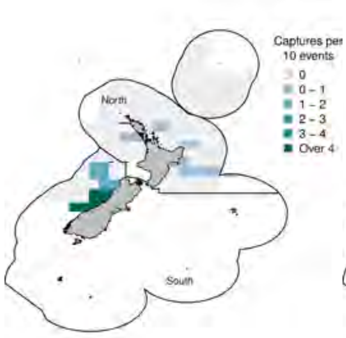
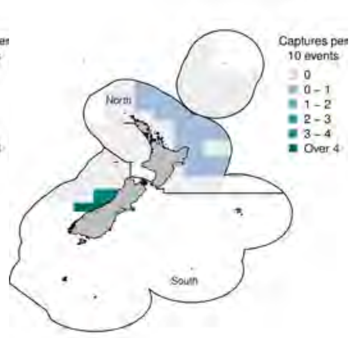


Figure A-4: Areas used as covariates in the large-vessel (≥45 m length) surface-longline fisheries models. The colours give the capture rate (birds per 100 sets) for each of the species groups within each statistical area.

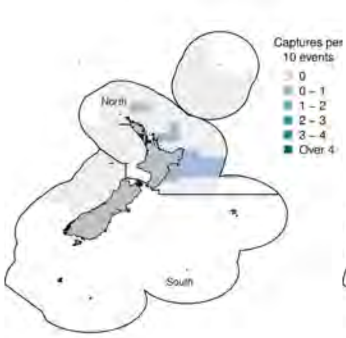
(a) White-capped albatross



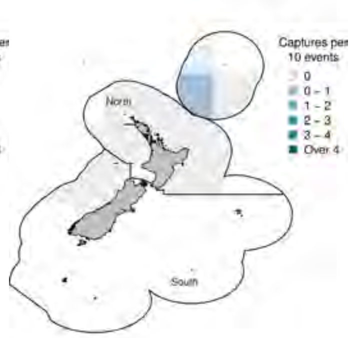
(b) Southern Buller's alb.



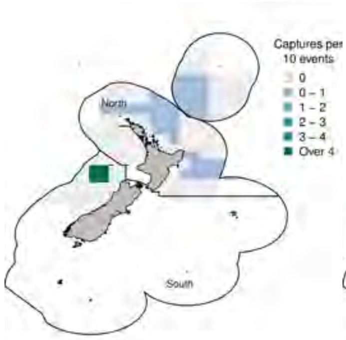
(c) Salvin's albatross



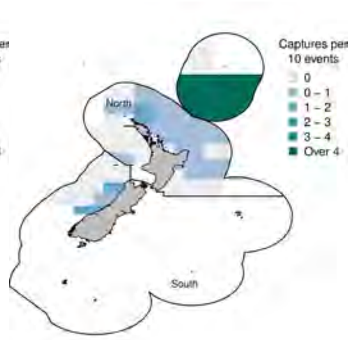
(d) Sooty shearwater



(e) White-chinned petrel



(f) Other albatrosses



(g) Other birds

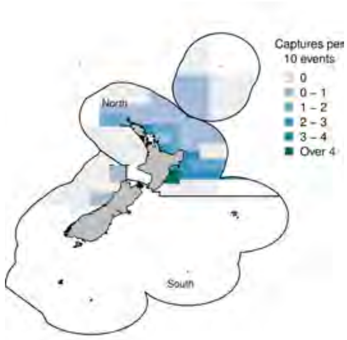
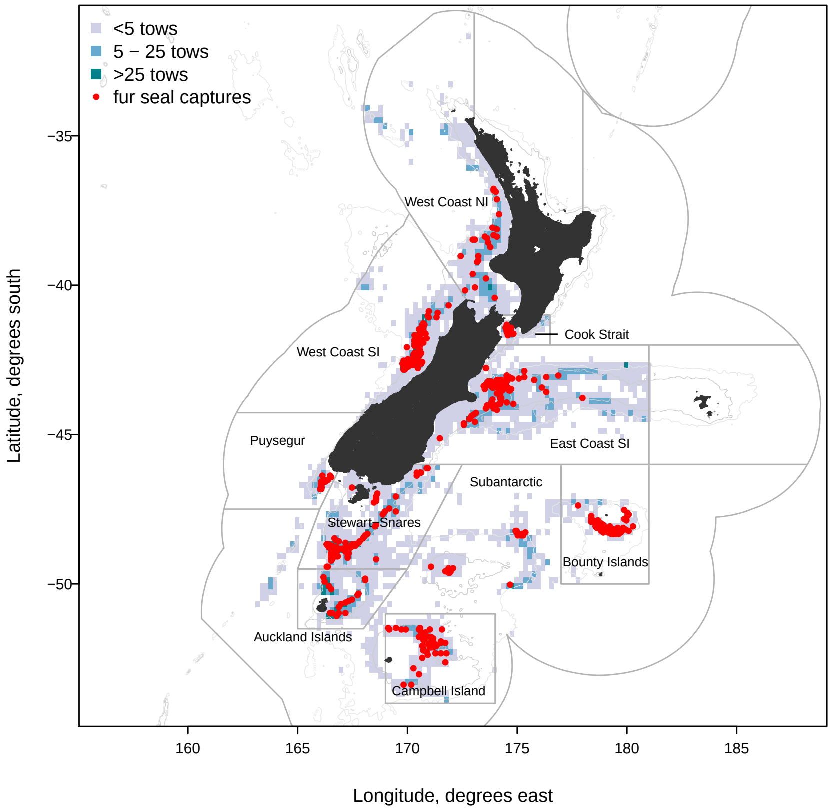
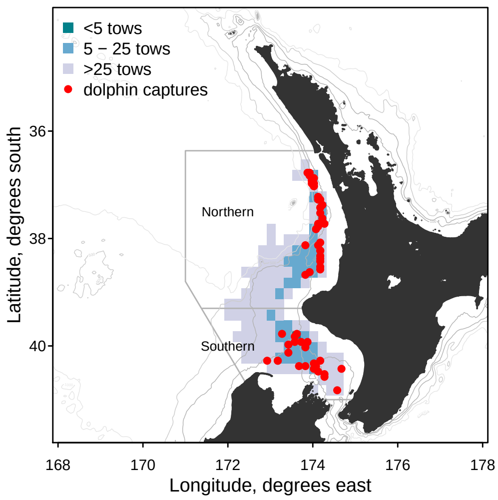


Figure A-5: Areas used as covariates in the small-vessel (<45 m length) surface-longline fisheries models. The colours give the capture rate (birds per 100 sets) for each of the species groups within each statistical area.

(a) Observed fur seal captures



(b) Observed common dolphin captures



(c) Observed sea lion captures

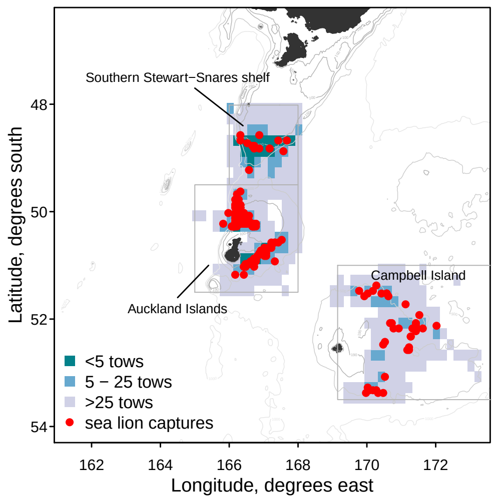


Figure A-6: Spatial distribution of observed fishing effort (blue squares) and observed marine mammal captures (red dots) used in statistical models to estimate total captures in New Zealand's Exclusive Economic Zone. Also indicated are the areas used for defining the models. The model data sets encompassed 10 fishing years for New Zealand fur seals, from 2002–03 to 2012–13, and 17 fishing years for common dolphins and New Zealand sea lions, from 1995–96 to 2012–13. The average annual observed fishing effort within 0.2°square cells is indicated with blue shades.

APPENDIX B Summaries of captures by species and fishery

B.1 White-capped albatross captures

B.1.1 White-capped albatross captures in trawl fisheries

Table B-1: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	85	1.24	860	645–1 096	0.66	0.50–0.84
2003–04	120 868	5.4	148	2.26	948	752–1 192	0.78	0.62–0.99
2004–05	120 438	6.4	243	3.15	1 228	1 003–1 549	1.02	0.83–1.29
2005–06	109 923	6.0	69	1.04	643	478–845	0.58	0.43–0.77
2006–07	103 306	7.7	57	0.72	510	369–689	0.49	0.36–0.67
2007–08	89 524	10.1	42	0.46	358	238–500	0.40	0.27–0.56
2008–09	87 548	11.2	97	0.99	477	365–624	0.54	0.42–0.71
2009–10	92 888	9.7	48	0.53	414	293–568	0.45	0.32–0.61
2010–11	86 090	8.6	41	0.55	390	271–541	0.45	0.31–0.63
2011–12	84 429	10.8	67	0.74	441	322–602	0.52	0.38–0.71
2012–13	83 722	14.8	119	0.96	454	337–611	0.54	0.40–0.73

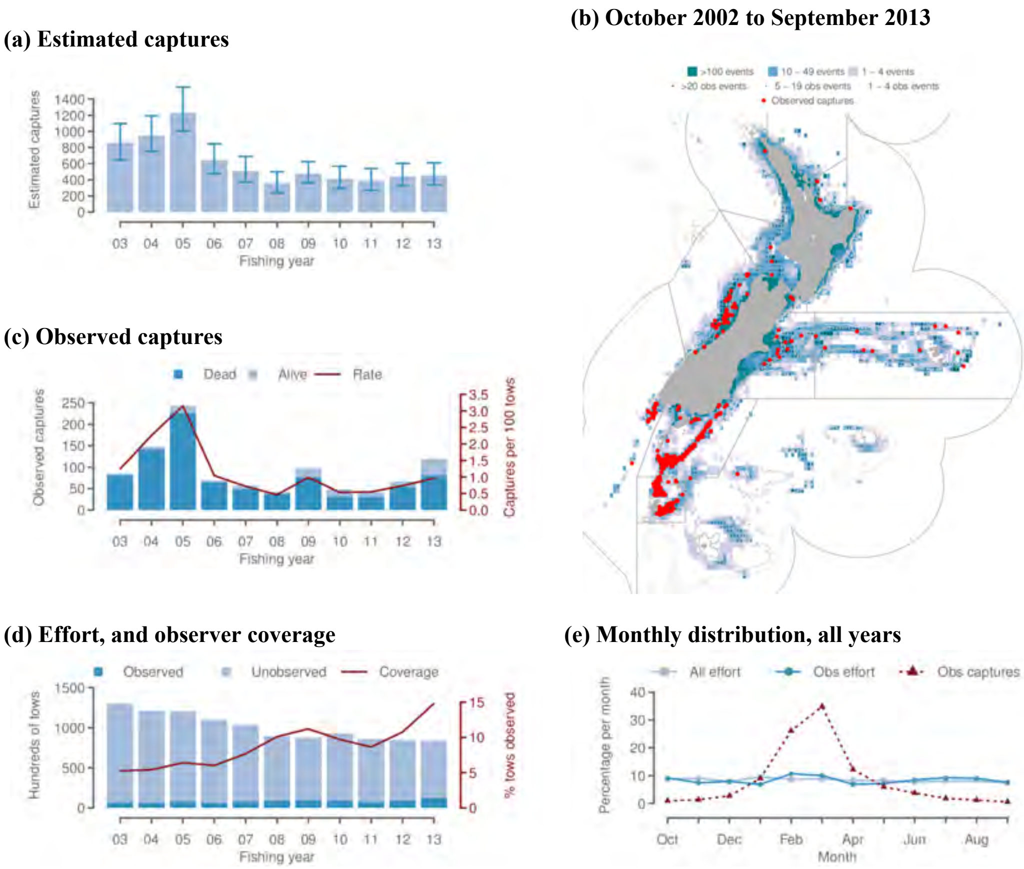


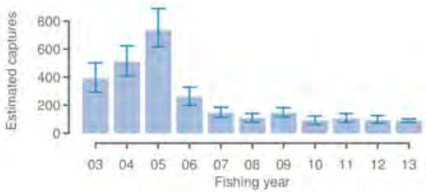
Figure B-7: White-capped albatross captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.1.2 White-capped albatross captures in squid trawl fisheries

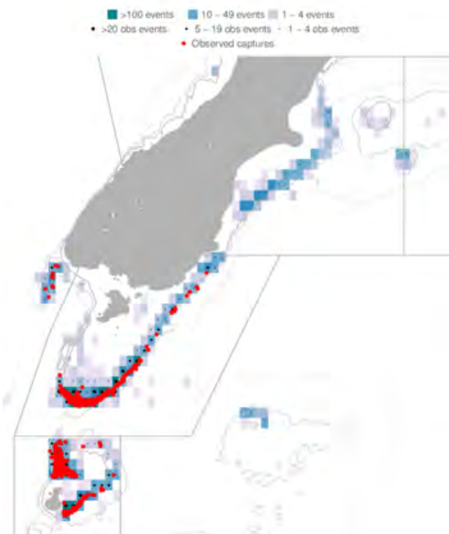
Table B-2: Annual fishing effort and number of tows observed in squid trawl fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 410	15.6	67	5.12	390	292–502	4.64	3.47–5.97
2003–04	8 336	21.2	139	7.85	511	410–623	6.13	4.92–7.47
2004–05	10 486	23.9	235	9.36	734	616–890	7.00	5.87–8.49
2005–06	8 575	12.9	47	4.26	258	199–329	3.01	2.32–3.84
2006–07	5 906	21.8	43	3.34	146	112–185	2.47	1.90–3.13
2007–08	4 236	34.4	39	2.68	108	79–141	2.55	1.86–3.33
2008–09	3 867	33.6	61	4.70	144	116–182	3.72	3.00–4.71
2009–10	3 789	28.2	20	1.87	91	64–123	2.40	1.69–3.25
2010–11	4 214	29.9	31	2.46	106	78–140	2.52	1.85–3.32
2011–12	3 505	39.4	36	2.61	95	72–125	2.71	2.05–3.57
2012–13	2 646	85.9	74	3.26	88	78–102	3.33	2.95–3.85

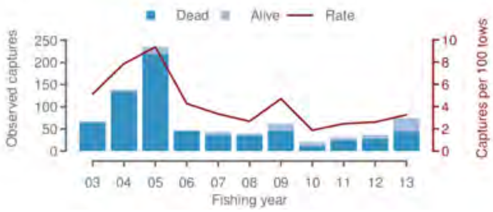
(a) Estimated captures



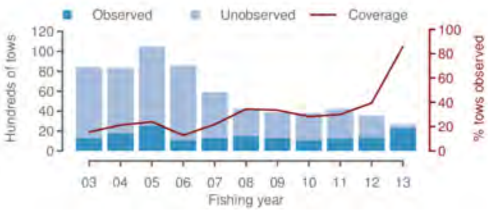
(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

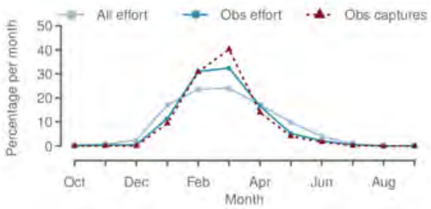


Figure B-8: White-capped albatross captures in squid trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (99.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.1.3 White-capped albatross captures in inshore trawl fisheries

Table B-3: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	177	88–307	0.48	0.24–0.84
2003–04	37 429	0.0	0	0.00	211	106–369	0.56	0.28–0.99
2004–05	40 829	0.0	0	0.00	258	130–447	0.63	0.32–1.09
2005–06	39 150	0.3	0	0.00	209	104–364	0.53	0.27–0.93
2006–07	35 831	0.8	4	1.33	208	106–352	0.58	0.30–0.98
2007–08	31 418	0.4	1	0.78	140	65–250	0.45	0.21–0.80
2008–09	33 102	3.5	10	0.87	185	101–306	0.56	0.31–0.92
2009–10	35 971	1.4	3	0.58	189	100–319	0.53	0.28–0.89
2010–11	34 986	1.3	1	0.22	175	87–298	0.50	0.25–0.85
2011–12	32 772	0.4	3	2.11	194	100–330	0.59	0.31–1.01
2012–13	33 263	0.5	1	0.59	209	109–357	0.63	0.33–1.07

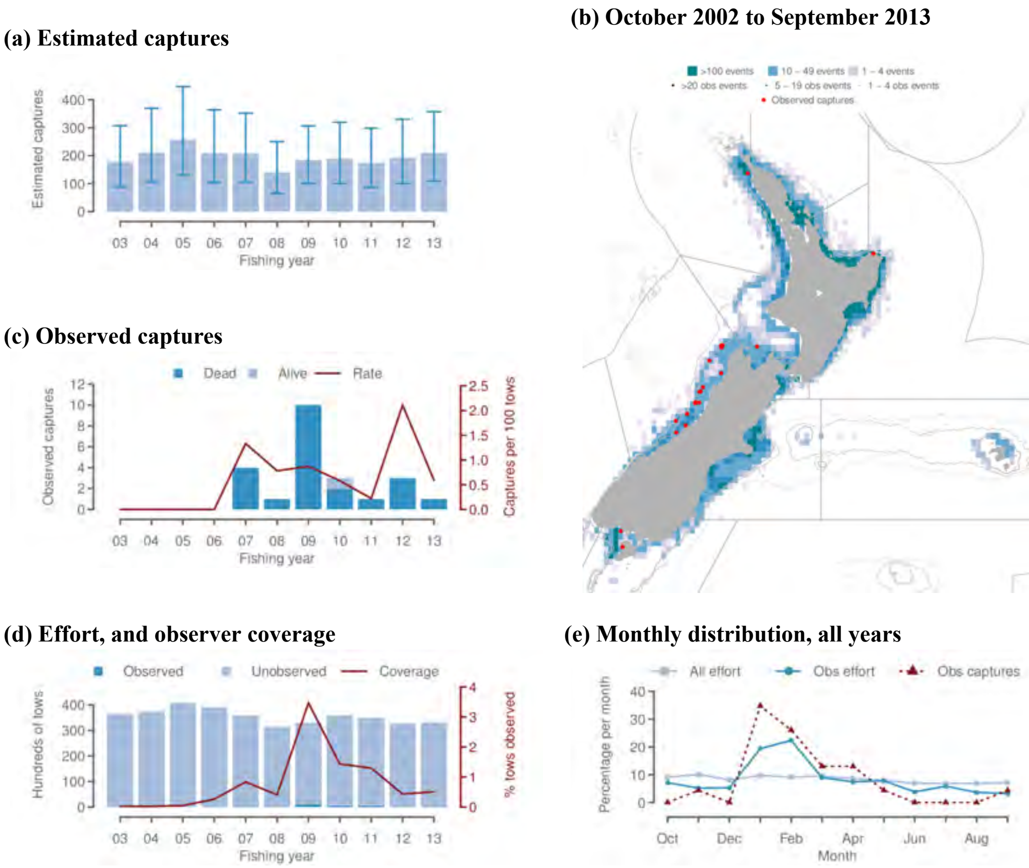


Figure B-9: White-capped albatross captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.1.4 White-capped albatross captures in middle-depth trawl fisheries

Table B-4: Annual fishing effort and number of tows observed in middle-depth trawl fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	11 178	3.1	2	0.57	95	54–149	0.85	0.48–1.33
2003–04	9 165	2.1	1	0.52	76	43–123	0.83	0.47–1.34
2004–05	9 188	2.4	2	0.90	95	56–148	1.03	0.61–1.61
2005–06	8 402	5.8	16	3.28	79	50–117	0.94	0.60–1.39
2006–07	8 197	4.8	4	1.02	68	39–105	0.83	0.48–1.28
2007–08	7 416	6.1	0	0.00	46	23–76	0.62	0.31–1.02
2008–09	7 235	10.1	17	2.32	65	42–97	0.90	0.58–1.34
2009–10	7 217	12.3	11	1.24	52	31–80	0.72	0.43–1.11
2010–11	7 252	8.5	2	0.32	44	21–74	0.61	0.29–1.02
2011–12	6 554	11.7	3	0.39	52	28–86	0.79	0.43–1.31
2012–13	6 451	19.2	24	1.93	72	48–108	1.12	0.74–1.67

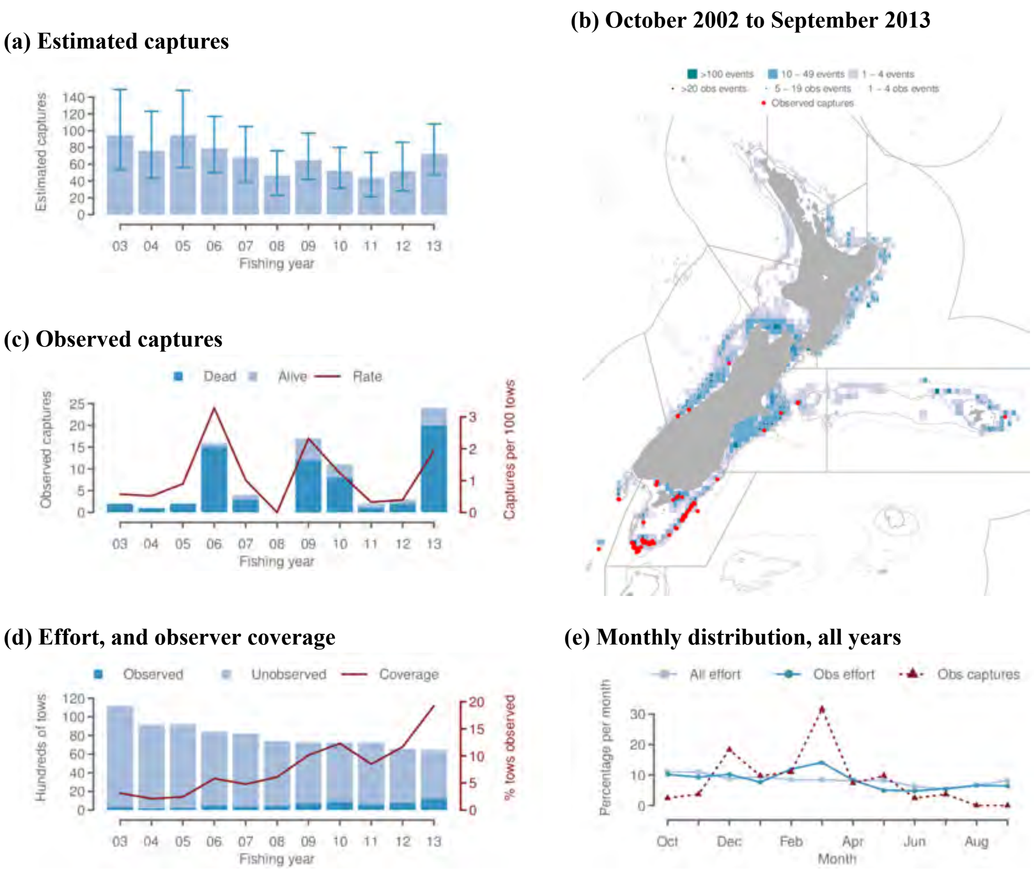


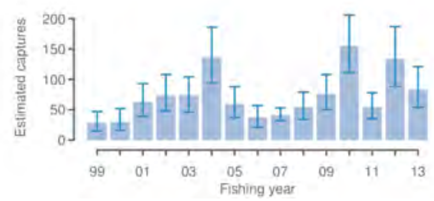
Figure B-10: White-capped albatross captures in middle-depth trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.1.5 White-capped albatross captures in surface-longline fisheries

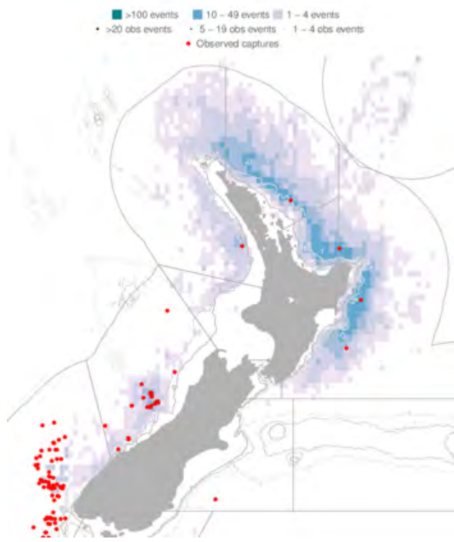
Table B-5: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	8	0.006	28	15–47	0.00	0.00–0.01
1999–00	8 271 067	10.4	6	0.007	30	16–52	0.00	0.00–0.01
2000–01	9 711 545	10.8	3	0.003	63	39–93	0.01	0.00–0.01
2001–02	10 841 737	9.1	13	0.013	74	48–108	0.01	0.00–0.01
2002–03	10 772 188	20.4	2	0.001	74	46–104	0.01	0.00–0.01
2003–04	7 386 329	21.8	17	0.011	136	94–186	0.02	0.01–0.03
2004–05	3 679 765	21.3	3	0.004	60	37–88	0.02	0.01–0.02
2005–06	3 690 119	19.1	2	0.003	37	21–57	0.01	0.01–0.02
2006–07	3 739 912	27.8	28	0.027	41	32–53	0.01	0.01–0.01
2007–08	2 246 189	18.8	4	0.009	54	34–79	0.02	0.02–0.04
2008–09	3 115 633	30.1	3	0.003	76	50–108	0.02	0.02–0.03
2009–10	2 995 264	22.2	31	0.047	155	111–206	0.05	0.04–0.07
2010–11	3 187 879	21.2	3	0.004	54	35–78	0.02	0.01–0.02
2011–12	3 100 277	23.5	8	0.011	134	88–187	0.04	0.03–0.06
2012–13	2 862 182	19.6	12	0.021	83	54–121	0.03	0.02–0.04

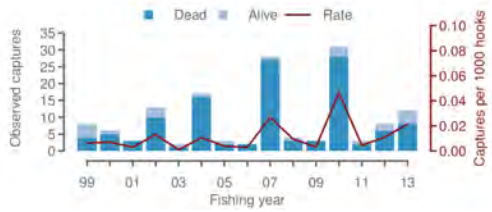
(a) Estimated captures



(b) October 1998 to September 2013



(c) Observed captures



(d) Effort, and observer coverage

(e) Monthly distribution, all years

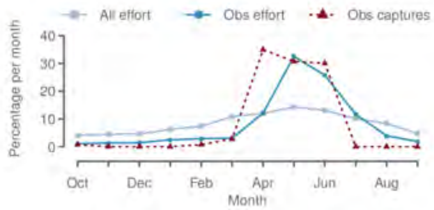


Figure B-11: White-capped albatross captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.1.6 White-capped albatross captures in small-vessel southern bluefin longline fisheries

Table B-6: Annual fishing effort and number of hooks observed in small-vessel southern bluefin longline fisheries, number of observed captures of white-capped albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-capped albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	428 815	0.0	0	–	5	1–12	0.01	0.00–0.03
1999–00	695 415	0.5	0	0.000	7	2–15	0.01	0.00–0.02
2000–01	977 027	2.5	0	0.000	36	21–53	0.04	0.02–0.05
2001–02	1 722 853	1.7	0	0.000	27	13–46	0.02	0.01–0.03
2002–03	2 357 331	0.0	0	–	47	28–68	0.02	0.01–0.03
2003–04	1 691 526	3.1	1	0.019	90	57–132	0.05	0.03–0.08
2004–05	1 023 395	9.0	0	0.000	44	26–65	0.04	0.03–0.06
2005–06	873 938	6.5	0	0.000	28	15–43	0.03	0.02–0.05
2006–07	566 301	13.3	1	0.013	4	1–10	0.01	0.00–0.02
2007–08	536 540	16.9	1	0.011	46	27–67	0.09	0.05–0.12
2008–09	681 008	8.7	1	0.017	70	44–101	0.10	0.06–0.15
2009–10	1 081 300	9.4	20	0.196	142	98–193	0.13	0.09–0.18
2010–11	833 595	8.5	0	0.000	46	28–68	0.06	0.03–0.08
2011–12	1 049 114	9.3	1	0.010	117	74–167	0.11	0.07–0.16
2012–13	1 051 177	3.9	9	0.217	71	47–104	0.07	0.04–0.10

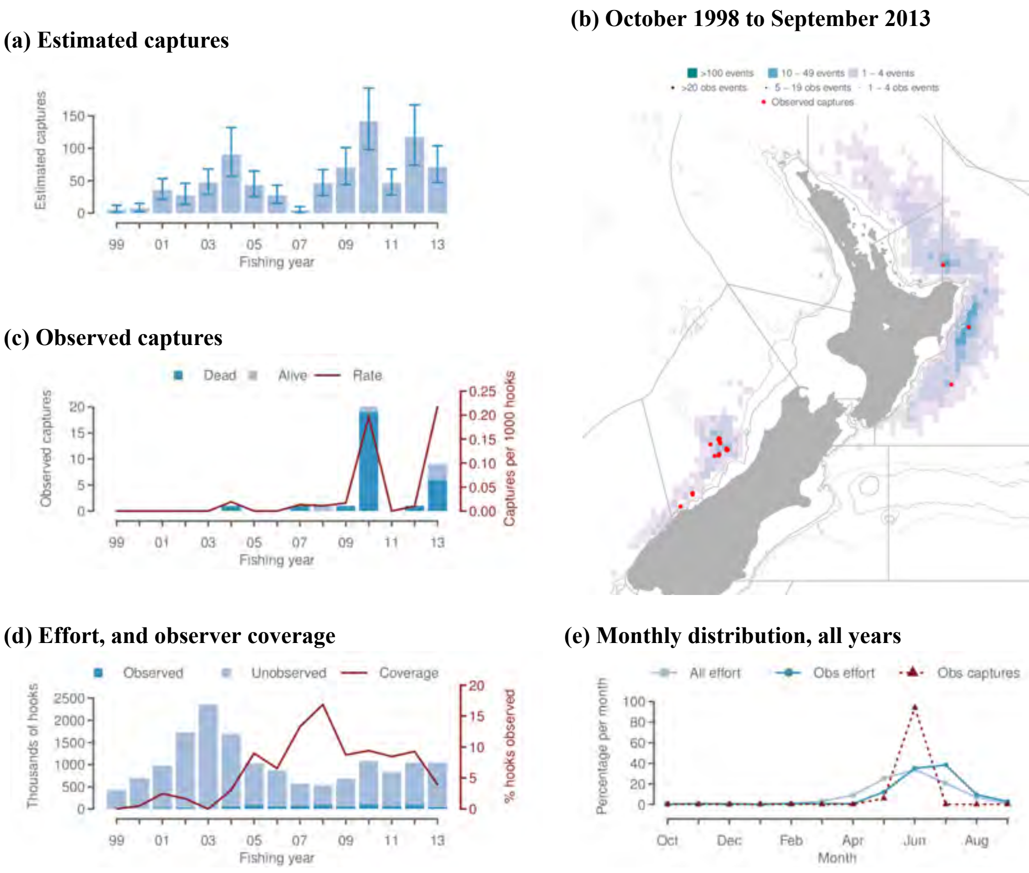


Figure B-12: White-capped albatross captures in small-vessel southern bluefin longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (94.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

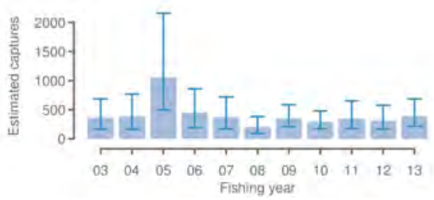
B.2 Salvin's albatross captures

B.2.1 Salvin's albatross captures in trawl fisheries

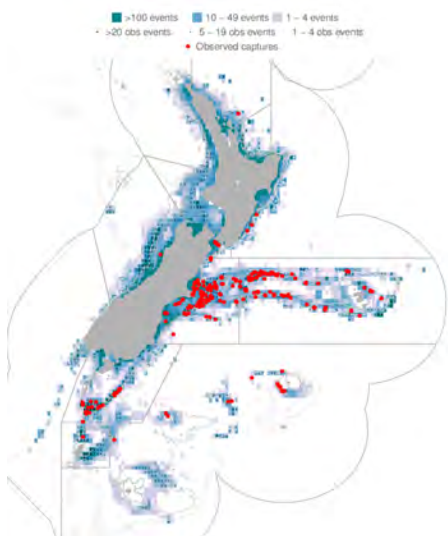
Table B-7: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of Salvin's albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of Salvin's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	24	0.35	360	166–685	0.28	0.13–0.53
2003–04	120 868	5.4	11	0.17	383	162–768	0.32	0.13–0.64
2004–05	120 438	6.4	37	0.48	1 052	496–2 160	0.87	0.41–1.79
2005–06	109 923	6.0	9	0.14	450	190–859	0.41	0.17–0.78
2006–07	103 306	7.7	14	0.18	376	170–720	0.36	0.16–0.70
2007–08	89 524	10.1	11	0.12	200	91–381	0.22	0.10–0.43
2008–09	87 548	11.2	36	0.37	355	207–586	0.41	0.24–0.67
2009–10	92 888	9.7	40	0.44	289	173–478	0.31	0.19–0.51
2010–11	86 090	8.6	20	0.27	350	176–652	0.41	0.20–0.76
2011–12	84 429	10.8	24	0.26	318	164–577	0.38	0.19–0.68
2012–13	83 722	14.8	47	0.38	387	212–685	0.46	0.25–0.82

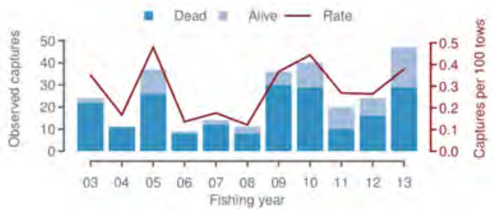
(a) Estimated captures



(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage

(e) Monthly distribution, all years

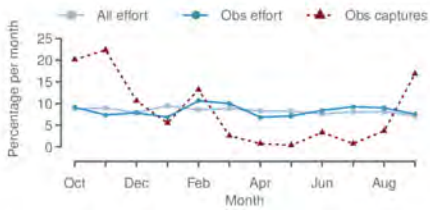


Figure B-13: Salvin's albatross captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.2.2 Salvin's albatross captures in inshore trawl fisheries

Table B-8: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of Salvin's albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of Salvin's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	141	36–353	0.39	0.10–0.97
2003–04	37 429	0.0	0	0.00	184	50–476	0.49	0.13–1.27
2004–05	40 829	0.0	0	0.00	516	153–1 314	1.26	0.37–3.22
2005–06	39 150	0.3	0	0.00	220	65–515	0.56	0.17–1.32
2006–07	35 831	0.8	3	1.00	186	60–437	0.52	0.17–1.22
2007–08	31 418	0.4	1	0.78	87	26–205	0.28	0.08–0.65
2008–09	33 102	3.5	11	0.96	161	67–330	0.49	0.20–1.00
2009–10	35 971	1.4	6	1.16	127	49–272	0.35	0.14–0.76
2010–11	34 986	1.3	0	0.00	147	47–337	0.42	0.13–0.96
2011–12	32 772	0.4	0	0.00	133	43–314	0.41	0.13–0.96
2012–13	33 263	0.5	0	0.00	175	61–397	0.53	0.18–1.19

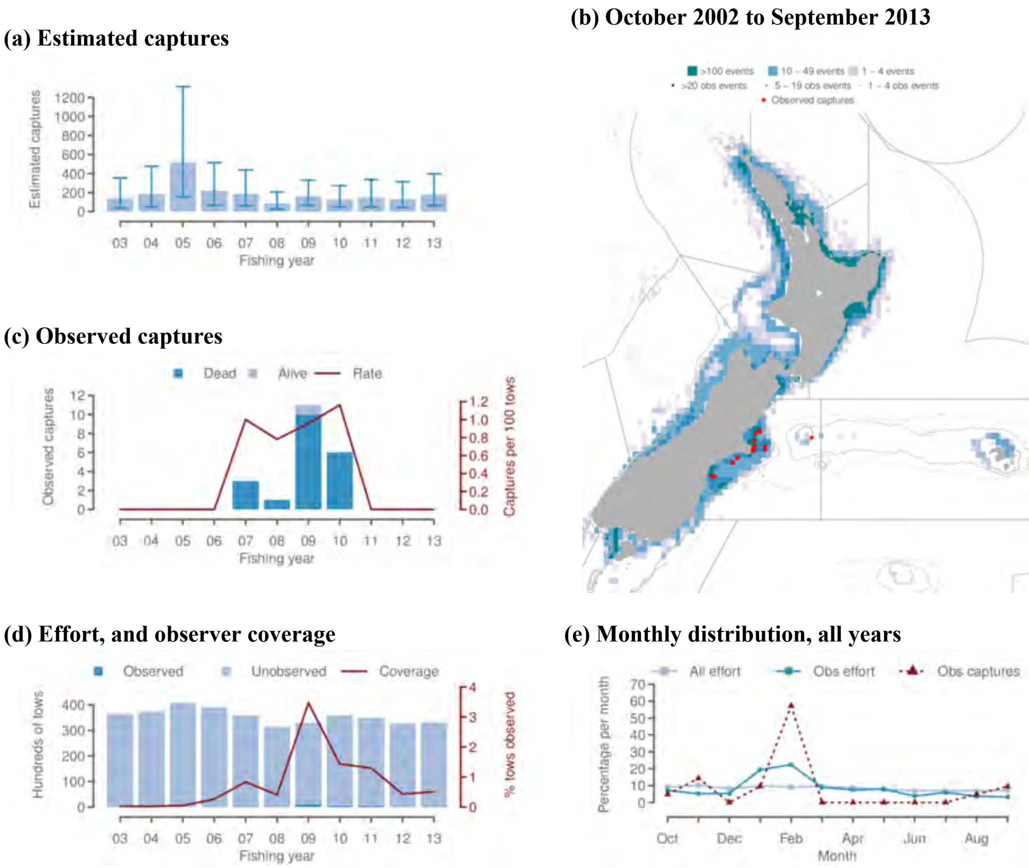


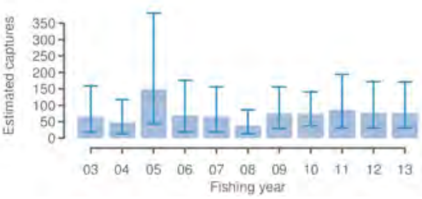
Figure B-14: Salvin's albatross captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.2.3 Salvin’s albatross captures in middle-depth trawl fisheries

Table B-9: Annual fishing effort and number of tows observed in middle-depth trawl fisheries, number of observed captures of Salvin’s albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of Salvin’s albatross (mean and 95% credible interval).

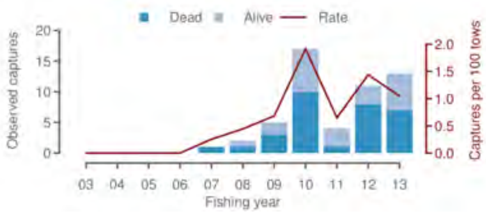
		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	11 178	3.1	0	0.00	65	18–159	0.58	0.16–1.42
2003–04	9 165	2.1	0	0.00	48	13–117	0.52	0.14–1.28
2004–05	9 188	2.4	0	0.00	149	44–381	1.62	0.48–4.15
2005–06	8 402	5.8	0	0.00	70	19–176	0.83	0.23–2.09
2006–07	8 197	4.8	1	0.25	65	19–156	0.79	0.23–1.90
2007–08	7 416	6.1	2	0.44	38	13–86	0.51	0.18–1.16
2008–09	7 235	10.1	5	0.68	74	29–156	1.02	0.40–2.16
2009–10	7 217	12.3	17	1.91	74	37–141	1.03	0.51–1.95
2010–11	7 252	8.5	4	0.65	86	31–194	1.19	0.43–2.68
2011–12	6 554	11.7	11	1.44	77	31–172	1.17	0.47–2.62
2012–13	6 451	19.2	13	1.05	76	31–171	1.18	0.48–2.65

(a) Estimated captures

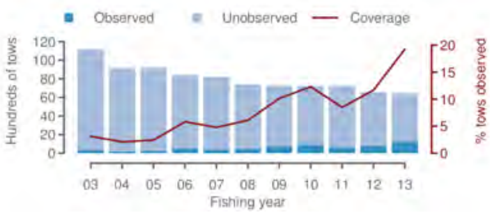


(b) October 2002 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

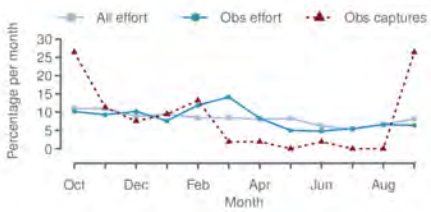


Figure B-15: Salvin’s albatross captures in middle-depth trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.2.4 Salvin's albatross captures in hoki trawl fisheries

Table B-10: Annual fishing effort and number of tows observed in hoki trawl fisheries, number of observed captures of Salvin's albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of Salvin's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	27 786	9.3	22	0.85	94	53–152	0.34	0.19–0.55
2003–04	22 523	10.4	2	0.09	73	30–139	0.32	0.13–0.62
2004–05	14 545	14.7	19	0.89	164	89–286	1.13	0.61–1.97
2005–06	11 590	15.3	6	0.34	67	29–137	0.58	0.25–1.18
2006–07	10 602	16.6	5	0.28	36	16–66	0.34	0.15–0.62
2007–08	8 788	21.4	1	0.05	23	8–47	0.26	0.09–0.53
2008–09	8 174	20.3	3	0.18	44	20–80	0.54	0.24–0.98
2009–10	9 965	20.7	6	0.29	39	21–67	0.39	0.21–0.67
2010–11	10 404	16.6	11	0.64	51	28–92	0.49	0.27–0.88
2011–12	11 333	22.8	6	0.23	46	24–81	0.41	0.21–0.71
2012–13	11 682	38.6	21	0.47	54	36–85	0.46	0.31–0.73

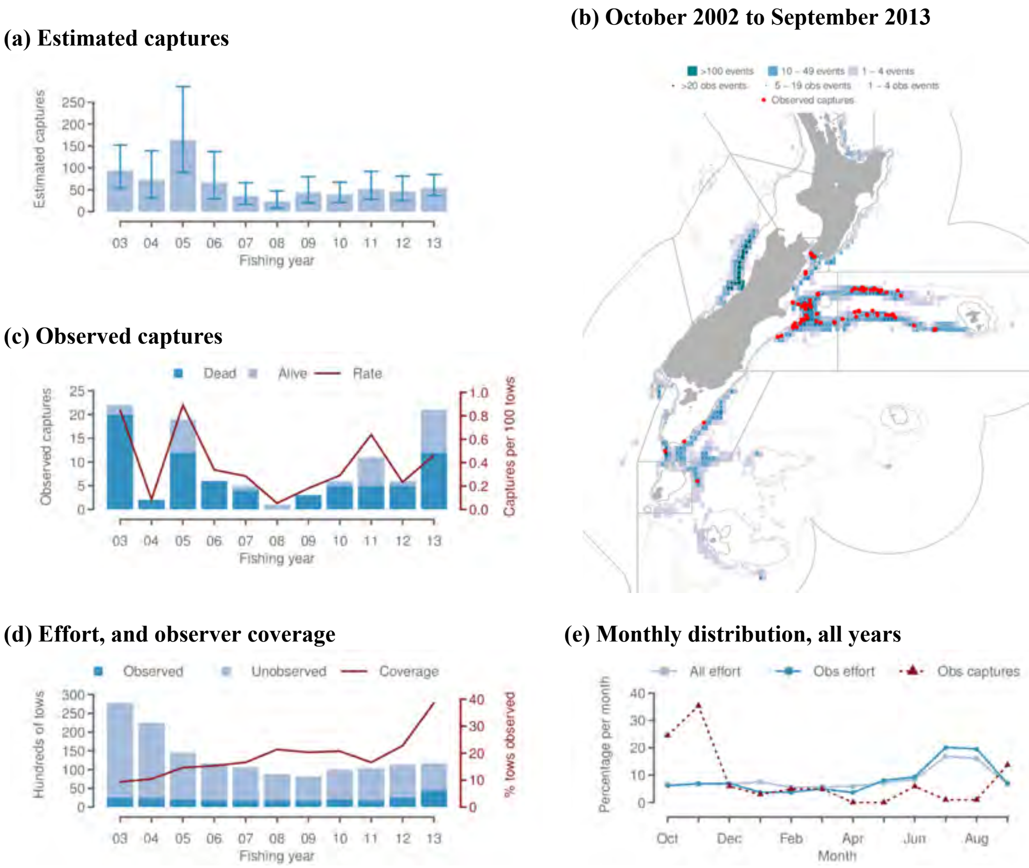


Figure B-16: Salvin's albatross captures in hoki trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (98.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.2.5 Salvin's albatross captures in bottom-longline fisheries

Table B-11: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of Salvin's albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of Salvin's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	0	0.000	229	165–325	0.00	0.00–0.01
1999–00	52 730 082	6.1	29	0.009	207	143–320	0.00	0.00–0.01
2000–01	50 713 196	8.9	91	0.020	222	174–300	0.00	0.00–0.01
2001–02	46 653 023	15.0	12	0.002	162	114–236	0.00	0.00–0.01
2002–03	37 761 838	28.5	15	0.001	122	74–208	0.00	0.00–0.01
2003–04	43 225 599	11.7	10	0.002	109	63–191	0.00	0.00–0.00
2004–05	41 844 688	6.9	0	0.000	125	56–255	0.00	0.00–0.01
2005–06	37 141 633	10.2	1	0.000	106	46–218	0.00	0.00–0.01
2006–07	38 149 420	6.1	22	0.010	149	78–276	0.00	0.00–0.01
2007–08	41 507 547	8.6	0	0.000	128	56–262	0.00	0.00–0.01
2008–09	37 426 952	10.8	1	0.000	126	56–249	0.00	0.00–0.01
2009–10	40 440 801	5.6	0	0.000	118	53–230	0.00	0.00–0.01
2010–11	40 904 091	4.2	2	0.001	133	56–275	0.00	0.00–0.01
2011–12	37 877 121	5.5	0	0.000	113	48–230	0.00	0.00–0.01
2012–13	32 525 173	1.2	0	0.000	88	33–190	0.00	0.00–0.01

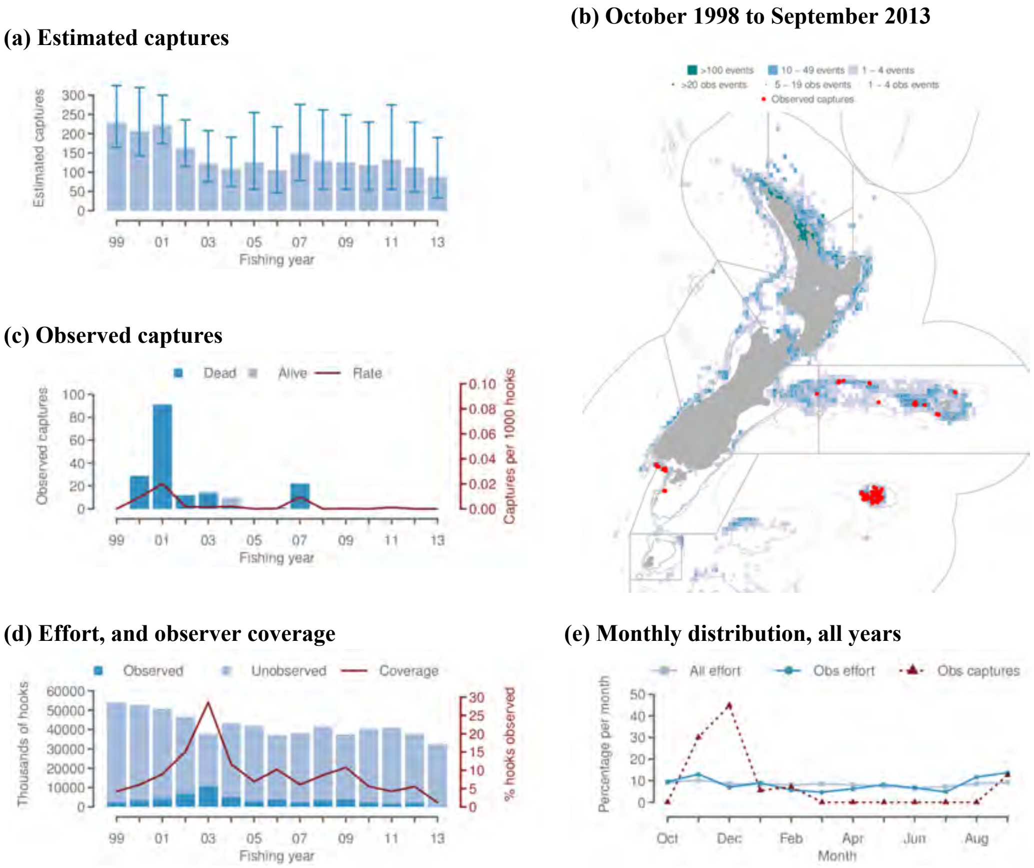


Figure B-17: Salvin's albatross captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.2.6 Salvin's albatross captures in large-vessel ling longline fisheries

Table B-12: Annual fishing effort and number of hooks observed in large-vessel ling longline fisheries, number of observed captures of Salvin's albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of Salvin's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	31 193 828	7.2	0	0.000	178	139–224	0.01	0.00–0.01
1999–00	29 495 559	10.8	29	0.009	151	117–200	0.01	0.00–0.01
2000–01	26 668 936	16.1	91	0.021	180	153–215	0.01	0.01–0.01
2001–02	25 824 647	27.2	12	0.002	126	96–162	0.00	0.00–0.01
2002–03	17 286 318	62.2	15	0.001	64	48–84	0.00	0.00–0.00
2003–04	22 345 397	21.0	10	0.002	46	32–62	0.00	0.00–0.00
2004–05	18 029 290	14.4	0	0.000	35	19–60	0.00	0.00–0.00
2005–06	13 598 832	26.4	1	0.000	22	11–37	0.00	0.00–0.00
2006–07	11 974 372	15.2	0	0.000	25	13–40	0.00	0.00–0.00
2007–08	12 653 906	23.7	0	0.000	23	11–36	0.00	0.00–0.00
2008–09	11 831 980	27.0	1	0.000	27	15–42	0.00	0.00–0.00
2009–10	12 219 034	14.1	0	0.000	29	16–45	0.00	0.00–0.00
2010–11	11 505 690	11.4	2	0.002	23	12–36	0.00	0.00–0.00
2011–12	10 526 805	15.9	0	0.000	22	11–35	0.00	0.00–0.00
2012–13	7 223 510	3.1	0	0.000	20	7–42	0.00	0.00–0.01

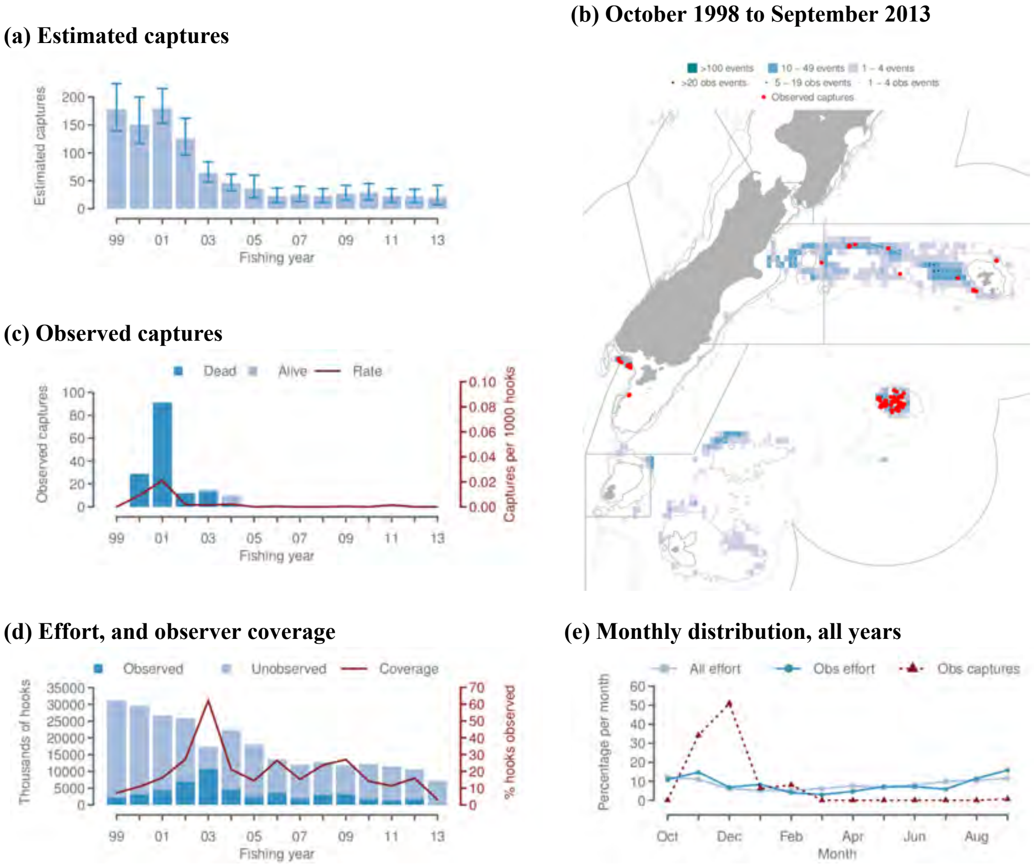


Figure B-18: Salvin's albatross captures in large-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (82.4% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

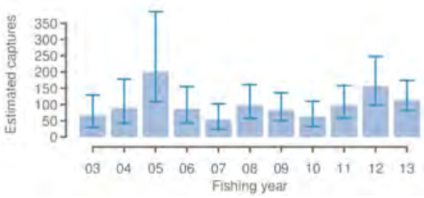
B.3 Southern Buller's albatross captures

B.3.1 Southern Buller's albatross captures in trawl fisheries

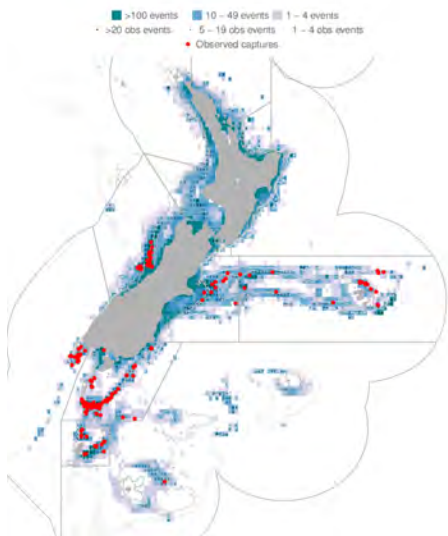
Table B-13: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of southern Buller's albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of southern Buller's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	6	0.09	67	29–129	0.05	0.02–0.10
2003–04	120 868	5.4	9	0.14	89	41–178	0.07	0.03–0.15
2004–05	120 438	6.4	24	0.31	200	108–386	0.17	0.09–0.32
2005–06	109 923	6.0	9	0.14	87	43–155	0.08	0.04–0.14
2006–07	103 306	7.7	5	0.06	53	23–102	0.05	0.02–0.10
2007–08	89 524	10.1	18	0.20	97	57–161	0.11	0.06–0.18
2008–09	87 548	11.2	18	0.18	83	50–136	0.09	0.06–0.16
2009–10	92 888	9.7	11	0.12	63	32–110	0.07	0.03–0.12
2010–11	86 090	8.6	20	0.27	98	58–158	0.11	0.07–0.18
2011–12	84 429	10.8	36	0.40	156	99–248	0.18	0.12–0.29
2012–13	83 722	14.8	57	0.46	112	80–174	0.13	0.10–0.21

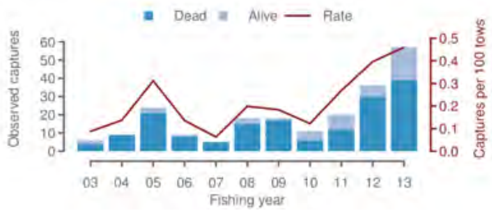
(a) Estimated captures



(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage

(e) Monthly distribution, all years

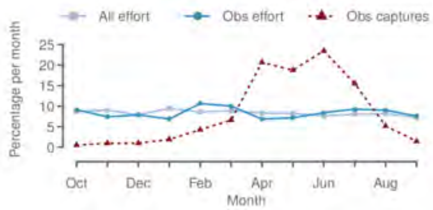


Figure B-19: Southern Buller's albatross captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.3.2 Southern Buller's albatross captures in bottom-longline fisheries

Table B-14: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of southern Buller's albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of southern Buller's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	1	0.000	66	25–127	0.00	0.00–0.00
1999–00	52 730 082	6.1	0	0.000	60	21–118	0.00	0.00–0.00
2000–01	50 713 196	8.9	0	0.000	61	21–120	0.00	0.00–0.00
2001–02	46 653 023	15.0	0	0.000	42	15–82	0.00	0.00–0.00
2002–03	37 761 838	28.5	1	0.000	52	18–105	0.00	0.00–0.00
2003–04	43 225 599	11.7	0	0.000	40	13–80	0.00	0.00–0.00
2004–05	41 844 688	6.9	0	0.000	83	28–165	0.00	0.00–0.00
2005–06	37 141 633	10.2	0	0.000	72	24–142	0.00	0.00–0.00
2006–07	38 149 420	6.1	0	0.000	119	41–240	0.00	0.00–0.01
2007–08	41 507 547	8.6	6	0.002	111	40–214	0.00	0.00–0.01
2008–09	37 426 952	10.8	0	0.000	84	28–166	0.00	0.00–0.00
2009–10	40 440 801	5.6	0	0.000	86	29–173	0.00	0.00–0.00
2010–11	40 904 091	4.2	0	0.000	77	26–153	0.00	0.00–0.00
2011–12	37 877 121	5.5	3	0.001	59	21–118	0.00	0.00–0.00
2012–13	32 525 173	1.2	0	0.000	49	16–101	0.00	0.00–0.00

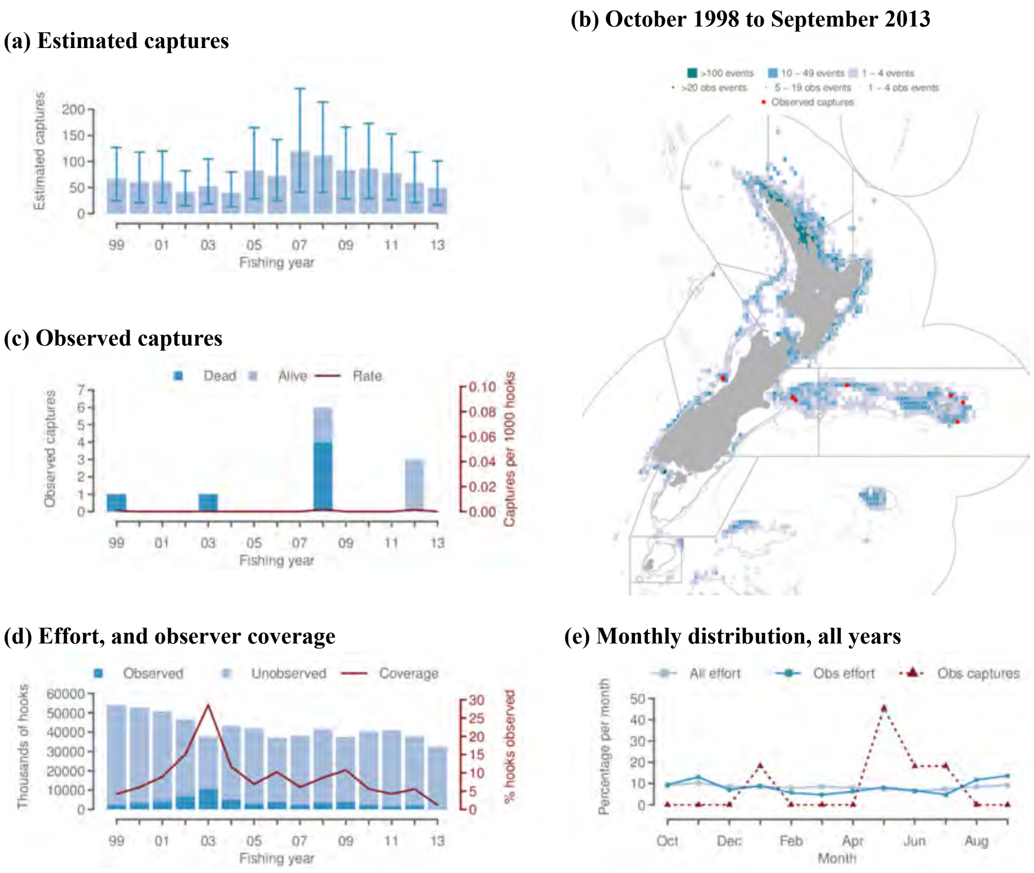


Figure B-20: Southern Buller's albatross captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.3.3 Southern Buller's albatross captures in surface-longline fisheries

Table B-15: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of southern Buller's albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of southern Buller's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	41	0.032	237	185–298	0.03	0.03–0.04
1999–00	8 271 067	10.4	16	0.019	239	179–306	0.03	0.02–0.04
2000–01	9 711 545	10.8	10	0.010	250	186–322	0.03	0.02–0.03
2001–02	10 841 737	9.1	61	0.062	316	249–395	0.03	0.02–0.04
2002–03	10 772 188	20.4	41	0.019	305	236–385	0.03	0.02–0.04
2003–04	7 386 329	21.8	39	0.024	211	163–265	0.03	0.02–0.04
2004–05	3 679 765	21.3	21	0.027	107	80–138	0.03	0.02–0.04
2005–06	3 690 119	19.1	14	0.020	109	81–143	0.03	0.02–0.04
2006–07	3 739 912	27.8	49	0.047	168	135–209	0.04	0.04–0.06
2007–08	2 246 189	18.8	21	0.050	108	80–143	0.05	0.04–0.06
2008–09	3 115 633	30.1	30	0.032	116	90–146	0.04	0.03–0.05
2009–10	2 995 264	22.2	69	0.104	169	139–204	0.06	0.05–0.07
2010–11	3 187 879	21.2	28	0.042	116	89–147	0.04	0.03–0.05
2011–12	3 100 277	23.5	31	0.043	118	91–149	0.04	0.03–0.05
2012–13	2 862 182	19.6	10	0.018	97	70–130	0.03	0.02–0.05

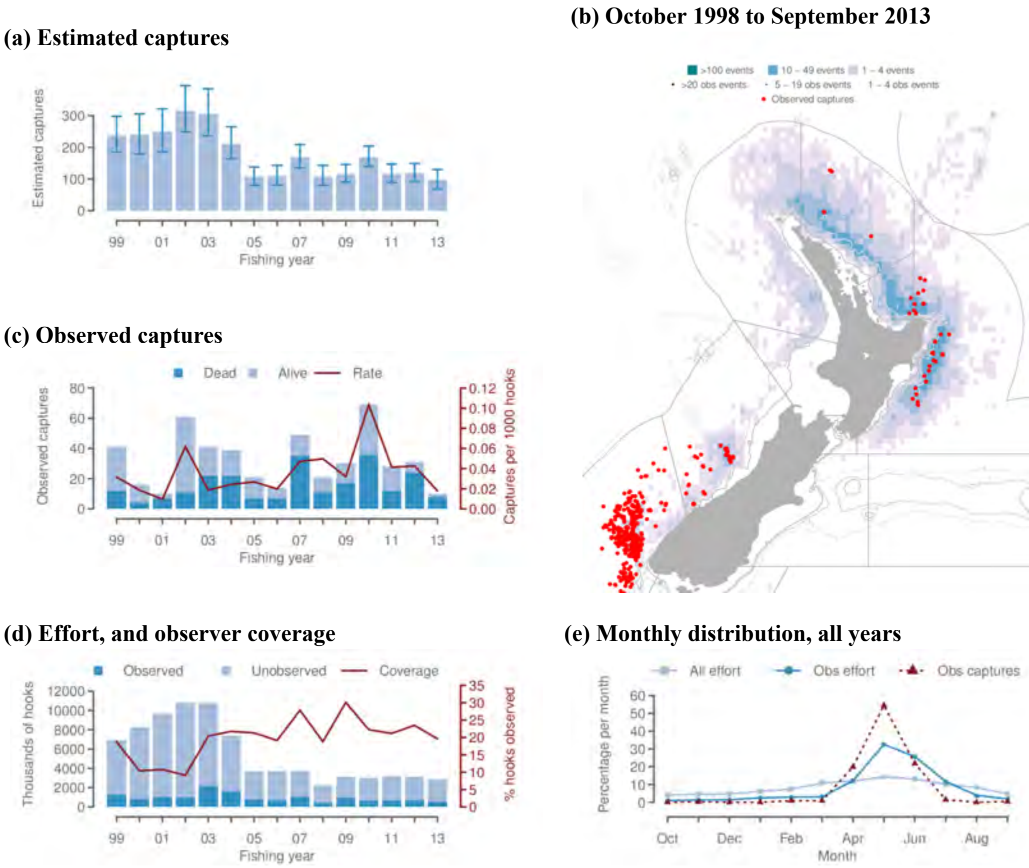


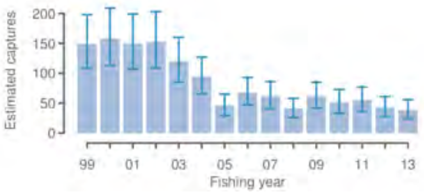
Figure B-21: Southern Buller's albatross captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.3.4 Southern Buller's albatross captures in small-vessel bigeye longline fisheries

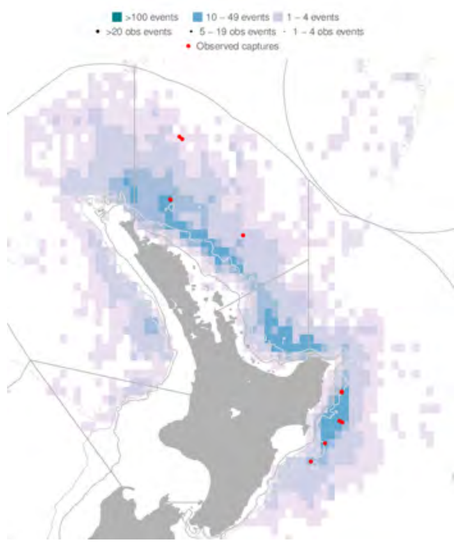
Table B-16: Annual fishing effort and number of hooks observed in small-vessel bigeye longline fisheries, number of observed captures of southern Buller's albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of southern Buller's albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	4 132 143	0.7	0	0.000	149	108–198	0.04	0.03–0.05
1999–00	5 682 409	0.6	0	0.000	158	113–209	0.03	0.02–0.04
2000–01	6 753 564	2.6	0	0.000	150	107–199	0.02	0.02–0.03
2001–02	6 798 527	1.3	2	0.022	152	109–203	0.02	0.02–0.03
2002–03	5 107 467	0.0	0	–	120	85–160	0.02	0.02–0.03
2003–04	3 411 185	2.0	0	0.000	94	65–127	0.03	0.02–0.04
2004–05	1 648 181	2.0	0	0.000	46	29–65	0.03	0.02–0.04
2005–06	1 831 766	1.9	2	0.058	68	47–93	0.04	0.03–0.05
2006–07	1 514 646	5.6	0	0.000	62	41–86	0.04	0.03–0.06
2007–08	967 829	2.5	2	0.082	41	26–58	0.04	0.03–0.06
2008–09	1 559 717	5.5	0	0.000	62	42–85	0.04	0.03–0.05
2009–10	1 247 437	6.4	0	0.000	51	33–73	0.04	0.03–0.06
2010–11	1 639 956	4.9	3	0.037	55	37–77	0.03	0.02–0.05
2011–12	1 285 123	2.5	0	0.000	43	28–61	0.03	0.02–0.05
2012–13	957 485	2.4	2	0.086	39	24–56	0.04	0.03–0.06

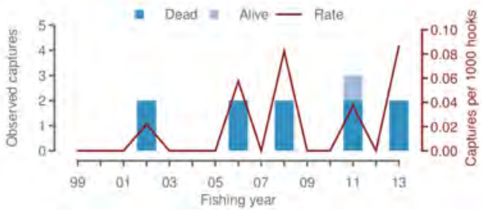
(a) Estimated captures



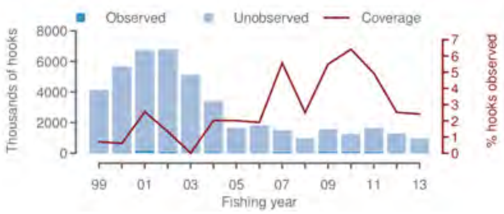
(b) October 1998 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

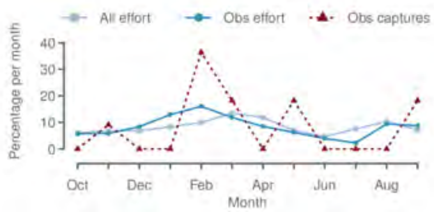


Figure B-22: Southern Buller's albatross captures in small-vessel bigeye longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (96.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.4 Other albatrosses captures

B.4.1 Other albatrosses captures in trawl fisheries

Table B-17: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of other albatross and observed capture rate (captures per hundred tows), estimated captures and capture rate of other albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[S]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	1	0.01	79	23–159	0.06	0.02–0.12
2003–04	120 868	5.4	5	0.08	101	44–197	0.08	0.04–0.16
2004–05	120 438	6.4	10	0.13	137	64–297	0.11	0.05–0.25
2005–06	109 923	6.0	8	0.12	116	53–232	0.11	0.05–0.21
2006–07	103 306	7.7	2	0.03	67	21–135	0.06	0.02–0.13
2007–08	89 524	10.1	5	0.06	70	30–125	0.08	0.03–0.14
2008–09	87 548	11.2	8	0.08	71	34–123	0.08	0.04–0.14
2009–10	92 888	9.7	11	0.12	83	41–148	0.09	0.04–0.16
2010–11	86 090	8.6	7	0.09	85	40–154	0.10	0.05–0.18
2011–12	84 429	10.8	12	0.13	99	50–190	0.12	0.06–0.23
2012–13	83 722	14.8	18	0.15	94	48–172	0.11	0.06–0.21

[S] All observed captures by species: albatrosses (30), Campbell black-browed albatross (14), southern royal albatross (12), Chatham Island albatross (10), smaller albatrosses (6), black-browed albatross (5), great albatrosses (4), wandering albatrosses (3), northern royal albatross (1), light-mantled sooty albatross (1), Gibson's albatross (1)

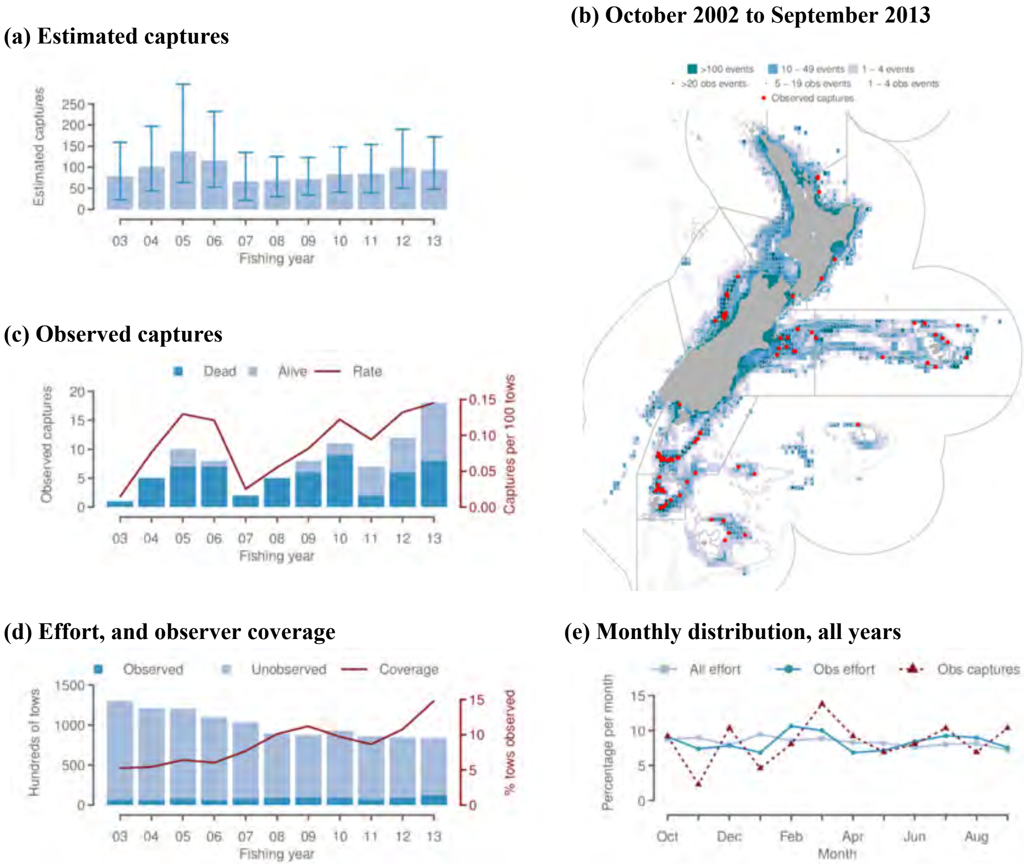


Figure B-23: Other albatross captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.4.2 Other albatrosses captures in bottom-longline fisheries

Table B-18: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of other albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	0	0.000	133	63–250	0.00	0.00–0.00
1999–00	52 730 082	6.1	16	0.005	149	77–270	0.00	0.00–0.01
2000–01	50 713 196	8.9	2	0.000	132	60–253	0.00	0.00–0.00
2001–02	46 653 023	15.0	9	0.001	123	61–228	0.00	0.00–0.00
2002–03	37 761 838	28.5	3	0.000	107	46–210	0.00	0.00–0.01
2003–04	43 225 599	11.7	0	0.000	94	40–183	0.00	0.00–0.00
2004–05	41 844 688	6.9	1	0.000	97	41–191	0.00	0.00–0.00
2005–06	37 141 633	10.2	5	0.001	88	40–170	0.00	0.00–0.00
2006–07	38 149 420	6.1	14	0.006	102	51–187	0.00	0.00–0.00
2007–08	41 507 547	8.6	4	0.001	89	40–173	0.00	0.00–0.00
2008–09	37 426 952	10.8	1	0.000	84	36–165	0.00	0.00–0.00
2009–10	40 440 801	5.6	0	0.000	82	35–163	0.00	0.00–0.00
2010–11	40 904 091	4.2	1	0.001	99	43–194	0.00	0.00–0.00
2011–12	37 877 121	5.5	3	0.001	87	39–172	0.00	0.00–0.00
2012–13	32 525 173	1.2	0	0.000	76	32–155	0.00	0.00–0.00

[s] All observed captures by species: Chatham Island albatross (23), albatrosses (17), wandering albatrosses (6), southern royal albatross (4), Campbell black-browed albatross (4), black-browed albatross (2), northern Buller's albatross (1), black-browed albatrosses (1), Indian Ocean yellow-nosed albatross (1)

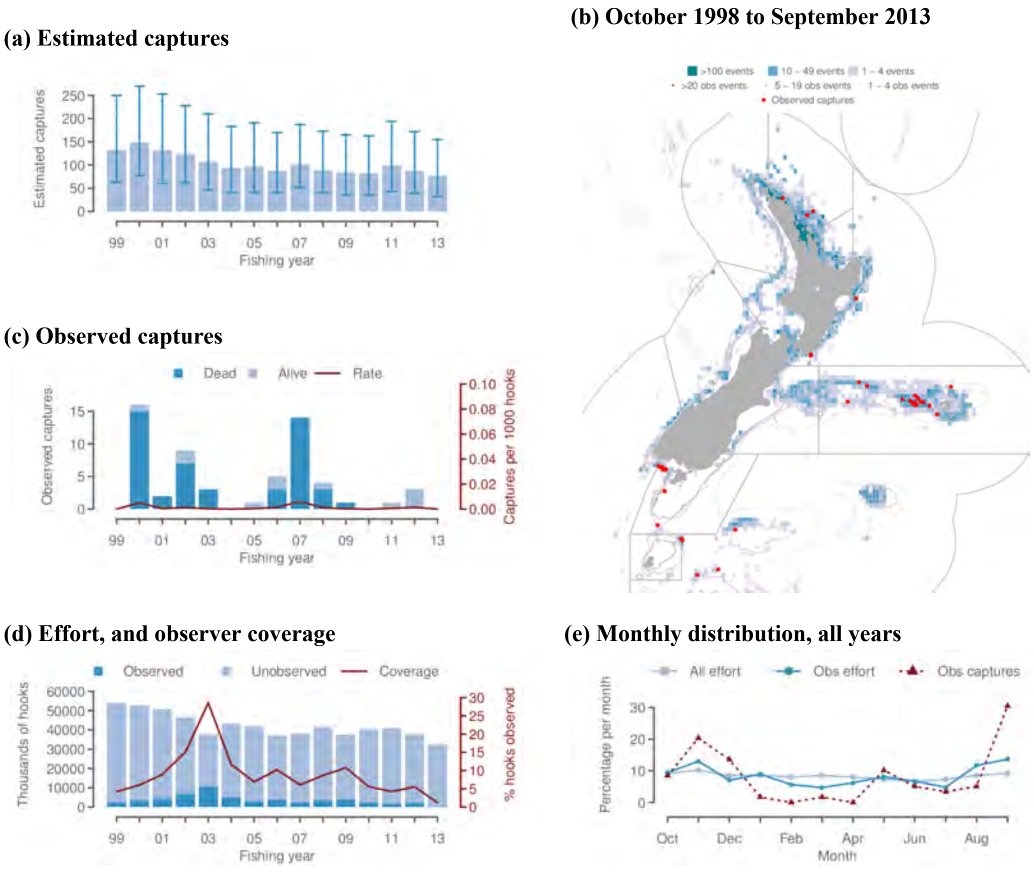


Figure B-24: Other albatross captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.4.3 Other albatrosses captures in surface-longline fisheries

Table B-19: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of other albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	11	0.008	186	101–341	0.03	0.01–0.05
1999–00	8 271 067	10.4	13	0.015	231	129–396	0.03	0.02–0.05
2000–01	9 711 545	10.8	1	0.001	244	132–434	0.03	0.01–0.04
2001–02	10 841 737	9.1	5	0.005	283	160–498	0.03	0.01–0.05
2002–03	10 772 188	20.4	32	0.015	294	178–494	0.03	0.02–0.05
2003–04	7 386 329	21.8	3	0.002	137	78–229	0.02	0.01–0.03
2004–05	3 679 765	21.3	8	0.010	96	56–157	0.03	0.02–0.04
2005–06	3 690 119	19.1	9	0.013	228	114–482	0.06	0.03–0.13
2006–07	3 739 912	27.8	75	0.072	309	181–640	0.08	0.05–0.17
2007–08	2 246 189	18.8	3	0.007	78	45–132	0.03	0.02–0.06
2008–09	3 115 633	30.1	8	0.009	79	47–128	0.03	0.02–0.04
2009–10	2 995 264	22.2	20	0.030	168	99–307	0.06	0.03–0.10
2010–11	3 187 879	21.2	4	0.006	129	66–251	0.04	0.02–0.08
2011–12	3 100 277	23.5	16	0.022	150	80–305	0.05	0.03–0.10
2012–13	2 862 182	19.6	4	0.007	184	84–406	0.06	0.03–0.14

[s] All observed captures by species: Campbell black-browed albatross (54), Antipodean albatross (41), Gibson's albatross (40), albatrosses (34), wandering albatrosses (9), southern royal albatross (8), Antipodean and Gibson's albatrosses (7), black-browed albatross (6), wandering albatross (4), black-browed albatrosses (4), light-mantled sooty albatross (2), smaller albatrosses (1), northern royal albatross (1), northern Buller's albatross (1)

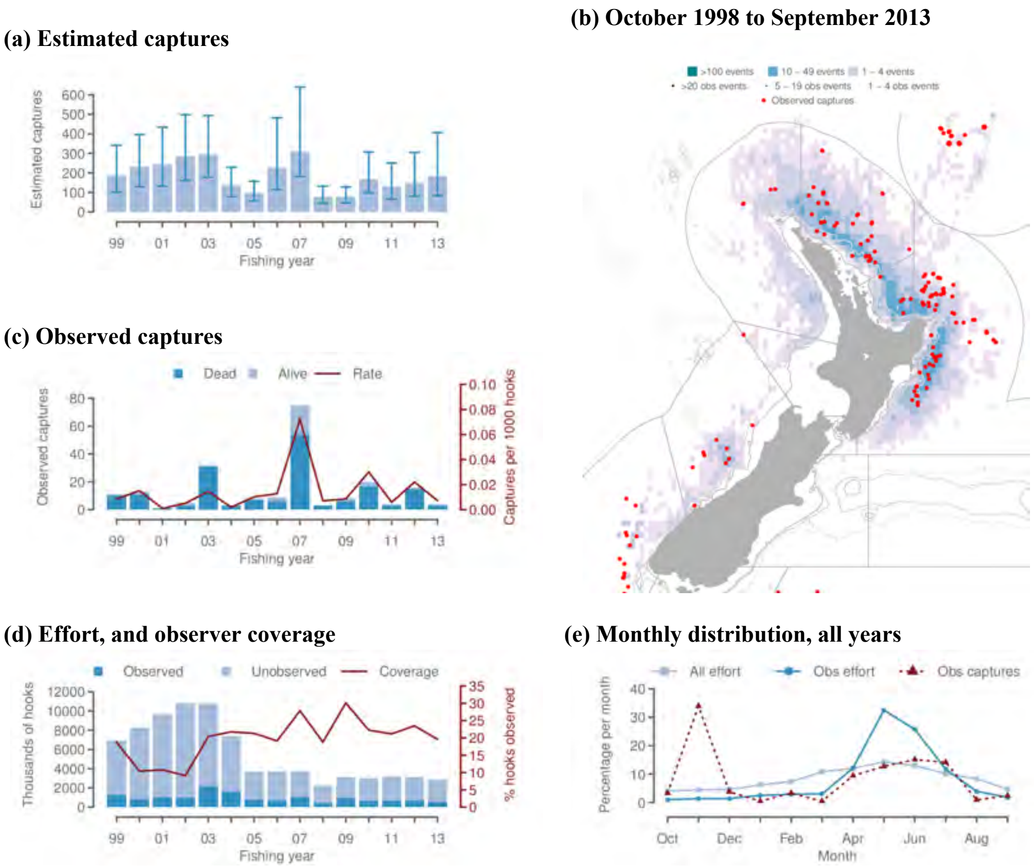


Figure B-25: Other albatross captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.4.4 Other albatrosses captures in small-vessel bigeye longline fisheries

Table B-20: Annual fishing effort and number of hooks observed in small-vessel bigeye longline fisheries, number of observed captures of other albatross and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other albatross (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	4 132 143	0.7	0	0.000	109	52–206	0.03	0.01–0.05
1999–00	5 682 409	0.6	2	0.058	155	76–290	0.03	0.01–0.05
2000–01	6 753 564	2.6	0	0.000	157	78–286	0.02	0.01–0.04
2001–02	6 798 527	1.3	3	0.033	180	88–337	0.03	0.01–0.05
2002–03	5 107 467	0.0	0	–	134	63–261	0.03	0.01–0.05
2003–04	3 411 185	2.0	0	0.000	69	32–130	0.02	0.01–0.04
2004–05	1 648 181	2.0	0	0.000	31	12–60	0.02	0.01–0.04
2005–06	1 831 766	1.9	0	0.000	47	21–89	0.03	0.01–0.05
2006–07	1 514 646	5.6	2	0.024	46	21–90	0.03	0.01–0.06
2007–08	967 829	2.5	1	0.041	31	14–55	0.03	0.01–0.06
2008–09	1 559 717	5.5	4	0.047	38	19–66	0.02	0.01–0.04
2009–10	1 247 437	6.4	12	0.150	49	28–81	0.04	0.02–0.06
2010–11	1 639 956	4.9	3	0.037	43	20–84	0.03	0.01–0.05
2011–12	1 285 123	2.5	6	0.185	48	23–88	0.04	0.02–0.07
2012–13	957 485	2.4	1	0.043	31	13–61	0.03	0.01–0.06

[s] All observed captures by species: Antipodean albatross (11), Gibson's albatross (8), wandering albatross (3), Campbell black-browed albatross (3), wandering albatrosses (2), Antipodean and Gibson's albatrosses (2), southern royal albatross (1), northern royal albatross (1), black-browed albatrosses (1), black-browed albatross (1), albatrosses (1)

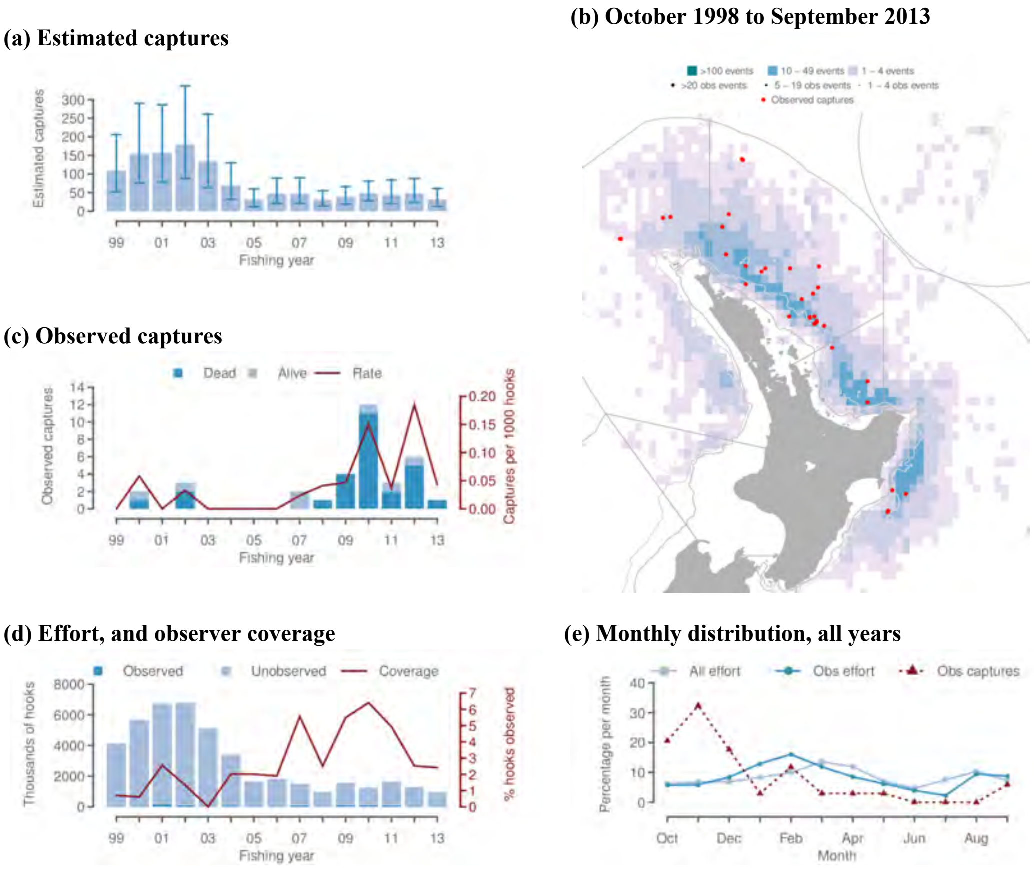


Figure B-26: Other albatross captures in small-vessel bigeye longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (96.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

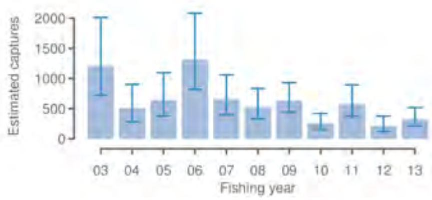
B.5 Sooty shearwater captures

B.5.1 Sooty shearwater captures in trawl fisheries

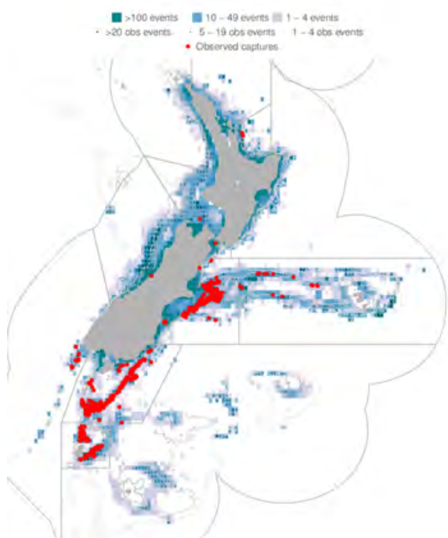
Table B-21: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per hundred tows), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	120	1.75	1 205	726–2 013	0.93	0.56–1.55
2003–04	120 868	5.4	54	0.82	508	283–904	0.42	0.23–0.75
2004–05	120 438	6.4	74	0.96	642	378–1 097	0.53	0.31–0.91
2005–06	109 923	6.0	169	2.55	1 315	819–2 085	1.20	0.75–1.90
2006–07	103 306	7.7	84	1.06	659	399–1 062	0.64	0.39–1.03
2007–08	89 524	10.1	82	0.91	523	330–835	0.58	0.37–0.93
2008–09	87 548	11.2	152	1.55	631	435–931	0.72	0.50–1.06
2009–10	92 888	9.7	43	0.48	260	156–420	0.28	0.17–0.45
2010–11	86 090	8.6	109	1.46	573	373–895	0.67	0.43–1.04
2011–12	84 429	10.8	31	0.34	214	121–376	0.25	0.14–0.45
2012–13	83 722	14.8	110	0.89	321	212–518	0.38	0.25–0.62

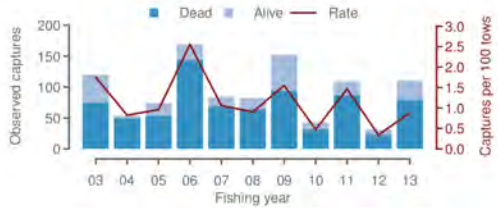
(a) Estimated captures



(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage

(e) Monthly distribution, all years

Figure B-27: Sooty shearwater captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.5.2 Sooty shearwater captures in squid trawl fisheries

Table B-22: Annual fishing effort and number of tows observed in squid trawl fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per hundred tows), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 410	15.6	77	5.89	398	245–662	4.73	2.91–7.87
2003–04	8 336	21.2	31	1.75	183	105–306	2.20	1.26–3.67
2004–05	10 486	23.9	70	2.79	340	216–549	3.24	2.06–5.24
2005–06	8 575	12.9	82	7.43	543	334–884	6.33	3.90–10.31
2006–07	5 906	21.8	52	4.03	264	159–435	4.47	2.69–7.37
2007–08	4 236	34.4	72	4.94	240	151–388	5.67	3.56–9.16
2008–09	3 867	33.6	96	7.40	230	159–354	5.95	4.11–9.15
2009–10	3 789	28.2	8	0.75	80	39–146	2.11	1.03–3.85
2010–11	4 214	29.9	52	4.12	204	129–317	4.84	3.06–7.52
2011–12	3 505	39.4	7	0.51	67	31–130	1.91	0.88–3.71
2012–13	2 646	85.9	68	2.99	85	71–119	3.21	2.68–4.50

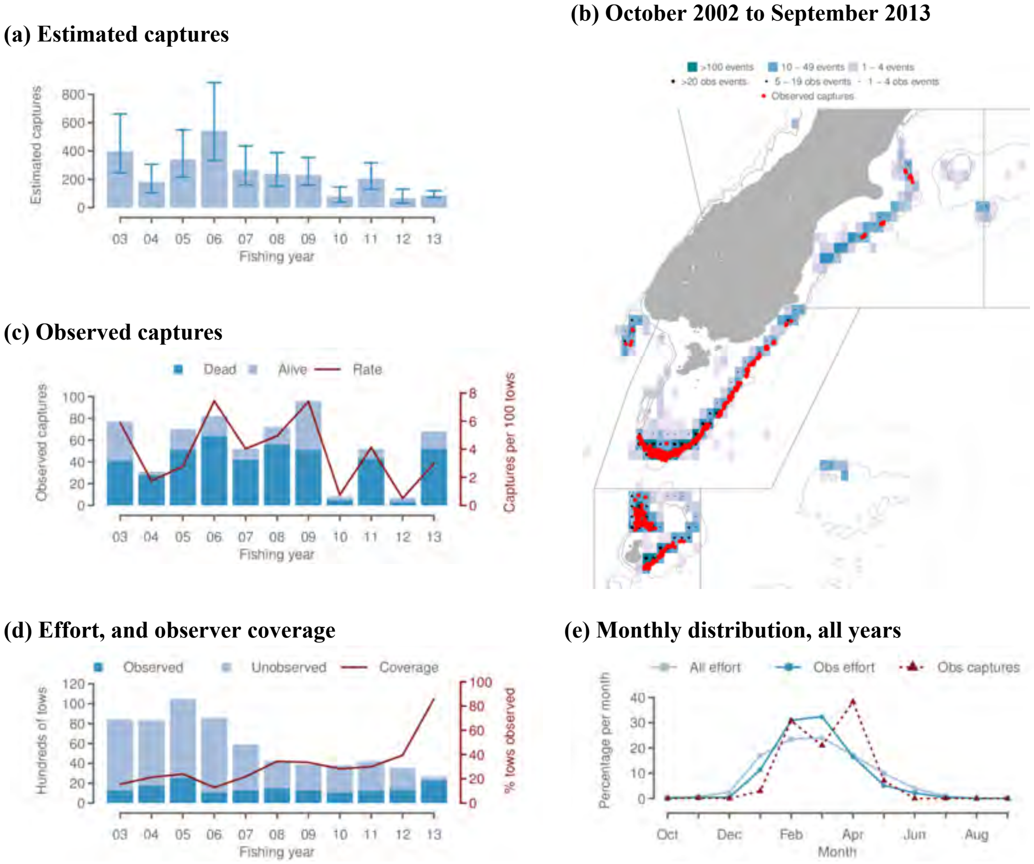


Figure B-28: Sooty shearwater captures in squid trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (99.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.5.3 Sooty shearwater captures in middle-depth trawl fisheries

Table B-23: Annual fishing effort and number of tows observed in middle-depth trawl fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per hundred tows), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	11 178	3.1	9	2.58	228	84–560	2.04	0.75–5.01
2003–04	9 165	2.1	7	3.63	132	44–331	1.44	0.48–3.61
2004–05	9 188	2.4	1	0.45	118	35–329	1.28	0.38–3.58
2005–06	8 402	5.8	53	10.86	277	126–640	3.30	1.50–7.62
2006–07	8 197	4.8	3	0.76	158	57–403	1.93	0.70–4.92
2007–08	7 416	6.1	0	0.00	123	46–295	1.66	0.62–3.98
2008–09	7 235	10.1	22	3.00	159	70–359	2.20	0.97–4.96
2009–10	7 217	12.3	7	0.79	62	24–147	0.86	0.33–2.04
2010–11	7 252	8.5	12	1.95	141	52–351	1.94	0.72–4.84
2011–12	6 554	11.7	17	2.22	63	29–147	0.96	0.44–2.24
2012–13	6 451	19.2	12	0.97	95	32–246	1.47	0.50–3.81

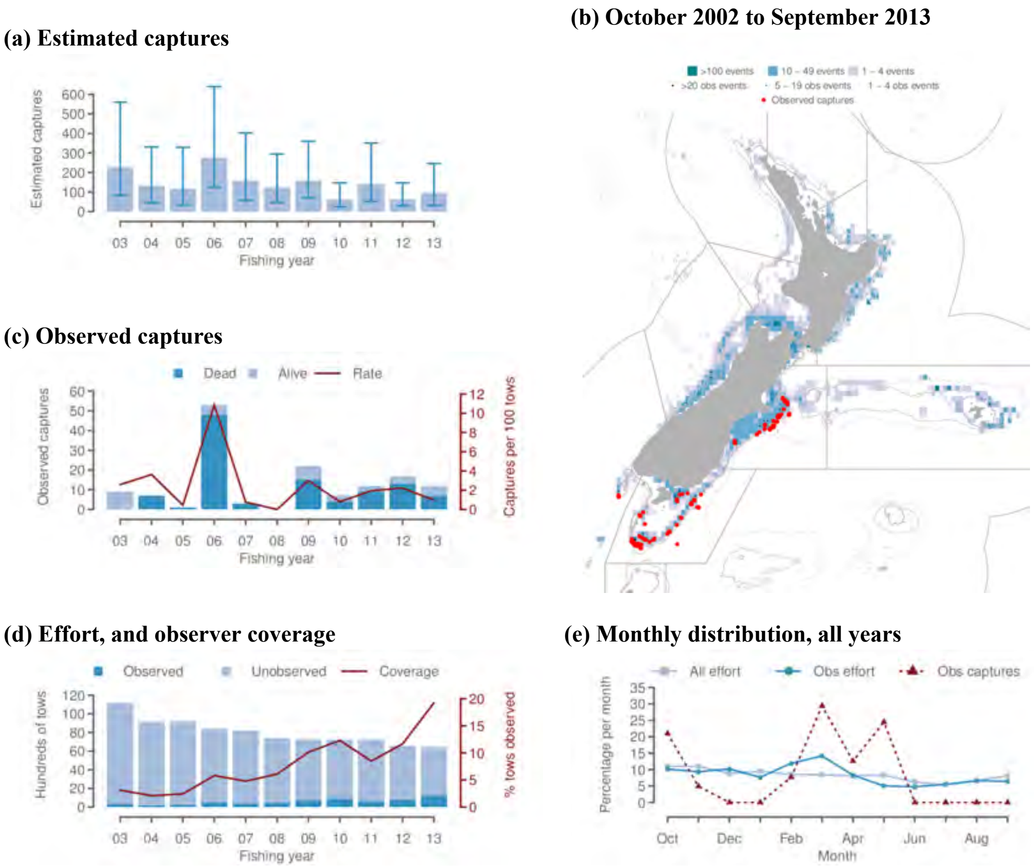


Figure B-29: Sooty shearwater captures in middle-depth trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.5.4 Sooty shearwater captures in hoki trawl fisheries

Table B-24: Annual fishing effort and number of tows observed in hoki trawl fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per hundred tows), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	27 786	9.3	30	1.16	291	155–529	1.05	0.56–1.90
2003–04	22 523	10.4	15	0.64	73	40–130	0.32	0.18–0.58
2004–05	14 545	14.7	2	0.09	48	22–90	0.33	0.15–0.62
2005–06	11 590	15.3	34	1.92	198	99–419	1.71	0.85–3.62
2006–07	10 602	16.6	9	0.51	74	38–133	0.70	0.36–1.25
2007–08	8 788	21.4	4	0.21	40	19–76	0.46	0.22–0.86
2008–09	8 174	20.3	17	1.02	68	40–116	0.83	0.49–1.42
2009–10	9 965	20.7	21	1.02	53	35–81	0.53	0.35–0.81
2010–11	10 404	16.6	21	1.22	93	51–174	0.89	0.49–1.67
2011–12	11 333	22.8	4	0.16	36	16–75	0.32	0.14–0.66
2012–13	11 682	38.6	18	0.40	59	34–107	0.51	0.29–0.92

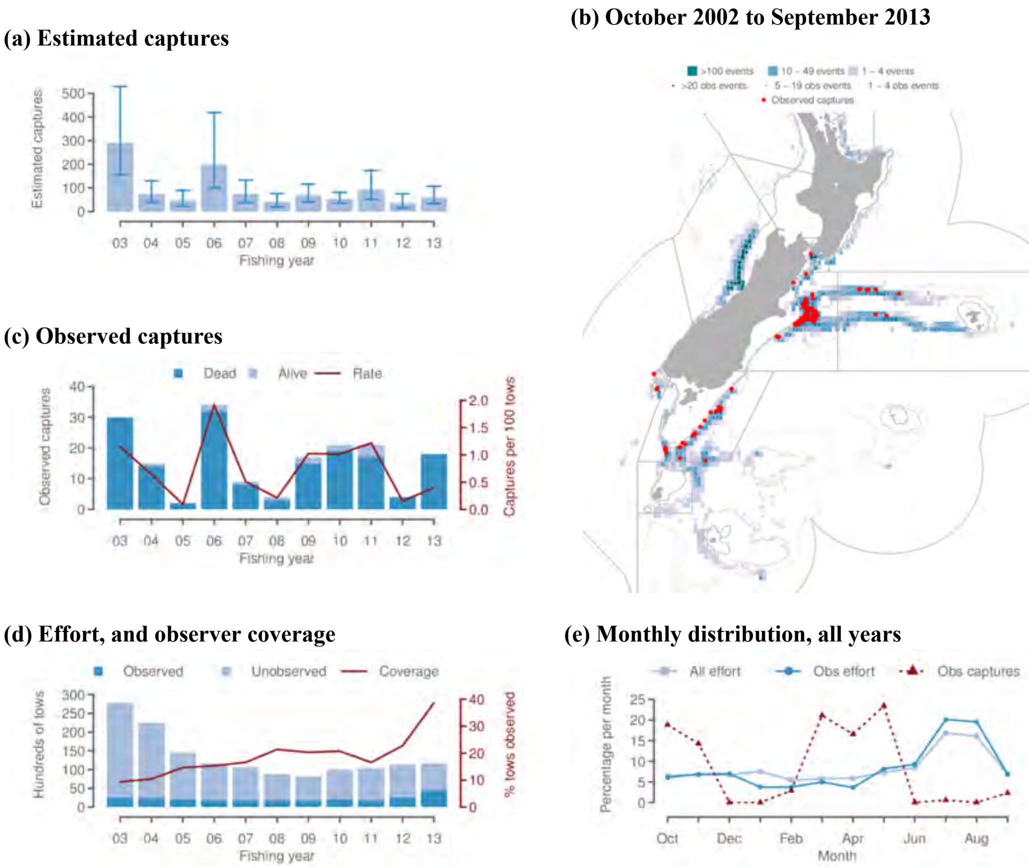


Figure B-30: Sooty shearwater captures in hoki trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (98.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.5.5 Sooty shearwater captures in inshore trawl fisheries

Table B-25: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per hundred tows), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	157	36–418	0.43	0.10–1.14
2003–04	37 429	0.0	0	0.00	73	15–196	0.20	0.04–0.52
2004–05	40 829	0.0	0	0.00	80	16–223	0.20	0.04–0.55
2005–06	39 150	0.3	0	0.00	164	42–403	0.42	0.11–1.03
2006–07	35 831	0.8	0	0.00	80	20–197	0.22	0.06–0.55
2007–08	31 418	0.4	0	0.00	58	14–139	0.18	0.04–0.44
2008–09	33 102	3.5	5	0.44	82	28–180	0.25	0.08–0.54
2009–10	35 971	1.4	0	0.00	35	8–90	0.10	0.02–0.25
2010–11	34 986	1.3	0	0.00	69	18–165	0.20	0.05–0.47
2011–12	32 772	0.4	0	0.00	28	6–73	0.09	0.02–0.22
2012–13	33 263	0.5	0	0.00	42	11–102	0.13	0.03–0.31

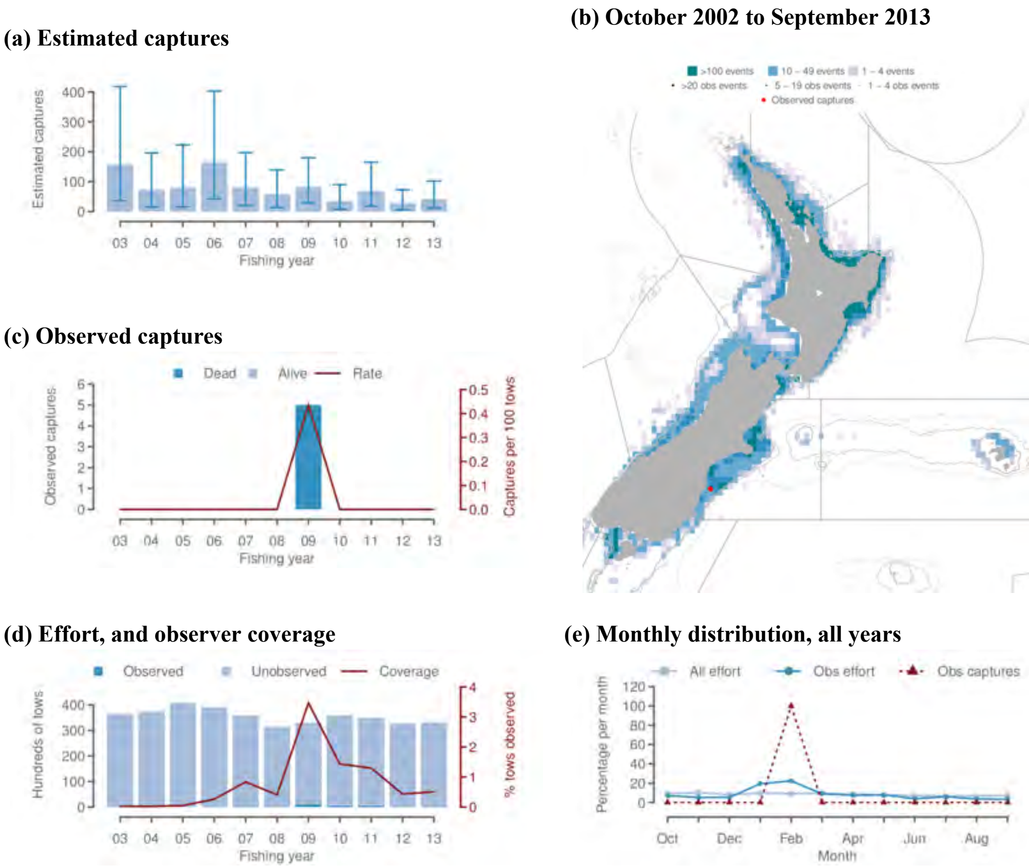


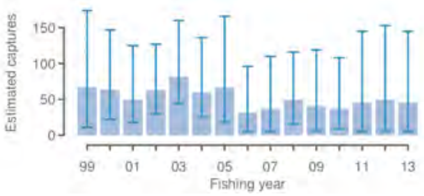
Figure B-31: Sooty shearwater captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.5.6 Sooty shearwater captures in bottom-longline fisheries

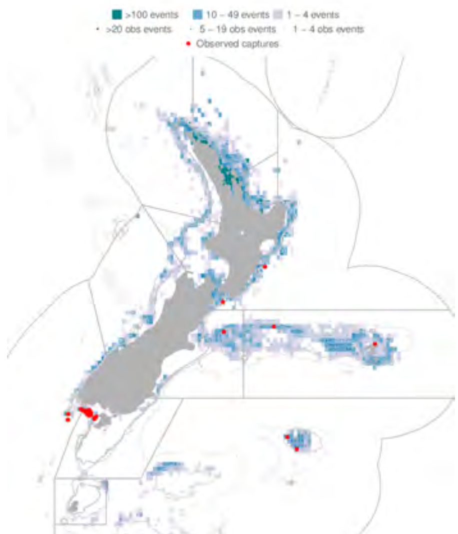
Table B-26: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of sooty shearwater and observed capture rate (captures per thousand hooks), estimated captures and capture rate of sooty shearwater (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	0	0.000	67	11–174	0.00	0.00–0.00
1999–00	52 730 082	6.1	7	0.002	63	22–147	0.00	0.00–0.00
2000–01	50 713 196	8.9	11	0.002	49	18–125	0.00	0.00–0.00
2001–02	46 653 023	15.0	16	0.002	63	29–127	0.00	0.00–0.00
2002–03	37 761 838	28.5	32	0.003	82	45–160	0.00	0.00–0.00
2003–04	43 225 599	11.7	17	0.003	59	25–136	0.00	0.00–0.00
2004–05	41 844 688	6.9	3	0.001	66	18–166	0.00	0.00–0.00
2005–06	37 141 633	10.2	3	0.001	31	5–96	0.00	0.00–0.00
2006–07	38 149 420	6.1	1	0.000	37	5–110	0.00	0.00–0.00
2007–08	41 507 547	8.6	6	0.002	49	16–116	0.00	0.00–0.00
2008–09	37 426 952	10.8	0	0.000	41	6–119	0.00	0.00–0.00
2009–10	40 440 801	5.6	7	0.003	37	9–108	0.00	0.00–0.00
2010–11	40 904 091	4.2	0	0.000	45	5–145	0.00	0.00–0.00
2011–12	37 877 121	5.5	0	0.000	50	6–153	0.00	0.00–0.00
2012–13	32 525 173	1.2	0	0.000	46	5–145	0.00	0.00–0.00

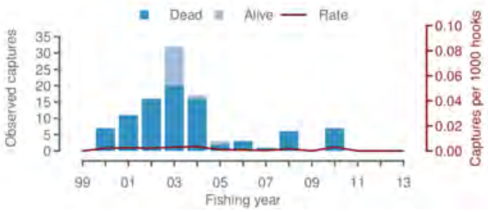
(a) Estimated captures



(b) October 1998 to September 2013



(c) Observed captures



(d) Effort, and observer coverage

(e) Monthly distribution, all years

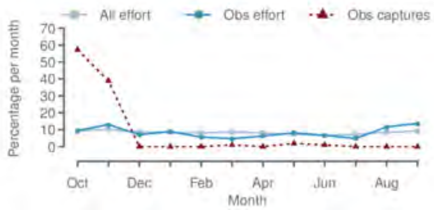


Figure B-32: Sooty shearwater captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6 White-chinned petrel captures

B.6.1 White-chinned petrel captures in trawl fisheries

Table B-27: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	13	0.19	129	69–218	0.10	0.05–0.17
2003–04	120 868	5.4	18	0.27	97	57–153	0.08	0.05–0.13
2004–05	120 438	6.4	55	0.71	221	153–319	0.18	0.13–0.26
2005–06	109 923	6.0	70	1.06	359	239–529	0.33	0.22–0.48
2006–07	103 306	7.7	29	0.37	140	84–220	0.14	0.08–0.21
2007–08	89 524	10.1	59	0.65	252	174–363	0.28	0.19–0.41
2008–09	87 548	11.2	104	1.06	305	227–411	0.35	0.26–0.47
2009–10	92 888	9.7	74	0.82	288	198–415	0.31	0.21–0.45
2010–11	86 090	8.6	130	1.75	454	324–643	0.53	0.38–0.75
2011–12	84 429	10.8	58	0.64	222	152–324	0.26	0.18–0.38
2012–13	83 722	14.8	276	2.23	372	328–437	0.44	0.39–0.52

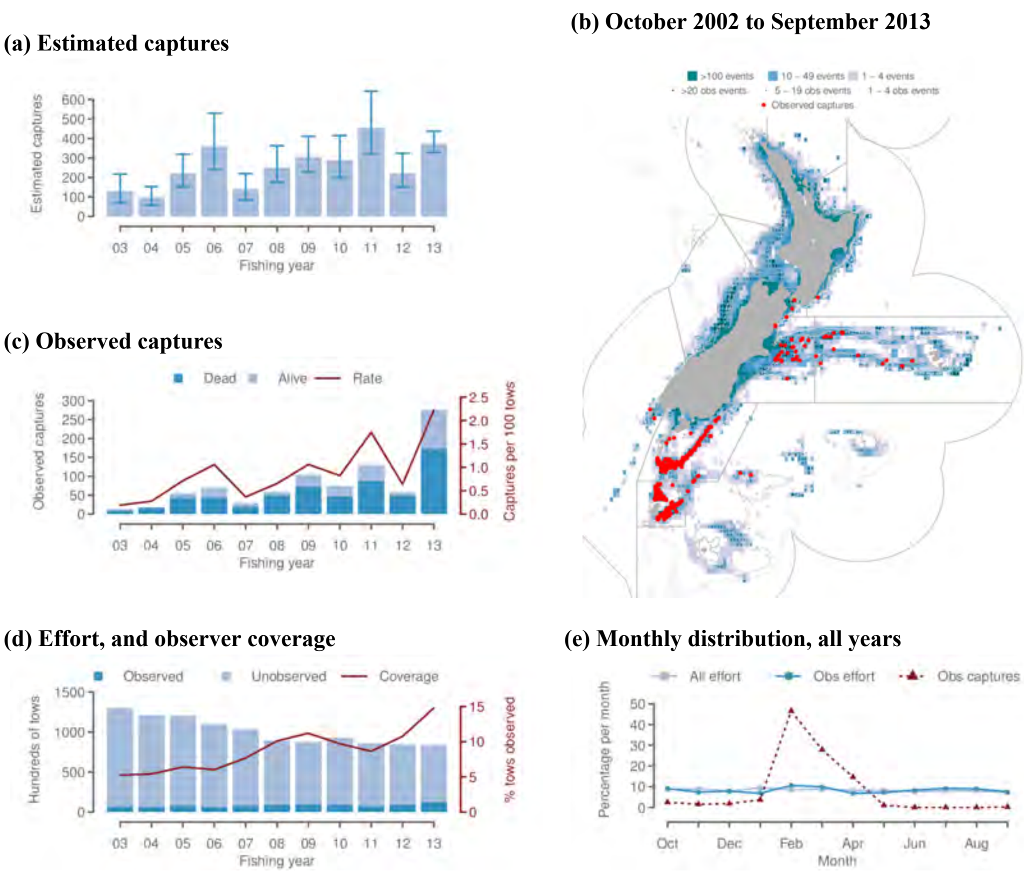


Figure B-33: White-chinned petrel captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.2 White-chinned petrel captures in squid trawl fisheries

Table B-28: Annual fishing effort and number of tows observed in squid trawl fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per hundred tows), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 410	15.6	7	0.54	72	36–127	0.86	0.43–1.51
2003–04	8 336	21.2	17	0.96	68	40–107	0.82	0.48–1.28
2004–05	10 486	23.9	51	2.03	166	117–237	1.58	1.12–2.26
2005–06	8 575	12.9	62	5.62	297	196–447	3.46	2.29–5.21
2006–07	5 906	21.8	25	1.94	97	58–153	1.64	0.98–2.59
2007–08	4 236	34.4	43	2.95	156	101–238	3.68	2.38–5.62
2008–09	3 867	33.6	93	7.16	203	153–277	5.25	3.96–7.16
2009–10	3 789	28.2	52	4.86	182	119–280	4.80	3.14–7.39
2010–11	4 214	29.9	36	2.85	227	134–371	5.39	3.18–8.80
2011–12	3 505	39.4	45	3.26	123	84–186	3.51	2.40–5.31
2012–13	2 646	85.9	221	9.72	240	225–275	9.07	8.50–10.39

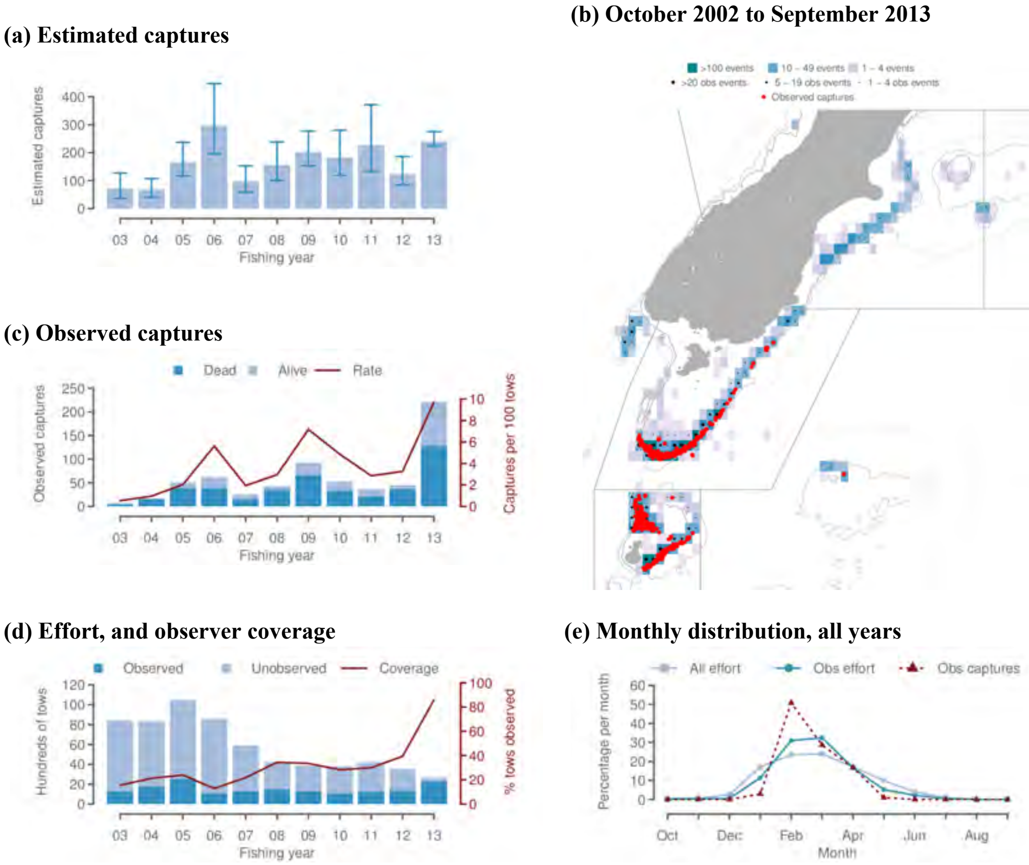


Figure B-34: White-chinned petrel captures in squid trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (99.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.3 White-chinned petrel captures in bottom-longline fisheries

Table B-29: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	5	0.002	358	158–845	0.01	0.00–0.02
1999–00	52 730 082	6.1	59	0.018	354	228–521	0.01	0.00–0.01
2000–01	50 713 196	8.9	211	0.047	989	648–1 606	0.02	0.01–0.03
2001–02	46 653 023	15.0	366	0.052	1 571	904–3 008	0.03	0.02–0.06
2002–03	37 761 838	28.5	132	0.012	494	338–708	0.01	0.01–0.02
2003–04	43 225 599	11.7	15	0.003	228	125–374	0.01	0.00–0.01
2004–05	41 844 688	6.9	11	0.004	272	139–472	0.01	0.00–0.01
2005–06	37 141 633	10.2	13	0.003	238	127–391	0.01	0.00–0.01
2006–07	38 149 420	6.1	12	0.005	461	203–1 056	0.01	0.01–0.03
2007–08	41 507 547	8.6	10	0.003	387	197–714	0.01	0.00–0.02
2008–09	37 426 952	10.8	1	0.000	304	146–532	0.01	0.00–0.01
2009–10	40 440 801	5.6	1	0.000	235	117–396	0.01	0.00–0.01
2010–11	40 904 091	4.2	24	0.014	422	243–666	0.01	0.01–0.02
2011–12	37 877 121	5.5	1	0.000	227	108–388	0.01	0.00–0.01
2012–13	32 525 173	1.2	0	0.000	190	88–347	0.01	0.00–0.01

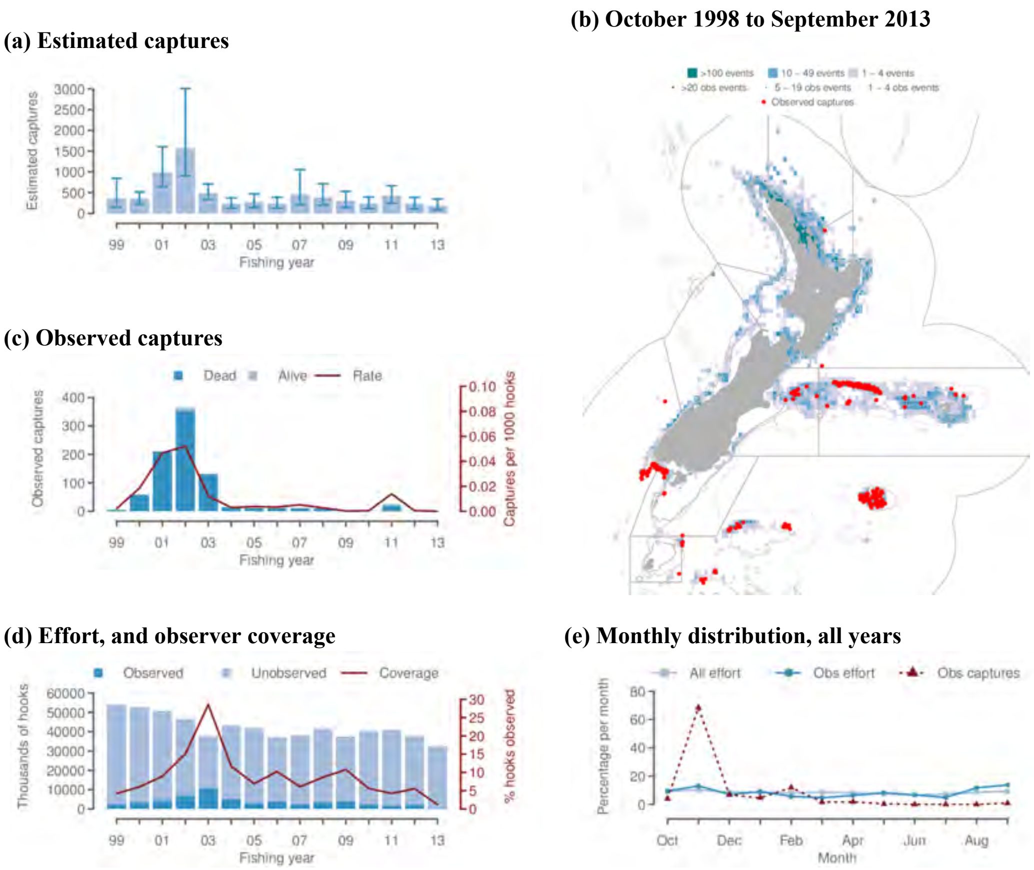


Figure B-35: White-chinned petrel captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.4 White-chinned petrel captures in large-vessel ling longline fisheries

Table B-30: Annual fishing effort and number of hooks observed in large-vessel ling longline fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	31 193 828	7.2	5	0.002	216	53–702	0.01	0.00–0.02
1999–00	29 495 559	10.8	59	0.018	201	134–316	0.01	0.00–0.01
2000–01	26 668 936	16.1	211	0.049	864	537–1 476	0.03	0.02–0.06
2001–02	25 824 647	27.2	366	0.052	1 470	806–2 896	0.06	0.03–0.11
2002–03	17 286 318	62.2	132	0.012	312	211–500	0.02	0.01–0.03
2003–04	22 345 397	21.0	15	0.003	53	26–108	0.00	0.00–0.00
2004–05	18 029 290	14.4	11	0.004	83	31–221	0.00	0.00–0.01
2005–06	13 598 832	26.4	13	0.004	54	25–120	0.00	0.00–0.01
2006–07	11 974 372	15.2	11	0.006	226	39–810	0.02	0.00–0.07
2007–08	12 653 906	23.7	6	0.002	137	34–402	0.01	0.00–0.03
2008–09	11 831 980	27.0	1	0.000	76	9–244	0.01	0.00–0.02
2009–10	12 219 034	14.1	1	0.001	20	2–76	0.00	0.00–0.01
2010–11	11 505 690	11.4	24	0.018	155	74–316	0.01	0.01–0.03
2011–12	10 526 805	15.9	1	0.001	30	3–108	0.00	0.00–0.01
2012–13	7 223 510	3.1	0	0.000	32	3–144	0.00	0.00–0.02

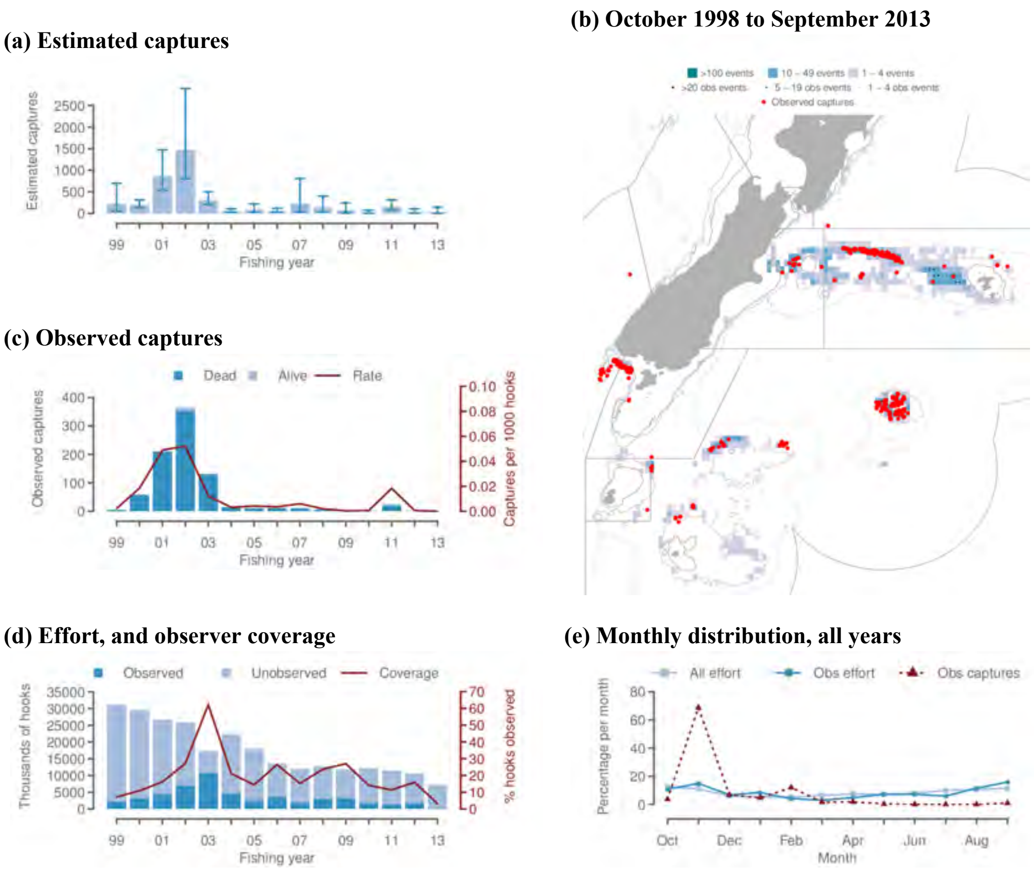


Figure B-36: White-chinned petrel captures in large-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (82.4% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.5 White-chinned petrel captures in small-vessel bluenose longline fisheries

Table B-31: Annual fishing effort and number of hooks observed in small-vessel bluenose longline fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 657 142	0.0	0	–	91	39–161	0.05	0.02–0.10
1999–00	1 954 125	0.0	0	–	94	40–165	0.05	0.02–0.08
2000–01	1 958 289	0.0	0	–	79	34–144	0.04	0.02–0.07
2001–02	1 556 950	0.0	0	–	65	27–120	0.04	0.02–0.08
2002–03	1 718 544	0.0	0	0.000	101	45–180	0.06	0.03–0.10
2003–04	2 754 744	0.0	0	–	117	51–211	0.04	0.02–0.08
2004–05	4 643 687	0.2	0	0.000	114	52–204	0.02	0.01–0.04
2005–06	5 110 600	0.0	0	–	125	55–221	0.02	0.01–0.04
2006–07	6 765 477	1.0	1	0.015	160	73–284	0.02	0.01–0.04
2007–08	8 282 062	1.9	0	0.000	148	65–259	0.02	0.01–0.03
2008–09	6 168 080	0.1	0	0.000	138	61–244	0.02	0.01–0.04
2009–10	5 846 729	0.4	0	0.000	126	56–222	0.02	0.01–0.04
2010–11	4 911 570	0.9	0	0.000	129	55–228	0.03	0.01–0.05
2011–12	3 666 731	0.0	0	0.000	90	39–161	0.02	0.01–0.04
2012–13	2 184 138	0.0	0	–	69	30–126	0.03	0.01–0.06

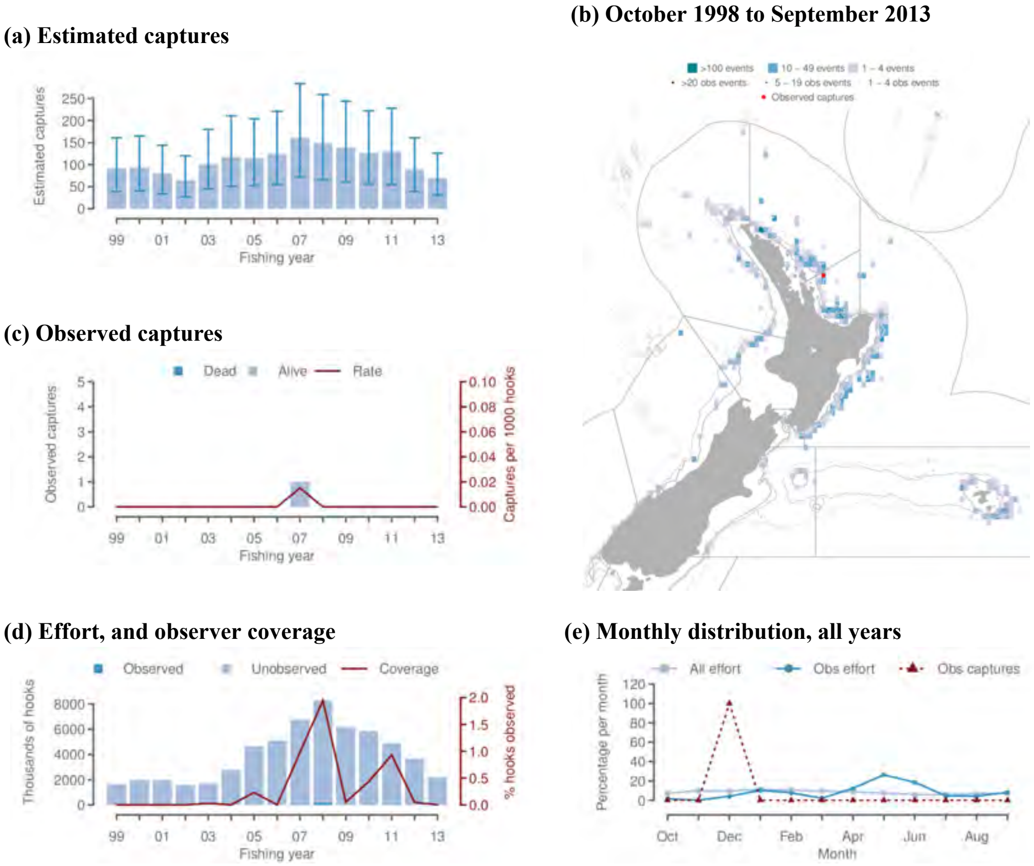


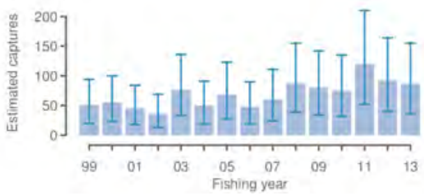
Figure B-37: White-chinned petrel captures in small-vessel bluenose longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.6 White-chinned petrel captures in small-vessel ling longline fisheries

Table B-32: Annual fishing effort and number of hooks observed in small-vessel ling longline fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

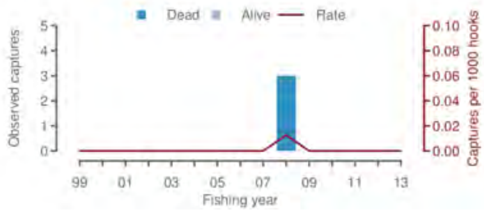
		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	3 127 560	0.0	0	–	51	20–94	0.02	0.01–0.03
1999–00	2 660 610	0.0	0	–	55	23–100	0.02	0.01–0.04
2000–01	2 231 568	0.0	0	–	46	18–84	0.02	0.01–0.04
2001–02	1 873 462	0.0	0	–	36	13–69	0.02	0.01–0.04
2002–03	2 481 081	0.2	0	0.000	76	33–136	0.03	0.01–0.05
2003–04	2 200 322	1.5	0	0.000	50	19–91	0.02	0.01–0.04
2004–05	3 538 481	0.6	0	0.000	68	28–123	0.02	0.01–0.03
2005–06	2 640 569	0.0	0	–	48	19–90	0.02	0.01–0.03
2006–07	4 881 424	7.1	0	0.000	60	24–111	0.01	0.00–0.02
2007–08	6 353 499	3.7	3	0.013	87	39–155	0.01	0.01–0.02
2008–09	5 755 734	8.9	0	0.000	80	34–142	0.01	0.01–0.02
2009–10	6 176 059	0.0	0	–	75	32–135	0.01	0.01–0.02
2010–11	6 797 522	2.1	0	0.000	120	52–210	0.02	0.01–0.03
2011–12	6 486 288	0.4	0	0.000	92	40–164	0.01	0.01–0.03
2012–13	5 745 174	0.0	0	–	87	37–155	0.02	0.01–0.03

(a) Estimated captures

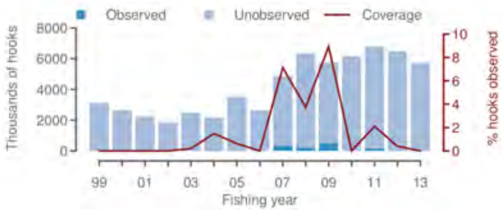


(b) October 1998 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

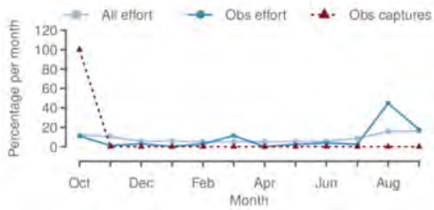


Figure B-38: White-chinned petrel captures in small-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (93.6% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.6.7 White-chinned petrel captures in surface-longline fisheries

Table B-33: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of white-chinned petrel and observed capture rate (captures per thousand hooks), estimated captures and capture rate of white-chinned petrel (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	1	0.001	77	42–120	0.01	0.01–0.02
1999–00	8 271 067	10.4	7	0.008	100	58–152	0.01	0.01–0.02
2000–01	9 711 545	10.8	2	0.002	107	60–165	0.01	0.01–0.02
2001–02	10 841 737	9.1	6	0.006	114	66–174	0.01	0.01–0.02
2002–03	10 772 188	20.4	4	0.002	89	51–137	0.01	0.00–0.01
2003–04	7 386 329	21.8	2	0.001	59	32–93	0.01	0.00–0.01
2004–05	3 679 765	21.3	3	0.004	33	18–53	0.01	0.00–0.01
2005–06	3 690 119	19.1	1	0.001	34	17–55	0.01	0.00–0.01
2006–07	3 739 912	27.8	5	0.005	33	19–50	0.01	0.01–0.01
2007–08	2 246 189	18.8	4	0.009	24	13–38	0.01	0.01–0.02
2008–09	3 115 633	30.1	3	0.003	29	16–46	0.01	0.01–0.01
2009–10	2 995 264	22.2	3	0.005	28	15–44	0.01	0.01–0.01
2010–11	3 187 879	21.2	8	0.012	37	22–56	0.01	0.01–0.02
2011–12	3 100 277	23.5	4	0.005	29	16–46	0.01	0.01–0.01
2012–13	2 862 182	19.6	1	0.002	24	12–40	0.01	0.00–0.01

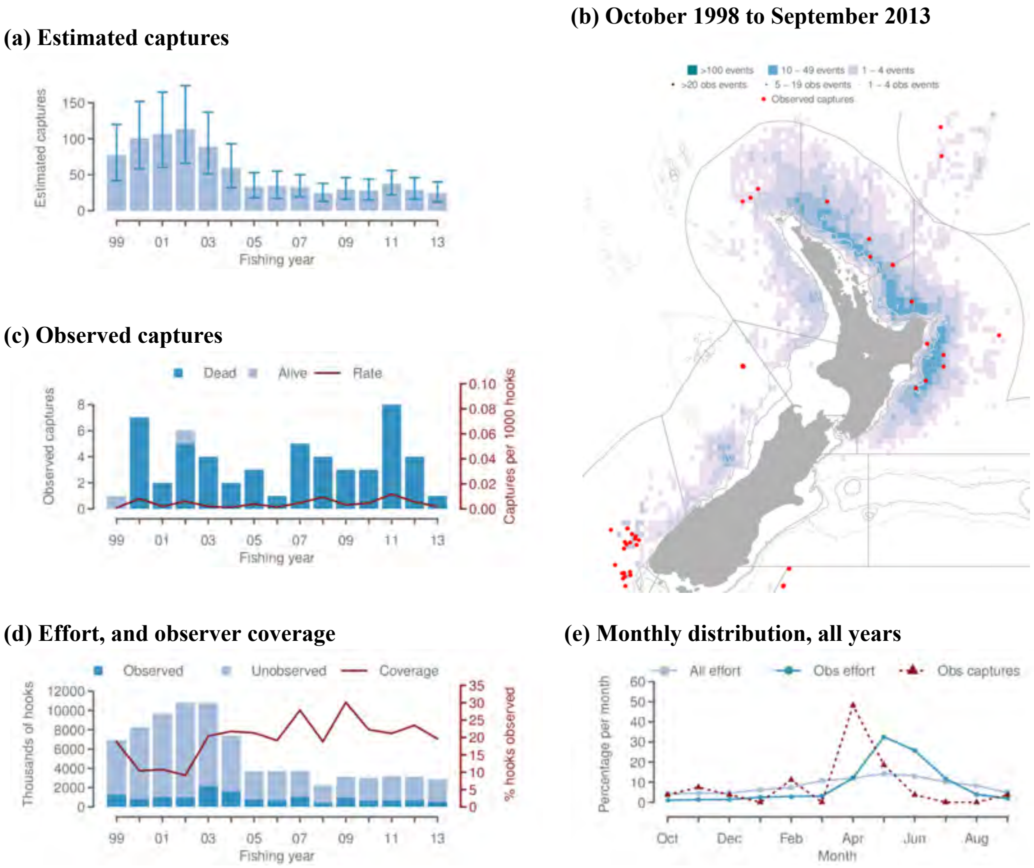


Figure B-39: White-chinned petrel captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7 Other bird captures

B.7.1 Other bird captures in trawl fisheries

Table B-34: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of other birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	20	0.29	610	254–1 310	0.47	0.20–1.01
2003–04	120 868	5.4	17	0.26	636	258–1 400	0.53	0.21–1.16
2004–05	120 438	6.4	40	0.52	1 027	460–2 259	0.85	0.38–1.88
2005–06	109 923	6.0	22	0.33	615	271–1 273	0.56	0.25–1.16
2006–07	103 306	7.7	20	0.25	505	220–1 034	0.49	0.21–1.00
2007–08	89 524	10.1	17	0.19	369	156–753	0.41	0.17–0.84
2008–09	87 548	11.2	54	0.55	539	292–983	0.62	0.33–1.12
2009–10	92 888	9.7	31	0.34	625	298–1 209	0.67	0.32–1.30
2010–11	86 090	8.6	35	0.47	518	260–979	0.60	0.30–1.14
2011–12	84 429	10.8	20	0.22	413	189–821	0.49	0.22–0.97
2012–13	83 722	14.8	82	0.66	863	429–1 706	1.03	0.51–2.04

[s] All observed captures by species: Cape petrel (52), fulmars, petrels, prions and shearwaters (39), grey petrel (38), flesh-footed shearwater (38), spotted shag (32), petrels, prions, and shearwaters (30), Westland petrel (18), common diving petrel (17), Cape petrels (17), fairy prion (13), northern giant petrel (7), antarctic prion (7), shearwaters (5), prions (5), large seabirds (4), grey-backed storm petrel (4), small seabirds (3), giant petrels (3), fulmar prion (3), black petrel (3), Snares Cape petrel (3), Procellaria petrels (3), New Zealand white-faced storm petrel (3), seabirds (2), gulls (2), black-bellied storm petrel (2), white-headed petrel (1), storm petrels (1), southern black-backed gull (1), short-tailed shearwater (1), mid-sized petrels & shearwaters (1)

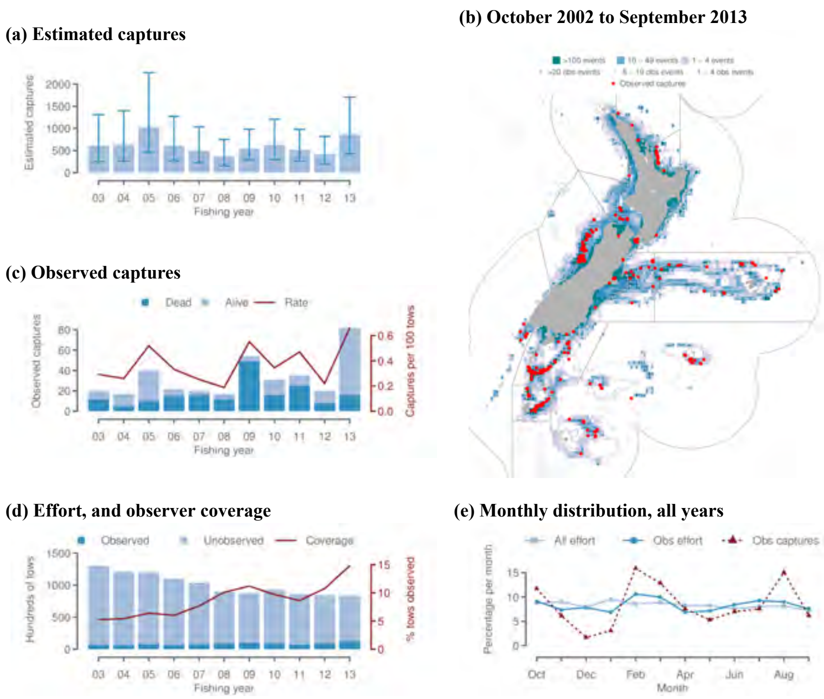


Figure B-40: Other bird captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.2 Other bird captures in flatfish trawl fisheries

Table B-35: Annual fishing effort and number of tows observed in flatfish trawl fisheries, number of observed captures of other birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	26 943	0.0	0	–	397	104–1 041	1.47	0.39–3.86
2003–04	26 325	0.0	0	–	427	113–1 128	1.62	0.43–4.28
2004–05	26 409	0.0	0	–	686	203–1 792	2.60	0.77–6.79
2005–06	22 867	0.0	0	–	406	127–997	1.78	0.56–4.36
2006–07	23 654	0.0	0	–	350	105–833	1.48	0.44–3.52
2007–08	18 881	0.1	0	0.00	248	75–597	1.31	0.40–3.16
2008–09	18 515	3.2	35	5.97	375	162–781	2.03	0.87–4.22
2009–10	20 150	1.4	0	0.00	414	137–956	2.05	0.68–4.74
2010–11	15 581	1.9	1	0.34	317	108–737	2.03	0.69–4.73
2011–12	17 526	1.4	0	0.00	273	86–646	1.56	0.49–3.69
2012–13	17 157	0.3	0	0.00	543	179–1 323	3.16	1.04–7.71

[s] All observed captures by species: spotted shag (32), gulls (2), southern black-backed gull (1), fulmars, petrels, prions and shearwaters (1)

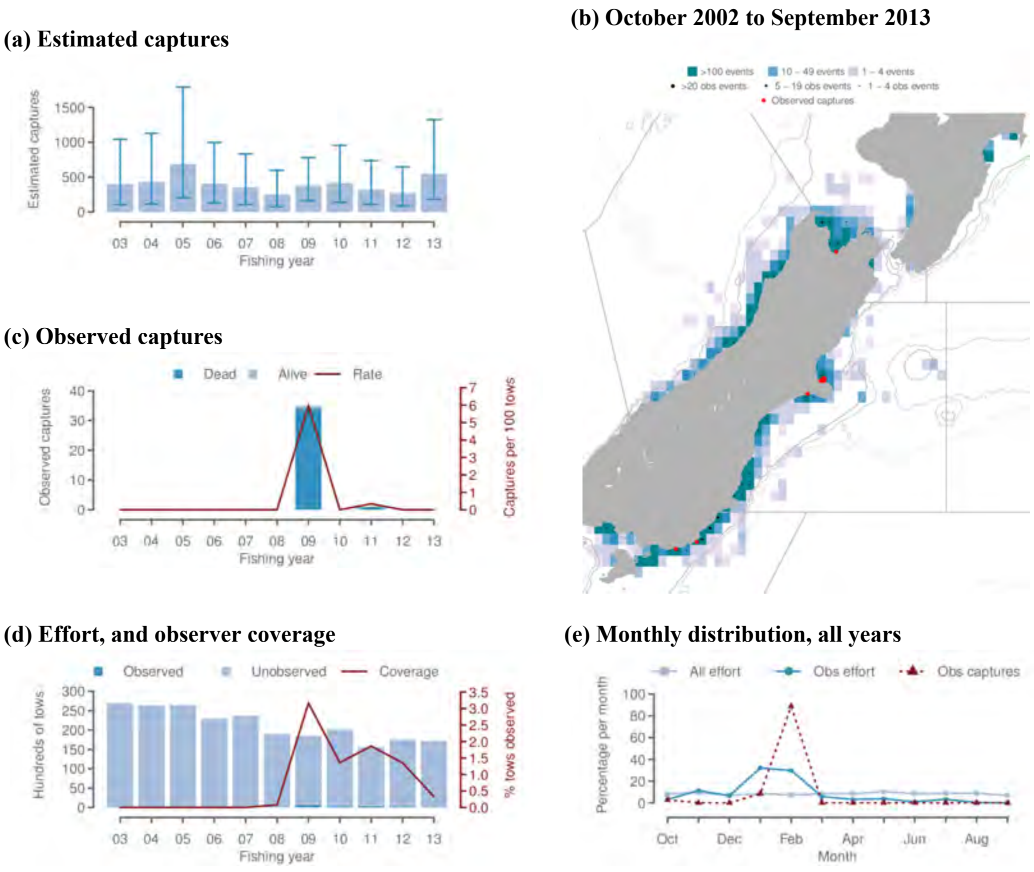


Figure B-41: Other bird captures in flatfish trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.3 Other bird captures in inshore trawl fisheries

Table B-36: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of other birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	46	6–147	0.13	0.02–0.40
2003–04	37 429	0.0	0	0.00	58	9–187	0.15	0.02–0.50
2004–05	40 829	0.0	0	0.00	103	17–341	0.25	0.04–0.84
2005–06	39 150	0.3	1	0.97	71	13–216	0.18	0.03–0.55
2006–07	35 831	0.8	3	1.00	57	13–160	0.16	0.04–0.45
2007–08	31 418	0.4	0	0.00	40	7–121	0.13	0.02–0.39
2008–09	33 102	3.5	0	0.00	60	11–170	0.18	0.03–0.51
2009–10	35 971	1.4	0	0.00	68	13–199	0.19	0.04–0.55
2010–11	34 986	1.3	0	0.00	66	12–195	0.19	0.03–0.56
2011–12	32 772	0.4	1	0.70	50	9–149	0.15	0.03–0.45
2012–13	33 263	0.5	0	0.00	97	19–278	0.29	0.06–0.84

[s] All observed captures by species: black petrel (2), small seabirds (1), large seabirds (1), flesh-footed shearwater (1)

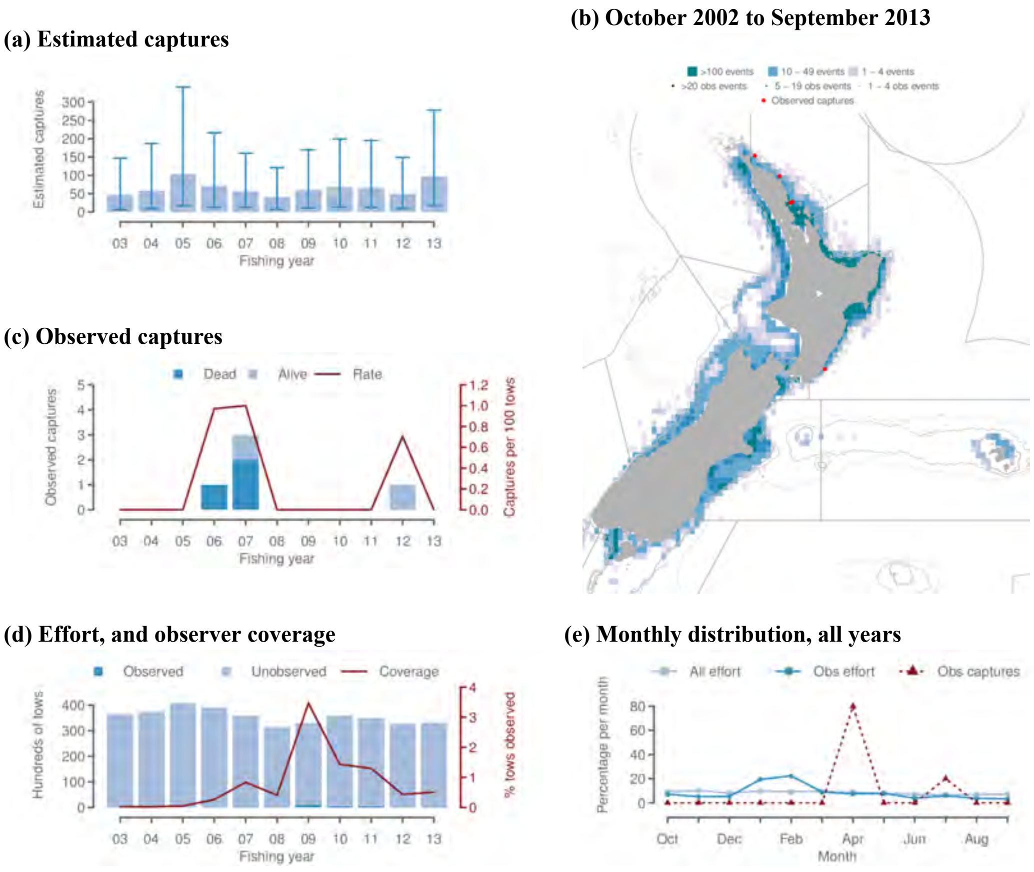


Figure B-42: Other bird captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.4 Other bird captures in bottom-longline fisheries

Table B-37: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	86	0.038	2 436	1 542–3 657	0.05	0.03–0.07
1999–00	52 730 082	6.1	87	0.027	1 401	888–1 994	0.03	0.02–0.04
2000–01	50 713 196	8.9	218	0.048	1 467	1 008–2 014	0.03	0.02–0.04
2001–02	46 653 023	15.0	23	0.003	897	508–1 353	0.02	0.01–0.03
2002–03	37 761 838	28.5	115	0.011	1 014	618–1 489	0.03	0.02–0.04
2003–04	43 225 599	11.7	11	0.002	674	353–1 061	0.02	0.01–0.02
2004–05	41 844 688	6.9	15	0.005	672	349–1 060	0.02	0.01–0.03
2005–06	37 141 633	10.2	18	0.005	578	311–898	0.02	0.01–0.02
2006–07	38 149 420	6.1	9	0.004	707	363–1 118	0.02	0.01–0.03
2007–08	41 507 547	8.6	14	0.004	645	345–995	0.02	0.01–0.02
2008–09	37 426 952	10.8	30	0.007	581	312–902	0.02	0.01–0.02
2009–10	40 440 801	5.6	60	0.026	628	346–959	0.02	0.01–0.02
2010–11	40 904 091	4.2	2	0.001	646	326–1 026	0.02	0.01–0.03
2011–12	37 877 121	5.5	1	0.000	573	290–912	0.02	0.01–0.02
2012–13	32 525 173	1.2	2	0.005	521	267–824	0.02	0.01–0.03

[s] All observed captures by species: grey petrel (426), black petrel (65), flesh-footed shearwater (53), Cape petrel (33), common diving petrel (24), fulmars, petrels, prions and shearwaters (17), Cape petrels (13), northern giant petrel (8), grey-faced petrel (6), Snares Cape petrel (6), southern giant petrel (5), fluttering shearwater (5), giant petrels (4), storm petrels (3), broad-billed prion (3), Buller's shearwater (3), southern black-backed gull (2), seagulls (2), prions (2), pied shag (2), Australasian gannet (2), small seabirds (1), shearwaters (1), red-billed gull (1), petrels, prions, and shearwaters (1), crested penguins (1), antarctic petrel (1), Westland petrel (1)

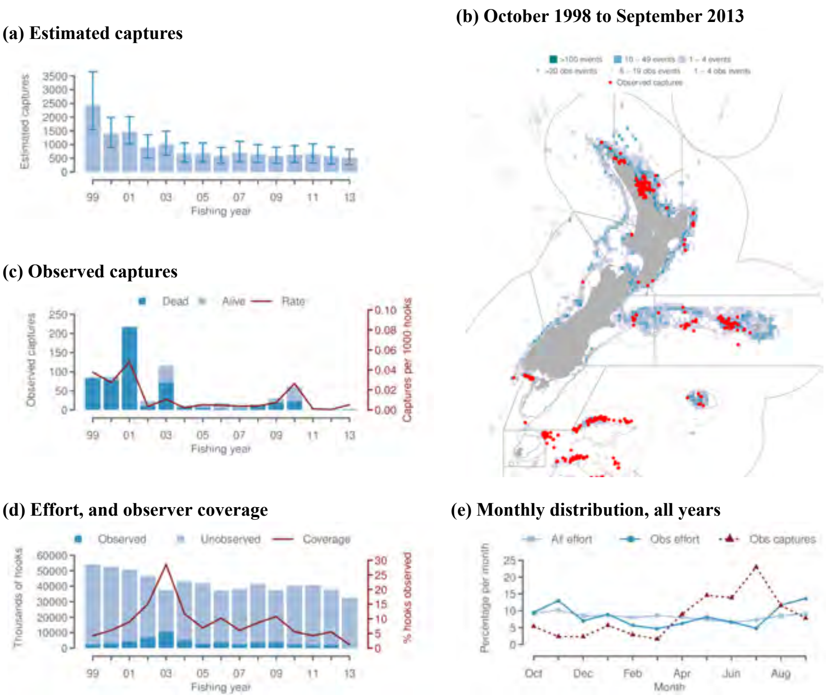


Figure B-43: Other bird captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.5 Other bird captures in small-vessel snapper longline fisheries

Table B-38: Annual fishing effort and number of hooks observed in small-vessel snapper longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	14 968 571	0.0	0	–	527	264–838	0.04	0.02–0.06
1999–00	16 287 395	0.0	0	–	563	284–899	0.03	0.02–0.06
2000–01	17 242 208	0.2	26	0.794	567	301–893	0.03	0.02–0.05
2001–02	15 309 436	0.0	0	–	500	251–803	0.03	0.02–0.05
2002–03	13 688 232	0.0	0	–	396	196–638	0.03	0.01–0.05
2003–04	12 246 568	1.5	10	0.055	345	176–549	0.03	0.01–0.04
2004–05	11 531 841	2.2	13	0.052	296	150–473	0.03	0.01–0.04
2005–06	11 696 113	1.0	12	0.103	247	125–390	0.02	0.01–0.03
2006–07	10 351 191	0.6	0	0.000	255	122–419	0.02	0.01–0.04
2007–08	9 053 797	0.0	0	–	218	99–355	0.02	0.01–0.04
2008–09	8 970 674	3.0	20	0.074	225	117–353	0.03	0.01–0.04
2009–10	11 033 205	4.4	30	0.062	245	132–377	0.02	0.01–0.03
2010–11	11 343 532	0.0	0	–	252	121–409	0.02	0.01–0.04
2011–12	11 039 780	0.0	0	–	222	104–362	0.02	0.01–0.03
2012–13	10 502 660	0.3	0	0.000	220	103–358	0.02	0.01–0.03

[s] All observed captures by species: flesh-footed shearwater (49), black petrel (28), grey petrel (11), fulmars, petrels, prions and shearwaters (8), fluttering shearwater (4), Buller's shearwater (3), pied shag (2), Australasian gannet (2), southern black-backed gull (1), shearwaters (1), red-billed gull (1), petrels, prions, and shearwaters (1)

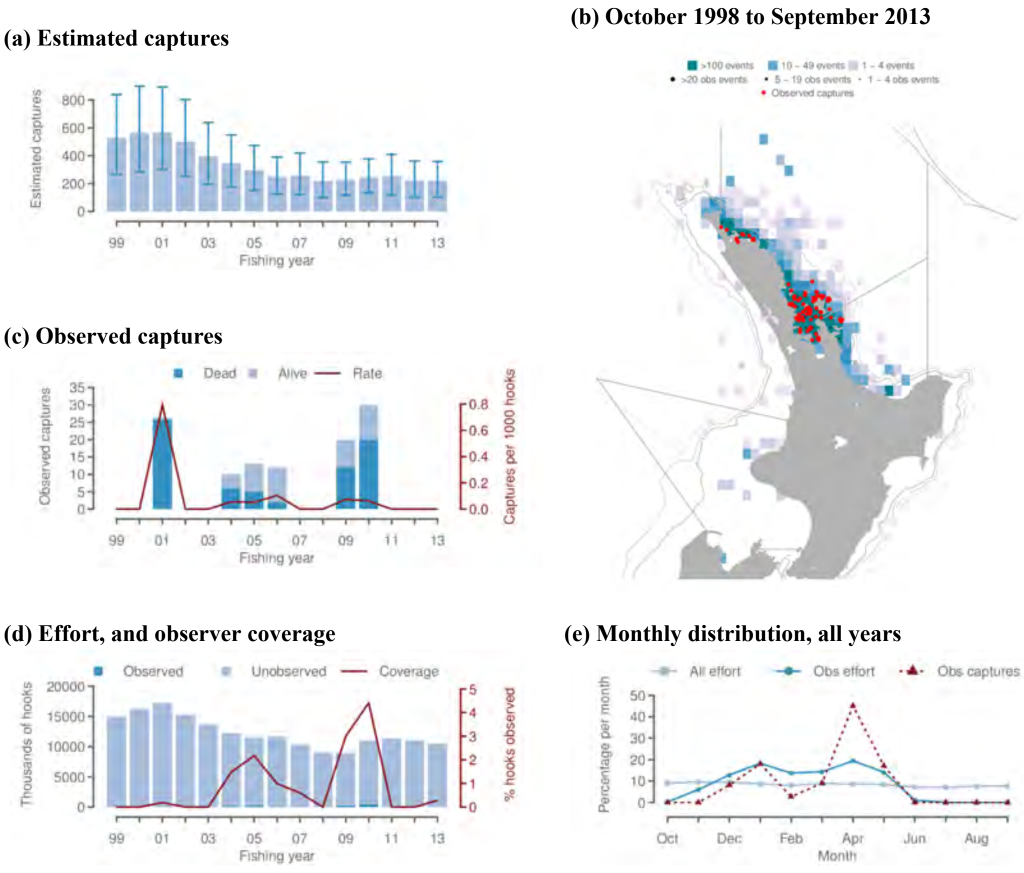


Figure B-44: Other bird captures in small-vessel snapper longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (98.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.6 Other bird captures in large-vessel ling longline fisheries

Table B-39: Annual fishing effort and number of hooks observed in large-vessel ling longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	31 193 828	7.2	84	0.038	1 590	866–2 768	0.05	0.03–0.09
1999–00	29 495 559	10.8	87	0.027	544	342–863	0.02	0.01–0.03
2000–01	26 668 936	16.1	190	0.044	611	439–874	0.02	0.02–0.03
2001–02	25 824 647	27.2	23	0.003	133	79–218	0.01	0.00–0.01
2002–03	17 286 318	62.2	113	0.011	278	183–497	0.02	0.01–0.03
2003–04	22 345 397	21.0	1	0.000	18	4–52	0.00	0.00–0.00
2004–05	18 029 290	14.4	2	0.001	16	5–34	0.00	0.00–0.00
2005–06	13 598 832	26.4	6	0.002	27	11–55	0.00	0.00–0.00
2006–07	11 974 372	15.2	1	0.001	9	1–29	0.00	0.00–0.00
2007–08	12 653 906	23.7	5	0.002	42	14–91	0.00	0.00–0.01
2008–09	11 831 980	27.0	2	0.001	11	3–29	0.00	0.00–0.00
2009–10	12 219 034	14.1	2	0.001	6	2–16	0.00	0.00–0.00
2010–11	11 505 690	11.4	0	0.000	4	0–17	0.00	0.00–0.00
2011–12	10 526 805	15.9	0	0.000	2	0–9	0.00	0.00–0.00
2012–13	7 223 510	3.1	0	0.000	10	1–30	0.00	0.00–0.00

[s] All observed captures by species: grey petrel (409), Cape petrel (29), common diving petrel (24), Cape petrels (12), fulmars, petrels, prions and shearwaters (9), northern giant petrel (8), Snares Cape petrel (6), southern giant petrel (5), giant petrels (4), storm petrels (3), broad-billed prion (3), prions (2), crested penguins (1), antarctic petrel (1)

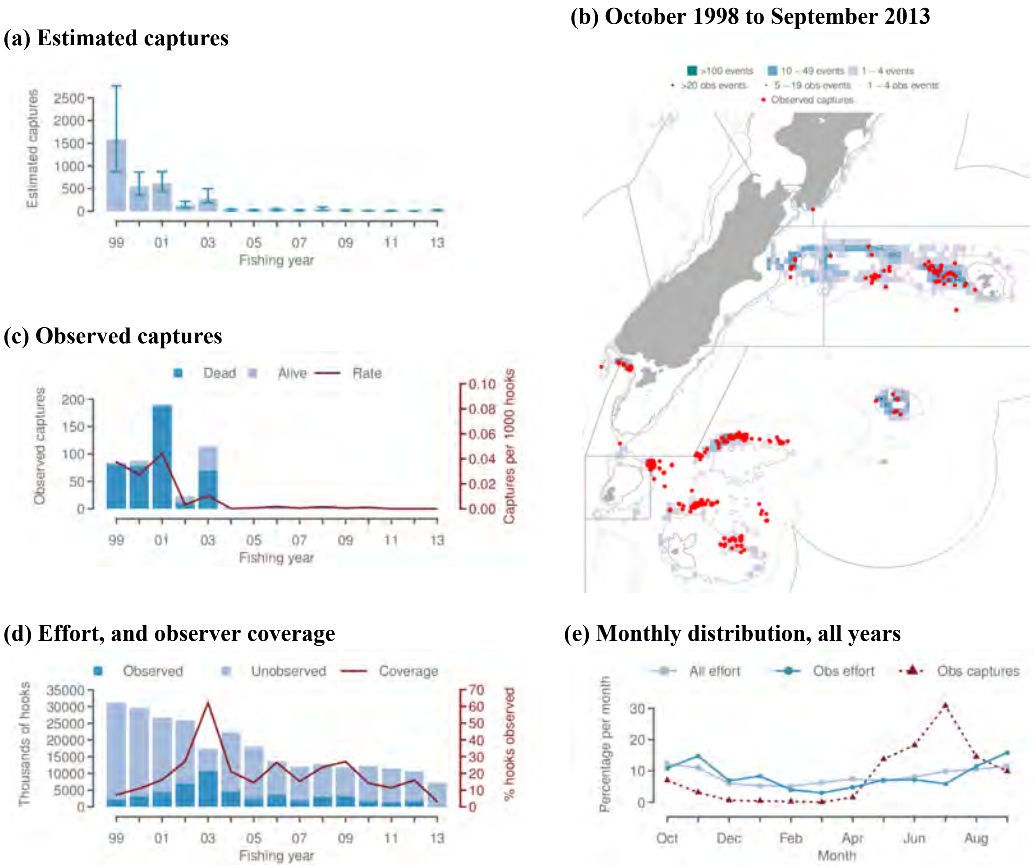


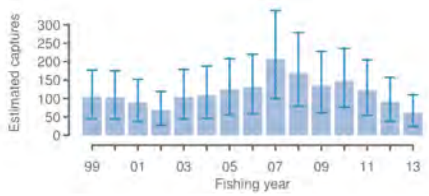
Figure B-45: Other bird captures in large-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (82.4% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.7 Other bird captures in small-vessel bluenose longline fisheries

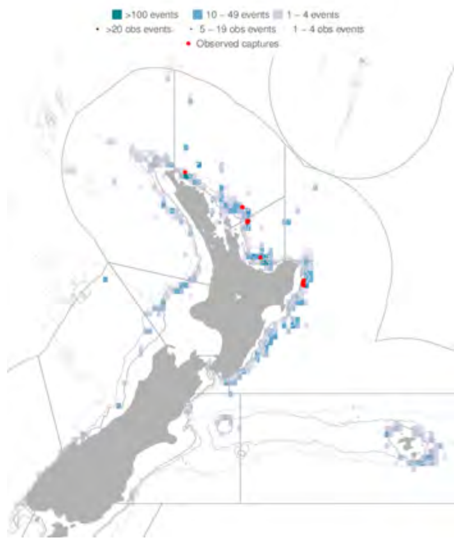
Table B-40: Annual fishing effort and number of hooks observed in small-vessel bluenose longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 657 142	0.0	0	–	105	46–177	0.06	0.03–0.11
1999–00	1 954 125	0.0	0	–	103	44–175	0.05	0.02–0.09
2000–01	1 958 289	0.0	0	–	89	36–152	0.05	0.02–0.08
2001–02	1 556 950	0.0	0	–	68	27–119	0.04	0.02–0.08
2002–03	1 718 544	0.0	0	0.000	104	44–179	0.06	0.03–0.10
2003–04	2 754 744	0.0	0	–	108	46–188	0.04	0.02–0.07
2004–05	4 643 687	0.2	0	0.000	124	55–208	0.03	0.01–0.04
2005–06	5 110 600	0.0	0	–	131	59–220	0.03	0.01–0.04
2006–07	6 765 477	1.0	4	0.060	206	99–339	0.03	0.01–0.05
2007–08	8 282 062	1.9	0	0.000	169	79–279	0.02	0.01–0.03
2008–09	6 168 080	0.1	0	0.000	135	61–228	0.02	0.01–0.04
2009–10	5 846 729	0.4	15	0.594	147	76–236	0.03	0.01–0.04
2010–11	4 911 570	0.9	2	0.044	121	54–205	0.02	0.01–0.04
2011–12	3 666 731	0.0	0	0.000	91	38–157	0.02	0.01–0.04
2012–13	2 184 138	0.0	0	–	61	23–110	0.03	0.01–0.05

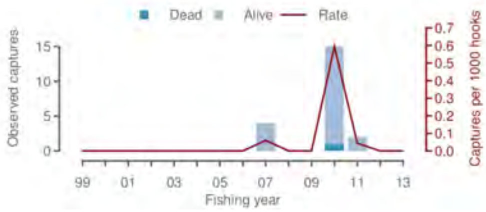
(a) Estimated captures



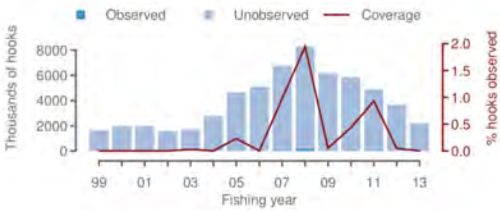
(b) October 1998 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

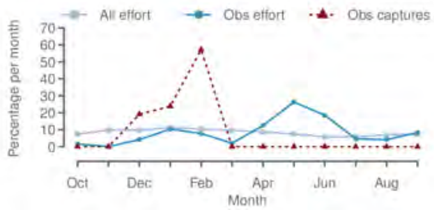


Figure B-46: Other bird captures in small-vessel bluenose longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.8 Other bird captures in small-vessel hapuka longline fisheries

Table B-41: Annual fishing effort and number of hooks observed in small-vessel hapuka longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 235 618	0.0	0	–	52	19–95	0.04	0.02–0.08
1999–00	1 187 391	0.0	0	–	67	26–117	0.06	0.02–0.10
2000–01	1 239 573	0.0	0	–	73	31–128	0.06	0.03–0.10
2001–02	1 114 359	0.0	0	–	92	38–157	0.08	0.03–0.14
2002–03	1 169 366	0.0	0	–	91	39–157	0.08	0.03–0.13
2003–04	1 667 850	0.0	0	–	80	33–139	0.05	0.02–0.08
2004–05	1 626 440	0.3	0	0.000	83	34–145	0.05	0.02–0.09
2005–06	1 242 568	0.0	0	–	51	18–92	0.04	0.01–0.07
2006–07	1 907 673	0.2	0	0.000	76	31–134	0.04	0.02–0.07
2007–08	1 988 566	3.7	9	0.121	59	27–99	0.03	0.01–0.05
2008–09	2 001 859	2.2	3	0.069	63	26–108	0.03	0.01–0.05
2009–10	2 507 912	0.3	13	1.561	89	45–145	0.04	0.02–0.06
2010–11	3 161 497	0.4	0	0.000	84	36–146	0.03	0.01–0.05
2011–12	3 010 076	0.4	0	0.000	104	45–180	0.03	0.01–0.06
2012–13	3 276 130	0.1	0	0.000	83	36–143	0.03	0.01–0.04

[s] All observed captures by species: black petrel (16), grey-faced petrel (6), flesh-footed shearwater (3)

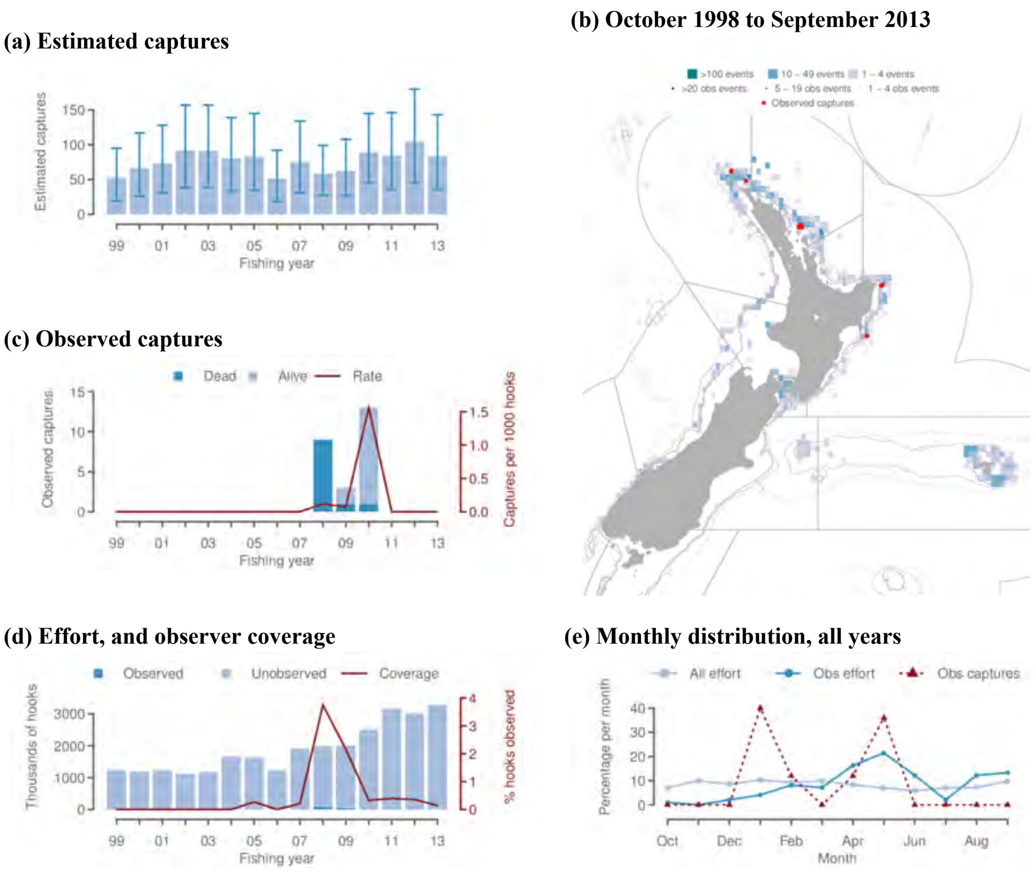


Figure B-47: Other bird captures in small-vessel hapuka longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (93.8% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

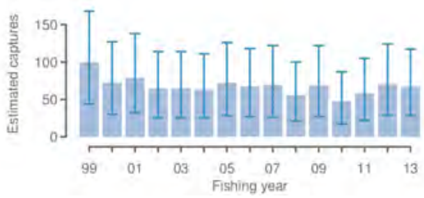
B.7.9 Other bird captures in small-vessel minor bottom-longline fisheries

Table B-42: Annual fishing effort and number of hooks observed in small-vessel minor bottom-longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 617 478	0.0	0	–	100	44–168	0.06	0.03–0.10
1999–00	966 198	0.0	0	–	73	30–127	0.08	0.03–0.13
2000–01	1 152 777	0.0	0	–	79	32–138	0.07	0.03–0.12
2001–02	793 859	0.0	0	–	65	25–114	0.08	0.03–0.14
2002–03	776 096	0.0	0	–	65	25–114	0.08	0.03–0.15
2003–04	1 018 750	0.1	0	0.000	63	25–111	0.06	0.02–0.11
2004–05	1 571 943	0.1	0	0.000	72	28–126	0.05	0.02–0.08
2005–06	1 563 060	2.6	0	0.000	67	27–118	0.04	0.02–0.08
2006–07	1 484 367	0.8	0	0.000	69	26–122	0.05	0.02–0.08
2007–08	1 706 527	0.4	0	0.000	56	21–100	0.03	0.01–0.06
2008–09	1 660 534	0.4	1	0.167	69	27–122	0.04	0.02–0.07
2009–10	1 269 156	2.8	0	0.000	47	17–87	0.04	0.01–0.07
2010–11	1 775 253	0.5	0	0.000	59	22–105	0.03	0.01–0.06
2011–12	2 113 969	2.0	1	0.023	70	29–124	0.03	0.01–0.06
2012–13	2 576 556	3.1	2	0.025	67	28–117	0.03	0.01–0.05

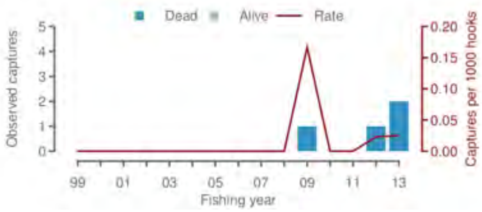
[s] All observed captures by species: southern black-backed gull (1), fluttering shearwater (1), flesh-footed shearwater (1), Westland petrel (1)

(a) Estimated captures

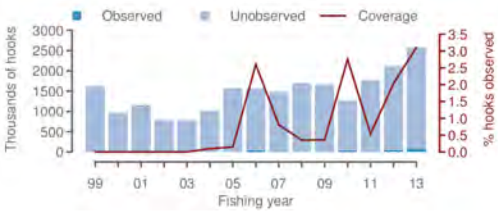


(b) October 1998 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

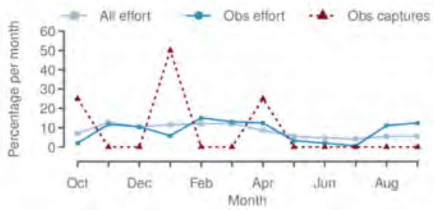


Figure B-48: Other bird captures in small-vessel minor bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (83.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.10 Other bird captures in small-vessel ling longline fisheries

Table B-43: Annual fishing effort and number of hooks observed in small-vessel ling longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	3 127 560	0.0	0	–	55	21–99	0.02	0.01–0.03
1999–00	2 660 610	0.0	0	–	50	19–90	0.02	0.01–0.03
2000–01	2 231 568	0.0	0	–	45	17–84	0.02	0.01–0.04
2001–02	1 873 462	0.0	0	–	39	14–71	0.02	0.01–0.04
2002–03	2 481 081	0.2	2	0.402	63	27–110	0.03	0.01–0.04
2003–04	2 200 322	1.5	0	0.000	42	15–79	0.02	0.01–0.04
2004–05	3 538 481	0.6	0	0.000	64	25–113	0.02	0.01–0.03
2005–06	2 640 569	0.0	0	–	32	10–63	0.01	0.00–0.02
2006–07	4 881 424	7.1	4	0.011	75	34–128	0.02	0.01–0.03
2007–08	6 353 499	3.7	0	0.000	80	33–139	0.01	0.01–0.02
2008–09	5 755 734	8.9	4	0.008	70	30–119	0.01	0.01–0.02
2009–10	6 176 059	0.0	0	–	72	30–126	0.01	0.00–0.02
2010–11	6 797 522	2.1	0	0.000	106	45–183	0.02	0.01–0.03
2011–12	6 486 288	0.4	0	0.000	70	29–121	0.01	0.00–0.02
2012–13	5 745 174	0.0	0	–	67	28–116	0.01	0.00–0.02

[s] All observed captures by species: Cape petrel (4), grey petrel (3), seagulls (2), small seabirds (1)

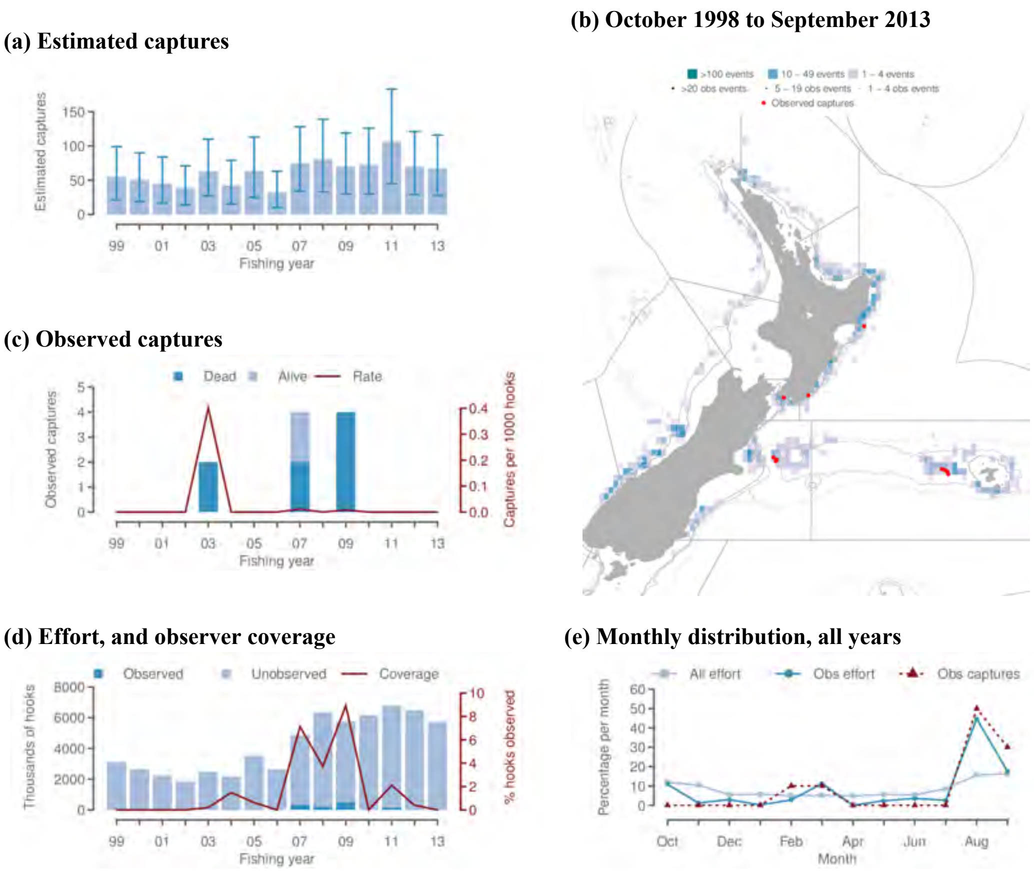


Figure B-49: Other bird captures in small-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (93.6% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.11 Other bird captures in surface-longline fisheries

Table B-44: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	22	0.017	941	621–1 475	0.14	0.09–0.21
1999–00	8 271 067	10.4	32	0.037	1 096	717–1 714	0.13	0.09–0.21
2000–01	9 711 545	10.8	35	0.033	1 153	767–1 776	0.12	0.08–0.18
2001–02	10 841 737	9.1	77	0.078	1 538	1 035–2 384	0.14	0.10–0.22
2002–03	10 772 188	20.4	27	0.012	1 268	837–1 954	0.12	0.08–0.18
2003–04	7 386 329	21.8	7	0.004	819	534–1 254	0.11	0.07–0.17
2004–05	3 679 765	21.3	5	0.006	304	195–472	0.08	0.05–0.13
2005–06	3 690 119	19.1	11	0.016	382	254–597	0.10	0.07–0.16
2006–07	3 739 912	27.8	27	0.026	378	251–591	0.10	0.07–0.16
2007–08	2 246 189	18.8	4	0.009	247	160–384	0.11	0.07–0.17
2008–09	3 115 633	30.1	10	0.011	293	197–432	0.09	0.06–0.14
2009–10	2 995 264	22.2	11	0.017	403	253–641	0.13	0.08–0.21
2010–11	3 187 879	21.2	4	0.006	351	212–572	0.11	0.07–0.18
2011–12	3 100 277	23.5	4	0.005	382	210–680	0.12	0.07–0.22
2012–13	2 862 182	19.6	0	0.000	382	218–676	0.13	0.08–0.24

[s] All observed captures by species: flesh-footed shearwater (141), grey petrel (58), black petrel (31), grey-faced petrel (24), Westland petrel (10), Cape petrels (6), white-headed petrel (2), southern giant petrel (2), large seabirds (1), gadfly petrels (1)

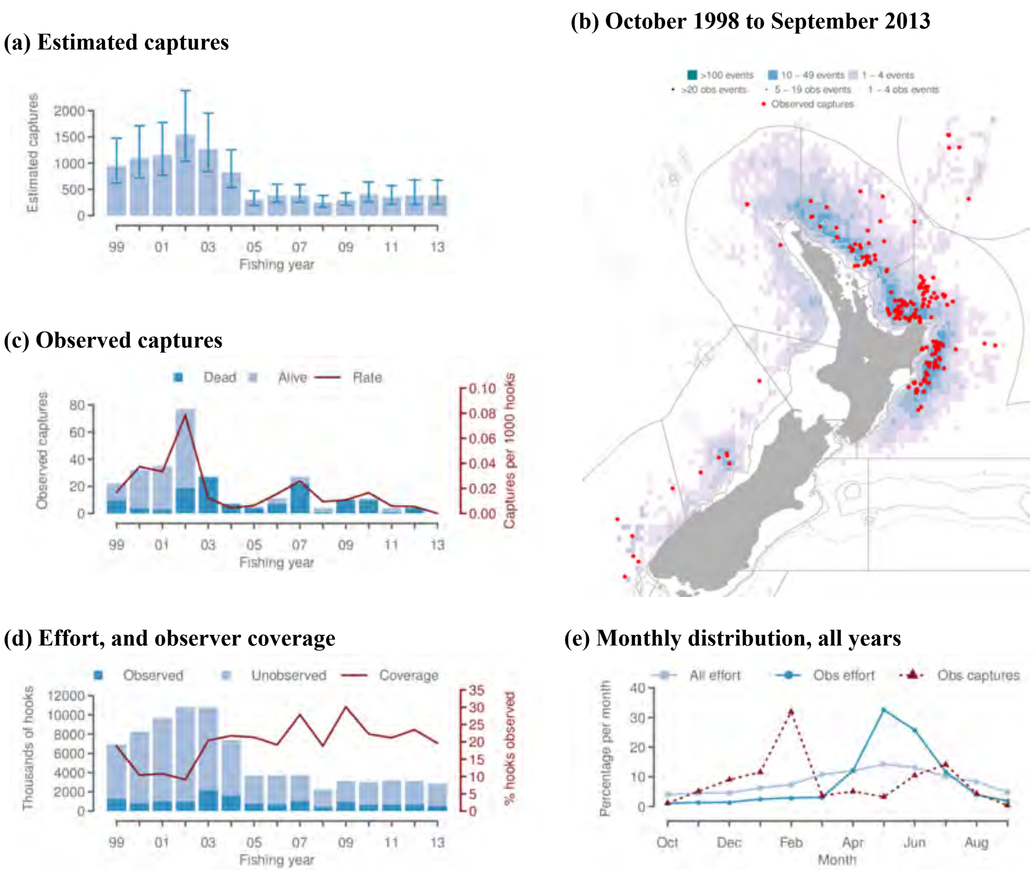


Figure B-50: Other bird captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.12 Other bird captures in small-vessel bigeye longline fisheries

Table B-45: Annual fishing effort and number of hooks observed in small-vessel bigeye longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	4 132 143	0.7	6	0.206	747	480–1 192	0.18	0.12–0.29
1999–00	5 682 409	0.6	31	0.901	891	581–1 409	0.16	0.10–0.25
2000–01	6 753 564	2.6	31	0.180	926	611–1 421	0.14	0.09–0.21
2001–02	6 798 527	1.3	69	0.757	1 146	761–1 782	0.17	0.11–0.26
2002–03	5 107 467	0.0	0	–	882	573–1 384	0.17	0.11–0.27
2003–04	3 411 185	2.0	1	0.014	617	397–967	0.18	0.12–0.28
2004–05	1 648 181	2.0	0	0.000	216	129–353	0.13	0.08–0.21
2005–06	1 831 766	1.9	4	0.115	310	197–498	0.17	0.11–0.27
2006–07	1 514 646	5.6	3	0.036	278	172–452	0.18	0.11–0.30
2007–08	967 829	2.5	2	0.082	170	108–266	0.18	0.11–0.27
2008–09	1 559 717	5.5	3	0.035	251	162–383	0.16	0.10–0.25
2009–10	1 247 437	6.4	6	0.075	320	190–529	0.26	0.15–0.42
2010–11	1 639 956	4.9	3	0.037	297	174–501	0.18	0.11–0.31
2011–12	1 285 123	2.5	1	0.031	247	140–435	0.19	0.11–0.34
2012–13	957 485	2.4	0	0.000	220	130–365	0.23	0.14–0.38

[s] All observed captures by species: flesh-footed shearwater (132), black petrel (21), grey-faced petrel (5), grey petrel (1), gadfly petrels (1)

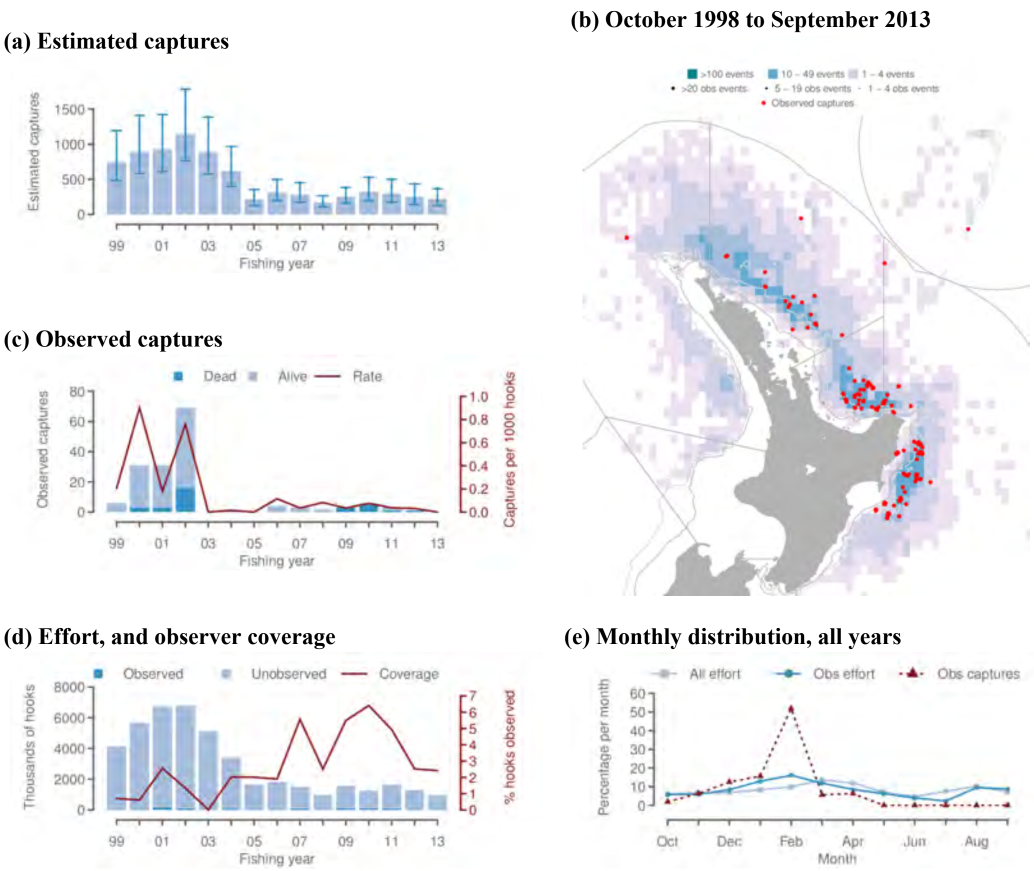


Figure B-51: Other bird captures in small-vessel bigeye longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (96.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.7.13 Other bird captures in small-vessel southern bluefin longline fisheries

Table B-46: Annual fishing effort and number of hooks observed in small-vessel southern bluefin longline fisheries, number of observed captures of other birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of other birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	428 815	0.0	0	–	16	5–36	0.04	0.01–0.08
1999–00	695 415	0.5	0	0.000	47	16–112	0.07	0.02–0.16
2000–01	977 027	2.5	0	0.000	63	27–125	0.06	0.03–0.13
2001–02	1 722 853	1.7	0	0.000	159	82–294	0.09	0.05–0.17
2002–03	2 357 331	0.0	0	–	165	86–308	0.07	0.04–0.13
2003–04	1 691 526	3.1	4	0.077	92	43–181	0.05	0.03–0.11
2004–05	1 023 395	9.0	0	0.000	30	13–56	0.03	0.01–0.05
2005–06	873 938	6.5	7	0.122	29	17–47	0.03	0.02–0.05
2006–07	566 301	13.3	8	0.106	22	13–35	0.04	0.02–0.06
2007–08	536 540	16.9	1	0.011	16	6–29	0.03	0.01–0.05
2008–09	681 008	8.7	2	0.034	25	11–49	0.04	0.02–0.07
2009–10	1 081 300	9.4	3	0.029	42	22–75	0.04	0.02–0.07
2010–11	833 595	8.5	1	0.014	32	12–71	0.04	0.01–0.09
2011–12	1 049 114	9.3	2	0.021	113	29–307	0.11	0.03–0.29
2012–13	1 051 177	3.9	0	0.000	92	28–249	0.09	0.03–0.24

[s] All observed captures by species: grey petrel (23), Westland petrel (3), Cape petrels (2)

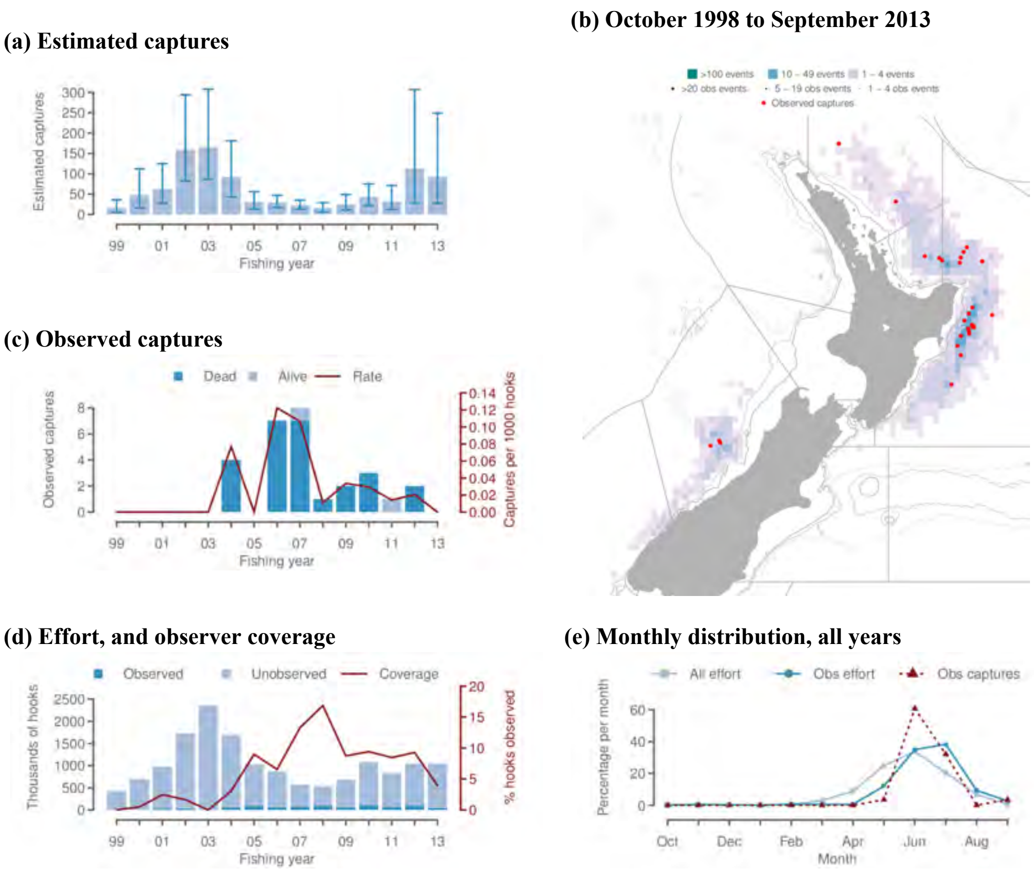


Figure B-52: Other bird captures in small-vessel southern bluefin longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (94.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8 All bird captures

B.8.1 All bird captures in trawl fisheries

Table B-47: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

			Observed		Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	269	3.93	3 311	2 540–4 449	2.54	1.95–3.42
2003–04	120 868	5.4	262	4.00	2 763	2 138–3 664	2.29	1.77–3.03
2004–05	120 438	6.4	483	6.26	4 509	3 466–6 089	3.74	2.88–5.06
2005–06	109 923	6.0	356	5.38	3 585	2 779–4 630	3.26	2.53–4.21
2006–07	103 306	7.7	211	2.66	2 310	1 774–3 035	2.24	1.72–2.94
2007–08	89 524	10.1	234	2.59	1 868	1 476–2 385	2.09	1.65–2.66
2008–09	87 548	11.2	469	4.78	2 460	2 039–3 033	2.81	2.33–3.46
2009–10	92 888	9.7	258	2.86	2 023	1 592–2 674	2.18	1.71–2.88
2010–11	86 090	8.6	362	4.86	2 468	1 990–3 121	2.87	2.31–3.63
2011–12	84 429	10.8	248	2.73	1 863	1 480–2 387	2.21	1.75–2.83
2012–13	83 722	14.8	709	5.72	2 604	2 055–3 465	3.11	2.45–4.14

[s] All observed captures by species: sooty shearwater (1028), New Zealand white-capped albatross (1016), white-chinned petrel (886), Salvin's albatross (273), southern Buller's albatross (213), Cape petrel (52), fulmars, petrels, prions and shearwaters (39), grey petrel (38), flesh-footed shearwater (38), spotted shag (32), petrels, prions, and shearwaters (30), albatrosses (30), Westland petrel (18), common diving petrel (17), Cape petrels (17), Campbell black-browed albatross (14), fairy prion (13), southern royal albatross (12), Chatham Island albatross (10), northern giant petrel (7), antarctic prion (7), smaller albatrosses (6), shearwaters (5), prions (5), black-browed albatross (5), large seabirds (4), grey-backed storm petrel (4), great albatrosses (4), wandering albatrosses (3), small seabirds (3), giant petrels (3), fulmar prion (3), black petrel (3), Snares Cape petrel (3), Procellaria petrels (3), New Zealand white-faced storm petrel (3), seabirds (2), gulls (2), black-bellied storm petrel (2), white-headed petrel (1), storm petrels (1), southern black-backed gull (1), short-tailed shearwater (1), northern royal albatross (1), mid-sized petrels & shearwaters (1), light-mantled sooty albatross (1), Gibson's albatross (1)

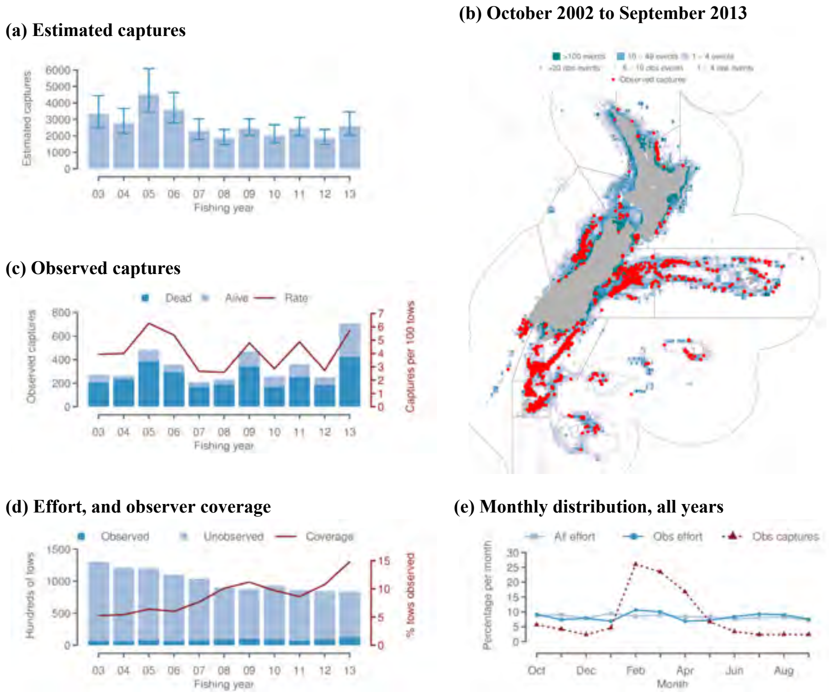


Figure B-53: All bird captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.2 All bird captures in squid trawl fisheries

Table B-48: Annual fishing effort and number of tows observed in squid trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 410	15.6	159	12.16	929	726–1 227	11.05	8.63–14.59
2003–04	8 336	21.2	204	11.52	857	717–1 027	10.28	8.60–12.32
2004–05	10 486	23.9	384	15.29	1 442	1 236–1 710	13.75	11.79–16.31
2005–06	8 575	12.9	200	18.13	1 203	947–1 568	14.03	11.04–18.29
2006–07	5 906	21.8	127	9.85	573	440–767	9.70	7.45–12.99
2007–08	4 236	34.4	162	11.12	540	425–705	12.75	10.03–16.64
2008–09	3 867	33.6	259	19.95	624	523–764	16.14	13.52–19.76
2009–10	3 789	28.2	92	8.60	401	311–521	10.58	8.21–13.75
2010–11	4 214	29.9	141	11.18	600	468–779	14.24	11.11–18.49
2011–12	3 505	39.4	106	7.68	344	277–438	9.81	7.90–12.50
2012–13	2 646	85.9	450	19.80	505	477–553	19.09	18.03–20.90

[s] All observed captures by species: New Zealand white-capped albatross (792), white-chinned petrel (652), sooty shearwater (615), southern Buller's albatross (87), fulmars, petrels, prions and shearwaters (29), petrels, prions, and shearwaters (24), Salvin's albatross (22), albatrosses (12), southern royal albatross (8), antarctic prion (7), shearwaters (5), common diving petrel (5), grey-backed storm petrel (3), giant petrels (3), fairy prion (3), Procellaria petrels (3), smaller albatrosses (2), Campbell black-browed albatross (2), white-headed petrel (1), seabirds (1), prions (1), mid-sized petrels & shearwaters (1), light-mantled sooty albatross (1), grey petrel (1), great albatrosses (1), black-browed albatross (1), black-bellied storm petrel (1), Cape petrel (1)

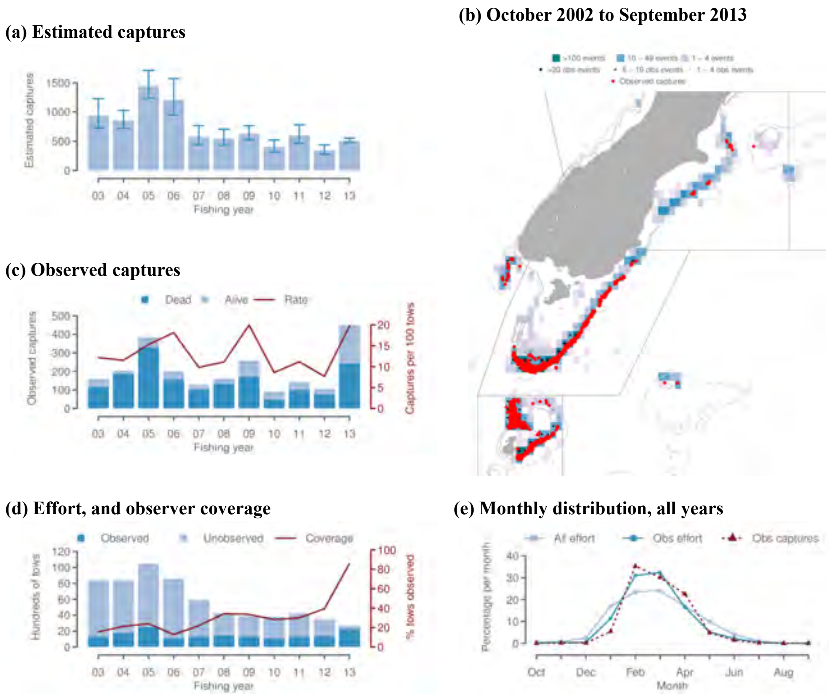


Figure B-54: All bird captures in squid trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (99.0% oof total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

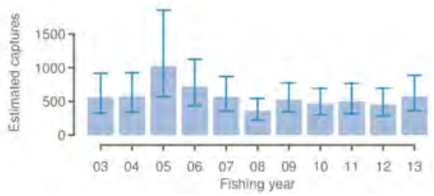
B.8.3 All bird captures in inshore trawl fisheries

Table B-49: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	558	329–918	1.53	0.90–2.51
2003–04	37 429	0.0	0	0.00	576	342–926	1.54	0.91–2.47
2004–05	40 829	0.0	0	0.00	1 028	572–1 856	2.52	1.40–4.55
2005–06	39 150	0.3	3	2.91	726	441–1 126	1.85	1.13–2.88
2006–07	35 831	0.8	10	3.33	567	354–870	1.58	0.99–2.43
2007–08	31 418	0.4	2	1.56	359	224–544	1.14	0.71–1.73
2008–09	33 102	3.5	26	2.26	523	346–774	1.58	1.05–2.34
2009–10	35 971	1.4	10	1.94	464	301–692	1.29	0.84–1.92
2010–11	34 986	1.3	1	0.22	502	316–767	1.43	0.90–2.19
2011–12	32 772	0.4	4	2.82	456	286–696	1.39	0.87–2.12
2012–13	33 263	0.5	1	0.59	574	363–888	1.73	1.09–2.67

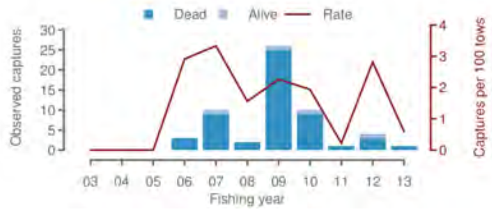
[s] All observed captures by species: New Zealand white-capped albatross (23), Salvin's albatross (21), sooty shearwater (5), black-browed albatross (2), black petrel (2), small seabirds (1), large seabirds (1), flesh-footed shearwater (1), albatrosses (1)

(a) Estimated captures

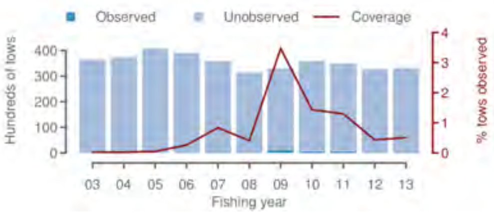


(b) October 2002 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

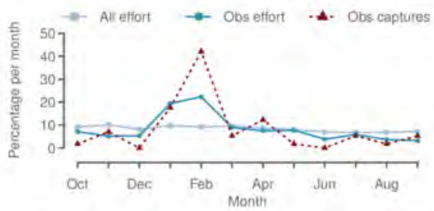


Figure B-55: All bird captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.4 All bird captures in flatfish trawl fisheries

Table B-50: Annual fishing effort and number of tows observed in flatfish trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	26 943	0.0	0	–	512	176–1 186	1.90	0.65–4.40
2003–04	26 325	0.0	0	–	508	172–1 197	1.93	0.65–4.55
2004–05	26 409	0.0	0	–	804	286–1 925	3.04	1.08–7.29
2005–06	22 867	0.0	0	–	505	199–1 104	2.21	0.87–4.83
2006–07	23 654	0.0	0	–	435	169–938	1.84	0.71–3.97
2007–08	18 881	0.1	0	0.00	303	115–659	1.60	0.61–3.49
2008–09	18 515	3.2	37	6.31	439	210–853	2.37	1.13–4.61
2009–10	20 150	1.4	0	0.00	464	178–1 015	2.30	0.88–5.04
2010–11	15 581	1.9	1	0.34	362	141–796	2.32	0.90–5.11
2011–12	17 526	1.4	3	1.27	323	127–696	1.84	0.72–3.97
2012–13	17 157	0.3	0	0.00	597	225–1 365	3.48	1.31–7.96

[s] All observed captures by species: spotted shag (32), New Zealand white-capped albatross (3), gulls (2), southern black-backed gull (1), sooty shearwater (1), fulmars, petrels, prions and shearwaters (1), Salvin's albatross (1)

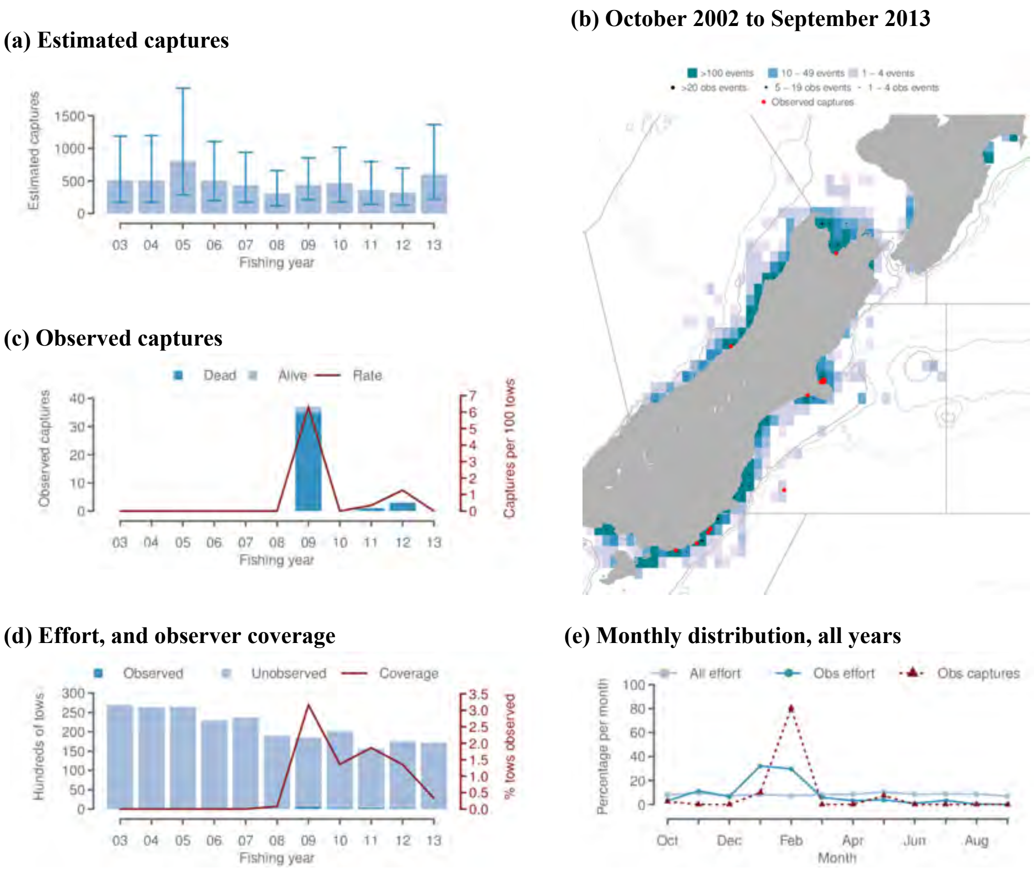


Figure B-56: All bird captures in flatfish trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.5 All bird captures in middle-depth trawl fisheries

Table B-51: Annual fishing effort and number of tows observed in middle-depth trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	11 178	3.1	13	3.72	434	257–770	3.88	2.30–6.89
2003–04	9 165	2.1	8	4.15	300	180–511	3.27	1.96–5.58
2004–05	9 188	2.4	4	1.79	442	267–764	4.81	2.91–8.32
2005–06	8 402	5.8	73	14.96	477	297–857	5.68	3.53–10.20
2006–07	8 197	4.8	12	3.05	334	205–593	4.07	2.50–7.23
2007–08	7 416	6.1	11	2.44	283	183–463	3.82	2.47–6.24
2008–09	7 235	10.1	64	8.73	373	255–591	5.16	3.52–8.17
2009–10	7 217	12.3	51	5.74	255	184–366	3.53	2.55–5.07
2010–11	7 252	8.5	32	5.19	354	223–586	4.88	3.08–8.08
2011–12	6 554	11.7	41	5.36	268	181–409	4.09	2.76–6.24
2012–13	6 451	19.2	92	7.41	335	228–521	5.19	3.53–8.08

[s] All observed captures by species: sooty shearwater (143), New Zealand white-capped albatross (82), white-chinned petrel (74), Salvin's albatross (53), southern Buller's albatross (29), fulmars, petrels, prions and shearwaters (4), common diving petrel (2), albatrosses (2), wandering albatrosses (1), southern royal albatross (1), short-tailed shearwater (1), prions (1), petrels, prions, and shearwaters (1), northern giant petrel (1), great albatrosses (1), flesh-footed shearwater (1), Westland petrel (1), Chatham Island albatross (1), Cape petrels (1), Cape petrel (1)

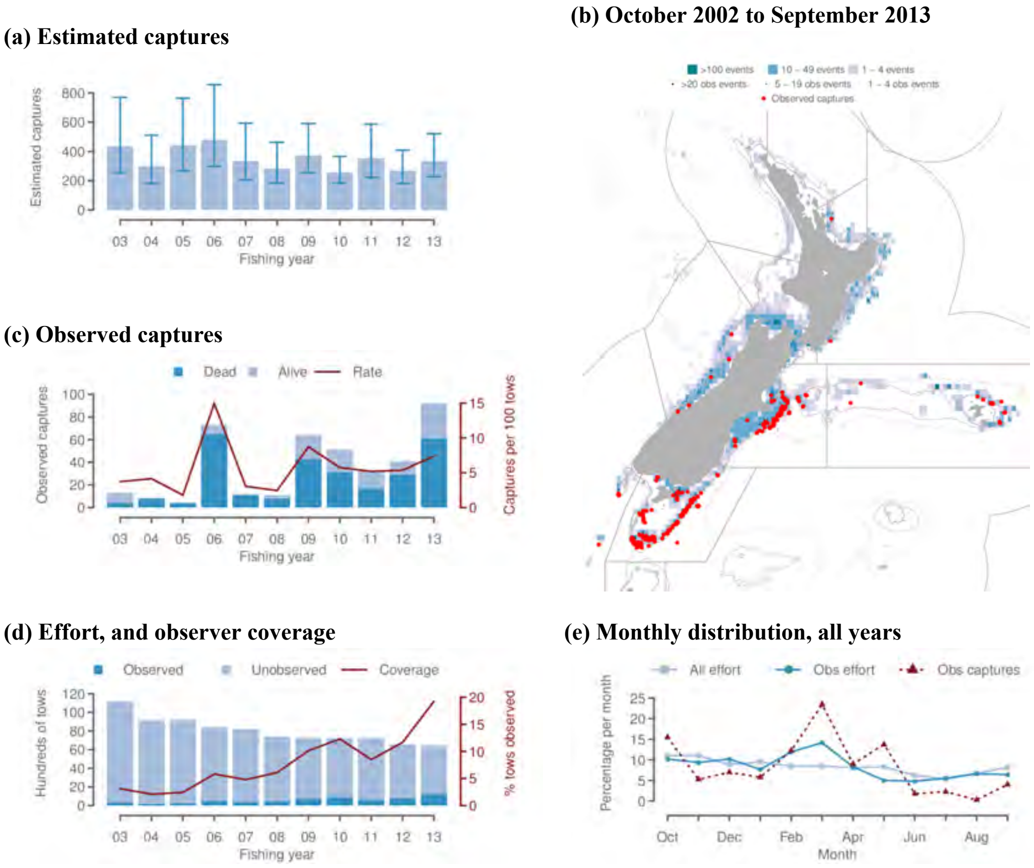


Figure B-57: All bird captures in middle-depth trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.6 All bird captures in hoki trawl fisheries

Table B-52: Annual fishing effort and number of tows observed in hoki trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	27 786	9.3	85	3.28	638	478–892	2.30	1.72–3.21
2003–04	22 523	10.4	33	1.41	332	254–433	1.47	1.13–1.92
2004–05	14 545	14.7	46	2.16	376	282–505	2.59	1.94–3.47
2005–06	11 590	15.3	54	3.04	352	232–580	3.04	2.00–5.00
2006–07	10 602	16.6	23	1.31	168	120–238	1.58	1.13–2.24
2007–08	8 788	21.4	28	1.49	141	105–191	1.60	1.19–2.17
2008–09	8 174	20.3	37	2.23	185	140–247	2.26	1.71–3.02
2009–10	9 965	20.7	53	2.57	197	158–247	1.98	1.59–2.48
2010–11	10 404	16.6	50	2.90	272	207–371	2.61	1.99–3.57
2011–12	11 333	22.8	59	2.29	242	194–307	2.14	1.71–2.71
2012–13	11 682	38.6	96	2.13	265	215–333	2.27	1.84–2.85

[s] All observed captures by species: sooty shearwater (175), Salvin's albatross (102), southern Buller's albatross (73), New Zealand white-capped albatross (65), white-chinned petrel (49), Cape petrel (31), Westland petrel (15), Campbell black-browed albatross (8), albatrosses (7), Cape petrels (5), fairy prion (4), common diving petrel (4), petrels, prions, and shearwaters (3), northern giant petrel (3), Snares Cape petrel (3), smaller albatrosses (2), prions (2), grey petrel (2), great albatrosses (2), southern royal albatross (1), small seabirds (1), seabirds (1), large seabirds (1), grey-backed storm petrel (1), fulmars, petrels, prions and shearwaters (1), flesh-footed shearwater (1), black-browed albatross (1), black-bellied storm petrel (1)

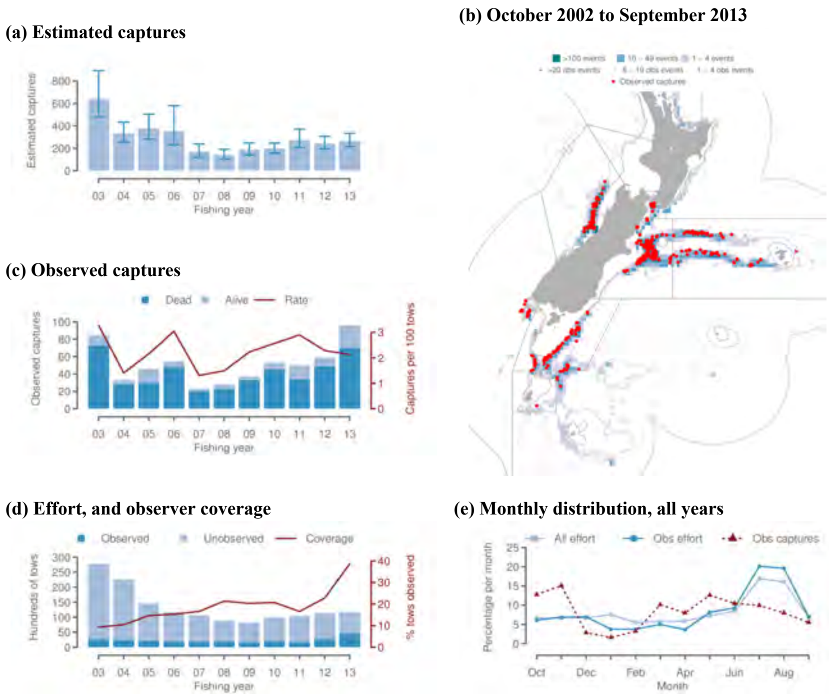


Figure B-58: All bird captures in hoki trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (98.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.7 All bird captures in scampi trawl fisheries

Table B-53: Annual fishing effort and number of tows observed in scampi trawl fisheries, number of observed captures of all birds and observed capture rate (captures per hundred tows), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	5 130	10.0	8	1.56	133	75–240	2.59	1.46–4.68
2003–04	3 753	11.0	8	1.94	94	58–148	2.50	1.55–3.94
2004–05	4 648	3.1	9	6.29	227	146–350	4.88	3.14–7.53
2005–06	4 867	6.8	13	3.93	185	122–275	3.80	2.51–5.65
2006–07	5 135	7.6	24	6.17	142	99–201	2.77	1.93–3.91
2007–08	4 804	10.9	11	2.10	132	88–197	2.75	1.83–4.10
2008–09	3 975	10.0	19	4.80	177	120–258	4.45	3.02–6.49
2009–10	4 248	8.2	5	1.44	135	82–216	3.18	1.93–5.08
2010–11	4 447	12.1	109	20.34	283	218–379	6.36	4.90–8.52
2011–12	4 509	10.2	9	1.96	165	109–248	3.66	2.42–5.50
2012–13	4 566	5.9	5	1.85	221	140–354	4.84	3.07–7.75

[s] All observed captures by species: white-chinned petrel (73), sooty shearwater (37), flesh-footed shearwater (35), Salvin's albatross (32), New Zealand white-capped albatross (19), southern Buller's albatross (8), albatrosses (5), Cape petrel (3), fulmars, petrels, prions and shearwaters (2), smaller albatrosses (1), northern giant petrel (1), common diving petrel (1), black petrel (1), Chatham Island albatross (1), Campbell black-browed albatross (1)

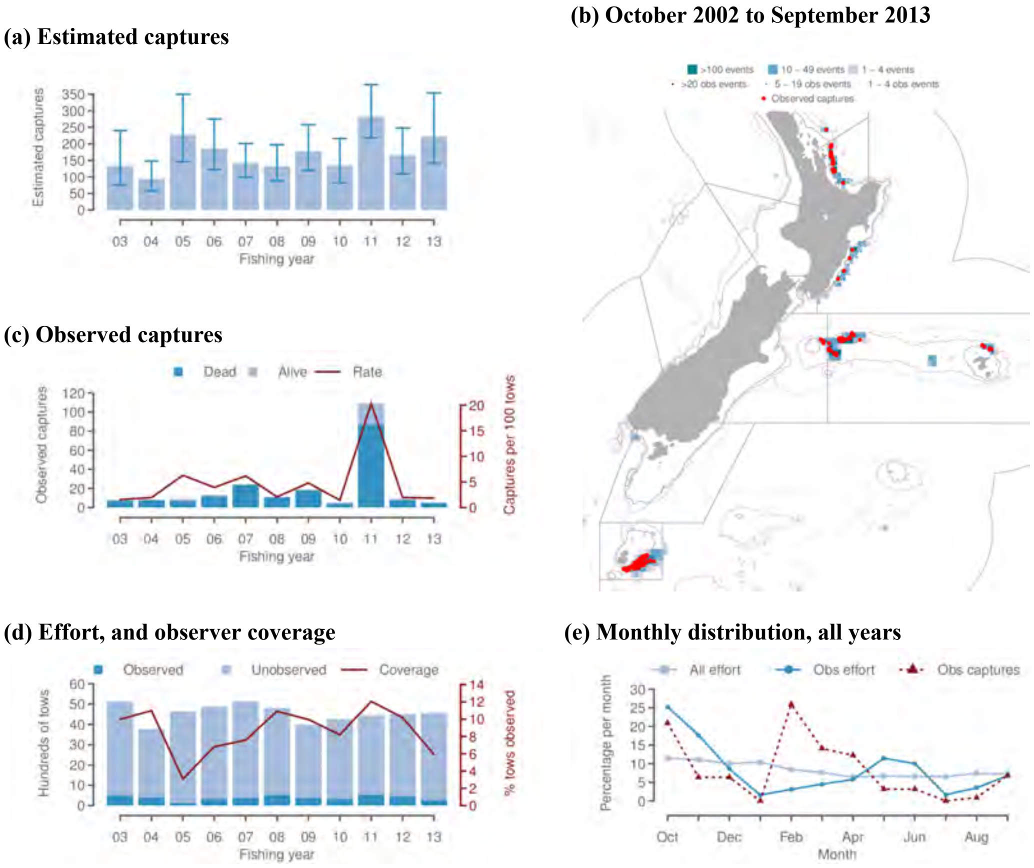


Figure B-59: All bird captures in scampi trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (97.8% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.8 All bird captures in bottom-longline fisheries

Table B-54: Annual fishing effort and number of hooks observed in bottom-longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	54 043 909	4.2	92	0.040	3 306	2 356–4 636	0.06	0.04–0.09
1999–00	52 730 082	6.1	202	0.063	2 251	1 701–2 878	0.04	0.03–0.05
2000–01	50 713 196	8.9	534	0.118	2 932	2 295–3 767	0.06	0.05–0.07
2001–02	46 653 023	15.0	427	0.061	2 868	2 040–4 373	0.06	0.04–0.09
2002–03	37 761 838	28.5	298	0.028	1 881	1 423–2 390	0.05	0.04–0.06
2003–04	43 225 599	11.7	54	0.011	1 219	844–1 632	0.03	0.02–0.04
2004–05	41 844 688	6.9	30	0.010	1 338	931–1 794	0.03	0.02–0.04
2005–06	37 141 633	10.2	41	0.011	1 133	800–1 505	0.03	0.02–0.04
2006–07	38 149 420	6.1	58	0.025	1 598	1 071–2 305	0.04	0.03–0.06
2007–08	41 507 547	8.6	40	0.011	1 443	1 020–1 921	0.03	0.02–0.05
2008–09	37 426 952	10.8	33	0.008	1 245	870–1 658	0.03	0.02–0.04
2009–10	40 440 801	5.6	68	0.030	1 214	856–1 604	0.03	0.02–0.04
2010–11	40 904 091	4.2	29	0.017	1 451	1 021–1 914	0.04	0.02–0.05
2011–12	37 877 121	5.5	10	0.005	1 135	772–1 530	0.03	0.02–0.04
2012–13	32 525 173	1.2	2	0.005	991	666–1 349	0.03	0.02–0.04

[s] All observed captures by species: white-chinned petrel (861), grey petrel (426), Salvin's albatross (183), sooty shearwater (103), black petrel (65), flesh-footed shearwater (53), Cape petrel (33), common diving petrel (24), Chatham Island albatross (23), fulmars, petrels, prions and shearwaters (17), albatrosses (17), Cape petrels (13), southern Buller's albatross (11), New Zealand white-capped albatross (10), northern giant petrel (8), wandering albatrosses (6), grey-faced petrel (6), Snares Cape petrel (6), southern giant petrel (5), fluttering shearwater (5), southern royal albatross (4), giant petrels (4), Campbell black-browed albatross (4), storm petrels (3), broad-billed prion (3), Buller's shearwater (3), southern black-backed gull (2), seagulls (2), prions (2), pied shag (2), black-browed albatross (2), Australasian gannet (2), small seabirds (1), shearwaters (1), red-billed gull (1), petrels, prions, and shearwaters (1), northern Buller's albatross (1), crested penguins (1), black-browed albatrosses (1), antarctic petrel (1), Westland petrel (1), Indian Ocean yellow-nosed albatross (1)

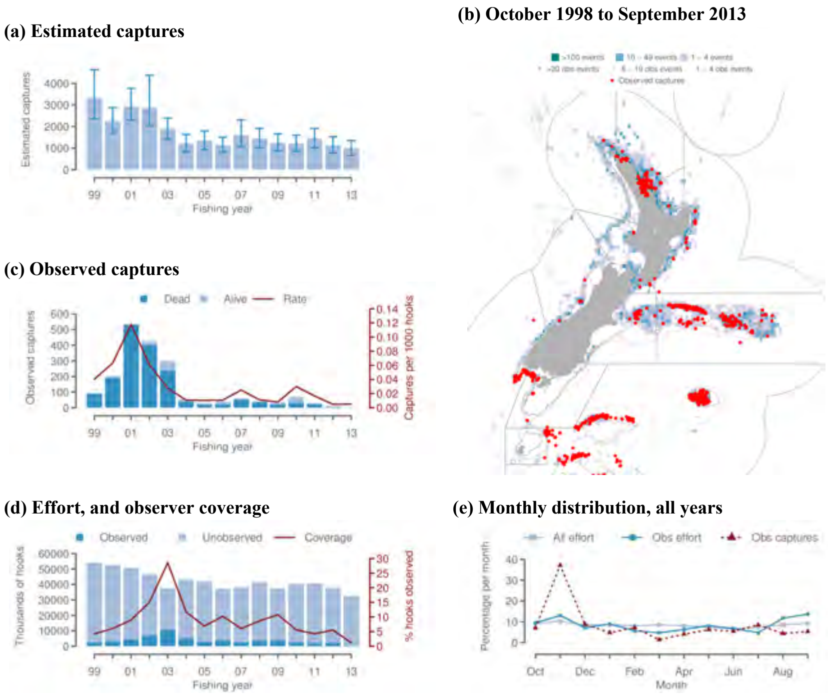


Figure B-60: All bird captures in bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (97.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.9 All bird captures in large-vessel ling longline fisheries

Table B-55: Annual fishing effort and number of hooks observed in large-vessel ling longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	31 193 828	7.2	90	0.040	2 061	1 266–3 336	0.07	0.04–0.11
1999–00	29 495 559	10.8	202	0.063	997	770–1 323	0.03	0.03–0.04
2000–01	26 668 936	16.1	505	0.117	1 715	1 315–2 386	0.06	0.05–0.09
2001–02	25 824 647	27.2	427	0.061	1 800	1 127–3 214	0.07	0.04–0.12
2002–03	17 286 318	62.2	295	0.027	718	558–987	0.04	0.03–0.06
2003–04	22 345 397	21.0	43	0.009	163	118–234	0.01	0.01–0.01
2004–05	18 029 290	14.4	17	0.007	193	117–348	0.01	0.01–0.02
2005–06	13 598 832	26.4	29	0.008	125	85–198	0.01	0.01–0.01
2006–07	11 974 372	15.2	13	0.007	279	89–866	0.02	0.01–0.07
2007–08	12 653 906	23.7	19	0.006	241	123–515	0.02	0.01–0.04
2008–09	11 831 980	27.0	5	0.002	140	61–316	0.01	0.01–0.03
2009–10	12 219 034	14.1	10	0.006	75	46–135	0.01	0.00–0.01
2010–11	11 505 690	11.4	27	0.021	198	113–363	0.02	0.01–0.03
2011–12	10 526 805	15.9	3	0.002	73	36–155	0.01	0.00–0.01
2012–13	7 223 510	3.1	0	0.000	88	42–209	0.01	0.01–0.03

[s] All observed captures by species: white-chinned petrel (856), grey petrel (409), Salvin's albatross (161), sooty shearwater (101), Cape petrel (29), common diving petrel (24), albatrosses (16), Cape petrels (12), Chatham Island albatross (11), fulmars, petrels, prions and shearwaters (9), northern giant petrel (8), New Zealand white-capped albatross (7), Snares Cape petrel (6), wandering albatrosses (5), southern giant petrel (5), southern royal albatross (4), southern Buller's albatross (4), giant petrels (4), storm petrels (3), broad-billed prion (3), prions (2), black-browed albatross (2), northern Buller's albatross (1), crested penguins (1), black-browed albatrosses (1), antarctic petrel (1)

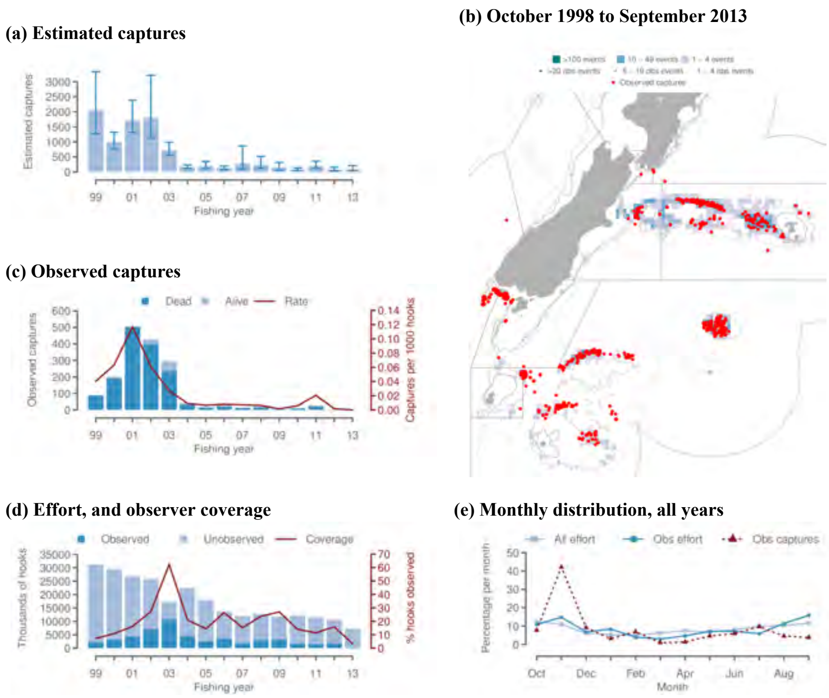


Figure B-61: All bird captures in large-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (82.4% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.10 All bird captures in small-vessel snapper longline fisheries

Table B-56: Annual fishing effort and number of hooks observed in small-vessel snapper longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	14 968 571	0.0	0	–	601	330–914	0.04	0.02–0.06
1999–00	16 287 395	0.0	0	–	641	353–981	0.04	0.02–0.06
2000–01	17 242 208	0.2	26	0.794	645	365–972	0.04	0.02–0.06
2001–02	15 309 436	0.0	0	–	567	310–873	0.04	0.02–0.06
2002–03	13 688 232	0.0	0	–	451	242–694	0.03	0.02–0.05
2003–04	12 246 568	1.5	10	0.055	388	215–594	0.03	0.02–0.05
2004–05	11 531 841	2.2	13	0.052	336	185–515	0.03	0.02–0.04
2005–06	11 696 113	1.0	12	0.103	281	156–427	0.02	0.01–0.04
2006–07	10 351 191	0.6	0	0.000	288	150–454	0.03	0.01–0.04
2007–08	9 053 797	0.0	0	–	247	127–385	0.03	0.01–0.04
2008–09	8 970 674	3.0	20	0.074	255	144–387	0.03	0.02–0.04
2009–10	11 033 205	4.4	30	0.062	275	160–410	0.02	0.01–0.04
2010–11	11 343 532	0.0	0	–	287	152–447	0.03	0.01–0.04
2011–12	11 039 780	0.0	0	–	252	134–395	0.02	0.01–0.04
2012–13	10 502 660	0.3	0	0.000	248	129–387	0.02	0.01–0.04

[s] All observed captures by species: flesh-footed shearwater (49), black petrel (28), grey petrel (11), fulmars, petrels, prions and shearwaters (8), fluttering shearwater (4), Buller's shearwater (3), pied shag (2), Australasian gannet (2), southern black-backed gull (1), shearwaters (1), red-billed gull (1), petrels, prions, and shearwaters (1)

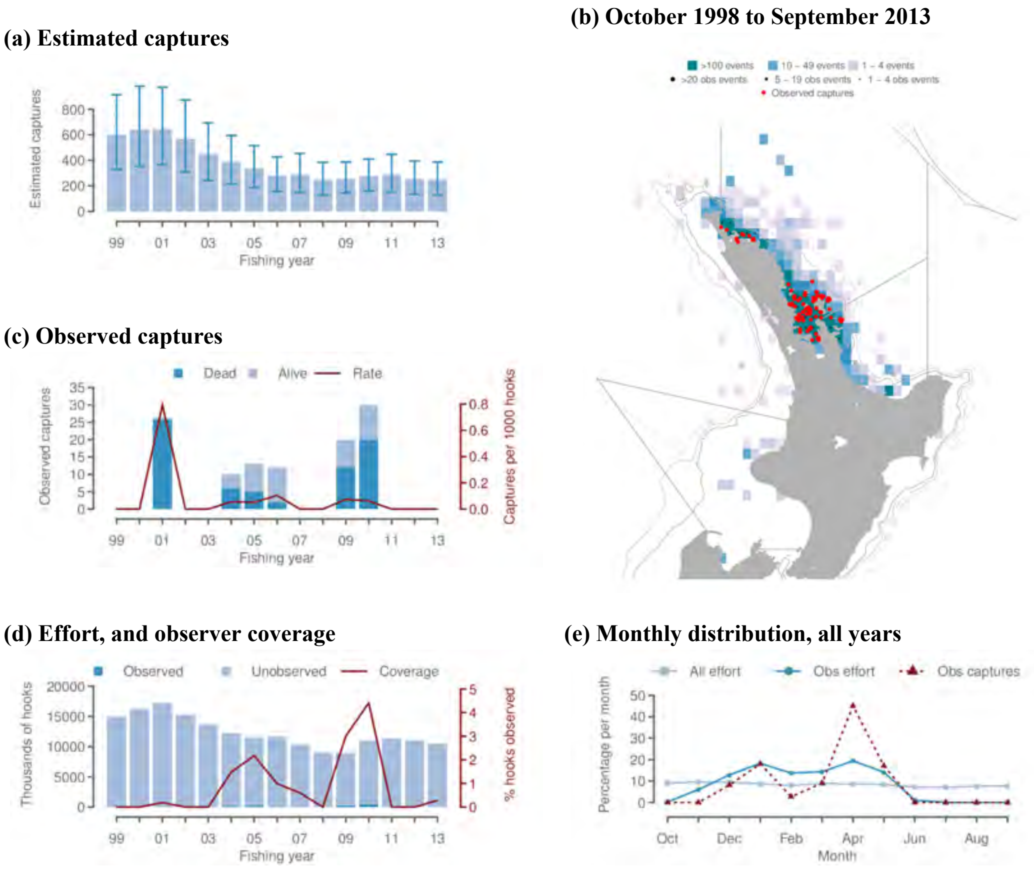


Figure B-62: All bird captures in small-vessel snapper longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (98.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.11 All bird captures in small-vessel bluenose longline fisheries

Table B-57: Annual fishing effort and number of hooks observed in small-vessel bluenose longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 657 142	0.0	0	–	242	153–347	0.15	0.09–0.21
1999–00	1 954 125	0.0	0	–	232	144–331	0.12	0.07–0.17
2000–01	1 958 289	0.0	0	–	204	126–295	0.10	0.06–0.15
2001–02	1 556 950	0.0	0	–	160	97–233	0.10	0.06–0.15
2002–03	1 718 544	0.0	0	0.000	233	143–340	0.14	0.08–0.20
2003–04	2 754 744	0.0	0	–	263	165–383	0.10	0.06–0.14
2004–05	4 643 687	0.2	0	0.000	321	207–447	0.07	0.04–0.10
2005–06	5 110 600	0.0	0	–	359	241–504	0.07	0.05–0.10
2006–07	6 765 477	1.0	5	0.075	507	340–702	0.07	0.05–0.10
2007–08	8 282 062	1.9	5	0.031	457	307–623	0.06	0.04–0.08
2008–09	6 168 080	0.1	0	0.000	375	247–520	0.06	0.04–0.08
2009–10	5 846 729	0.4	15	0.594	371	251–508	0.06	0.04–0.09
2010–11	4 911 570	0.9	2	0.044	333	218–466	0.07	0.04–0.09
2011–12	3 666 731	0.0	0	0.000	245	157–349	0.07	0.04–0.10
2012–13	2 184 138	0.0	0	–	161	101–237	0.07	0.05–0.11

[s] All observed captures by species: black petrel (21), southern Buller's albatross (2), Campbell black-browed albatross (2), white-chinned petrel (1), wandering albatrosses (1)

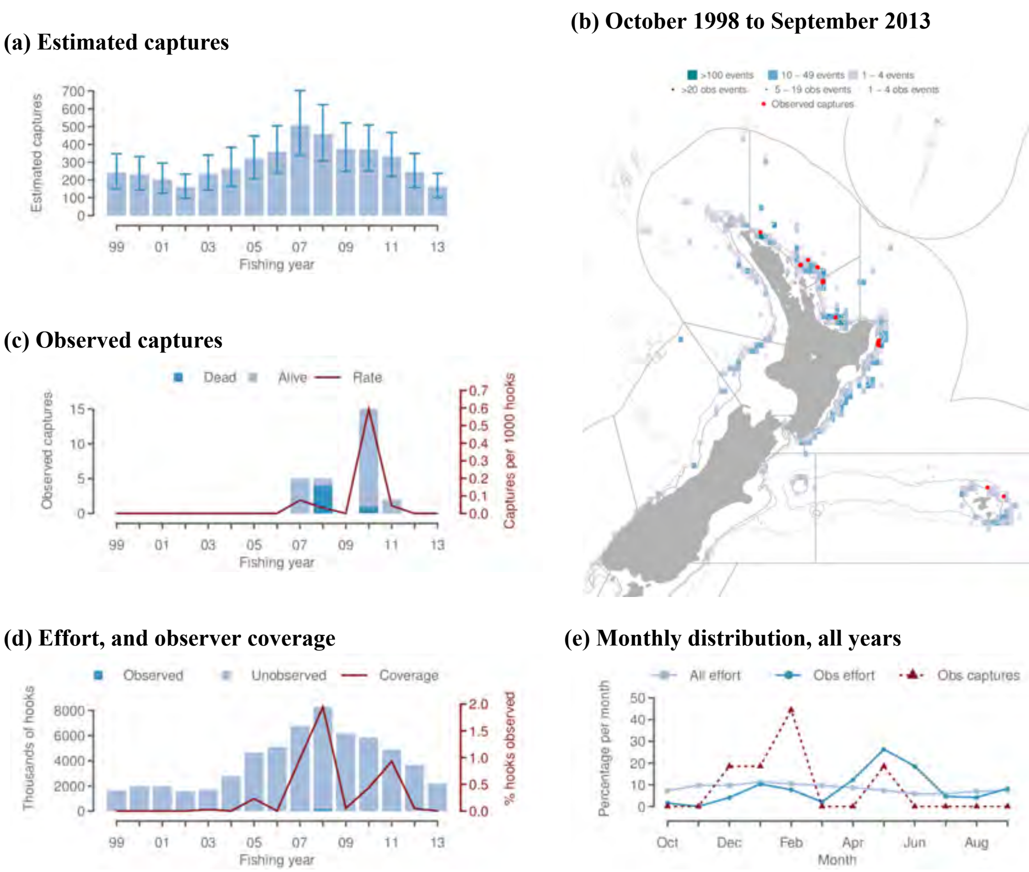


Figure B-63: All bird captures in small-vessel bluenose longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (95.2% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.12 All bird captures in small-vessel ling longline fisheries

Table B-58: Annual fishing effort and number of hooks observed in small-vessel ling longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	3 127 560	0.0	0	–	193	124–279	0.06	0.04–0.09
1999–00	2 660 610	0.0	0	–	191	124–276	0.07	0.05–0.10
2000–01	2 231 568	0.0	0	–	164	105–236	0.07	0.05–0.11
2001–02	1 873 462	0.0	0	–	141	89–208	0.08	0.05–0.11
2002–03	2 481 081	0.2	3	0.602	246	160–351	0.10	0.06–0.14
2003–04	2 200 322	1.5	1	0.031	169	107–248	0.08	0.05–0.11
2004–05	3 538 481	0.6	0	0.000	246	163–348	0.07	0.05–0.10
2005–06	2 640 569	0.0	0	–	146	92–216	0.06	0.03–0.08
2006–07	4 881 424	7.1	40	0.115	277	193–377	0.06	0.04–0.08
2007–08	6 353 499	3.7	3	0.013	286	191–403	0.05	0.03–0.06
2008–09	5 755 734	8.9	4	0.008	277	184–392	0.05	0.03–0.07
2009–10	6 176 059	0.0	0	–	258	170–357	0.04	0.03–0.06
2010–11	6 797 522	2.1	0	0.000	373	247–518	0.05	0.04–0.08
2011–12	6 486 288	0.4	5	0.194	292	192–415	0.05	0.03–0.06
2012–13	5 745 174	0.0	0	–	273	178–387	0.05	0.03–0.07

[s] All observed captures by species: Salvin's albatross (22), Chatham Island albatross (12), southern Buller's albatross (4), Cape petrel (4), white-chinned petrel (3), grey petrel (3), New Zealand white-capped albatross (3), seagulls (2), small seabirds (1), albatrosses (1), Indian Ocean yellow-nosed albatross (1)

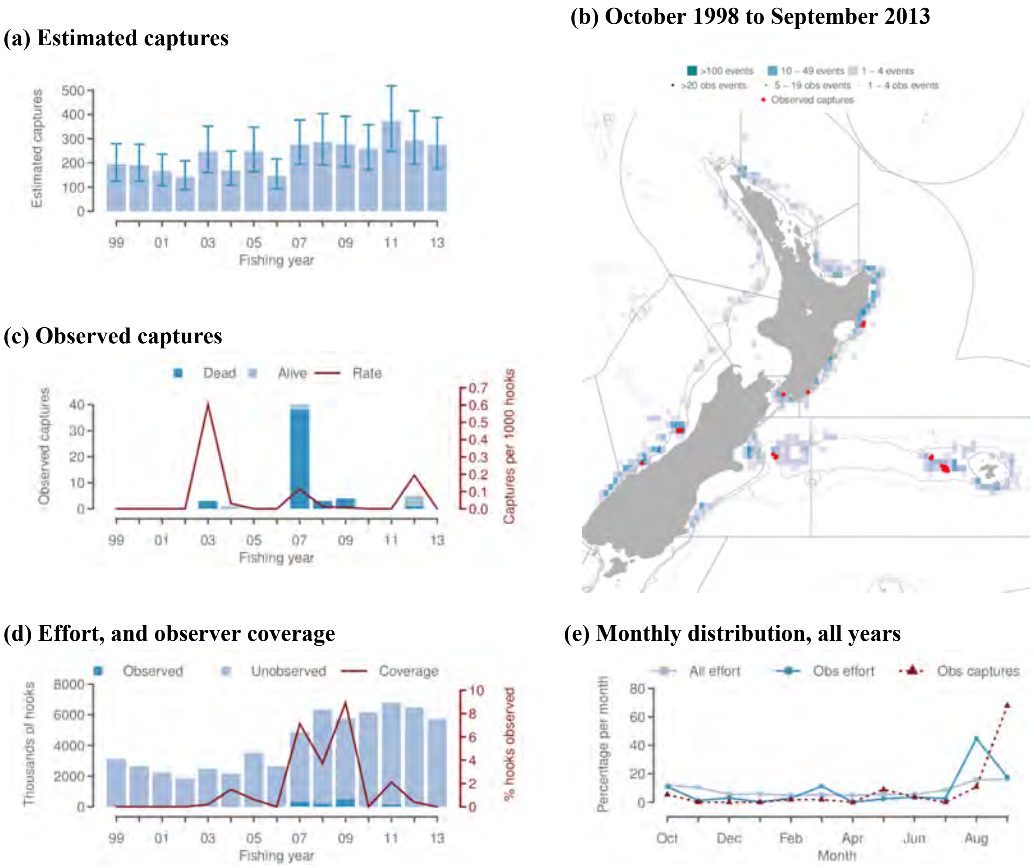


Figure B-64: All bird captures in small-vessel ling longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (93.6% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.13 All bird captures in small-vessel hapuka longline fisheries

Table B-59: Annual fishing effort and number of hooks observed in small-vessel hapuka longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

			Observed		Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 235 618	0.0	0	–	69	31–116	0.06	0.03–0.09
1999–00	1 187 391	0.0	0	–	82	38–135	0.07	0.03–0.11
2000–01	1 239 573	0.0	0	–	94	46–155	0.08	0.04–0.13
2001–02	1 114 359	0.0	0	–	115	56–185	0.10	0.05–0.17
2002–03	1 169 366	0.0	0	–	113	55–182	0.10	0.05–0.16
2003–04	1 667 850	0.0	0	–	102	50–166	0.06	0.03–0.10
2004–05	1 626 440	0.3	0	0.000	102	50–168	0.06	0.03–0.10
2005–06	1 242 568	0.0	0	–	65	29–110	0.05	0.02–0.09
2006–07	1 907 673	0.2	0	0.000	95	44–159	0.05	0.02–0.08
2007–08	1 988 566	3.7	10	0.134	74	38–119	0.04	0.02–0.06
2008–09	2 001 859	2.2	3	0.069	81	39–133	0.04	0.02–0.07
2009–10	2 507 912	0.3	13	1.561	113	61–177	0.05	0.02–0.07
2010–11	3 161 497	0.4	0	0.000	118	56–198	0.04	0.02–0.06
2011–12	3 010 076	0.4	0	0.000	141	70–236	0.05	0.02–0.08
2012–13	3 276 130	0.1	0	0.000	114	56–192	0.03	0.02–0.06

[s] All observed captures by species: black petrel (16), grey-faced petrel (6), flesh-footed shearwater (3), Campbell black-browed albatross (1)

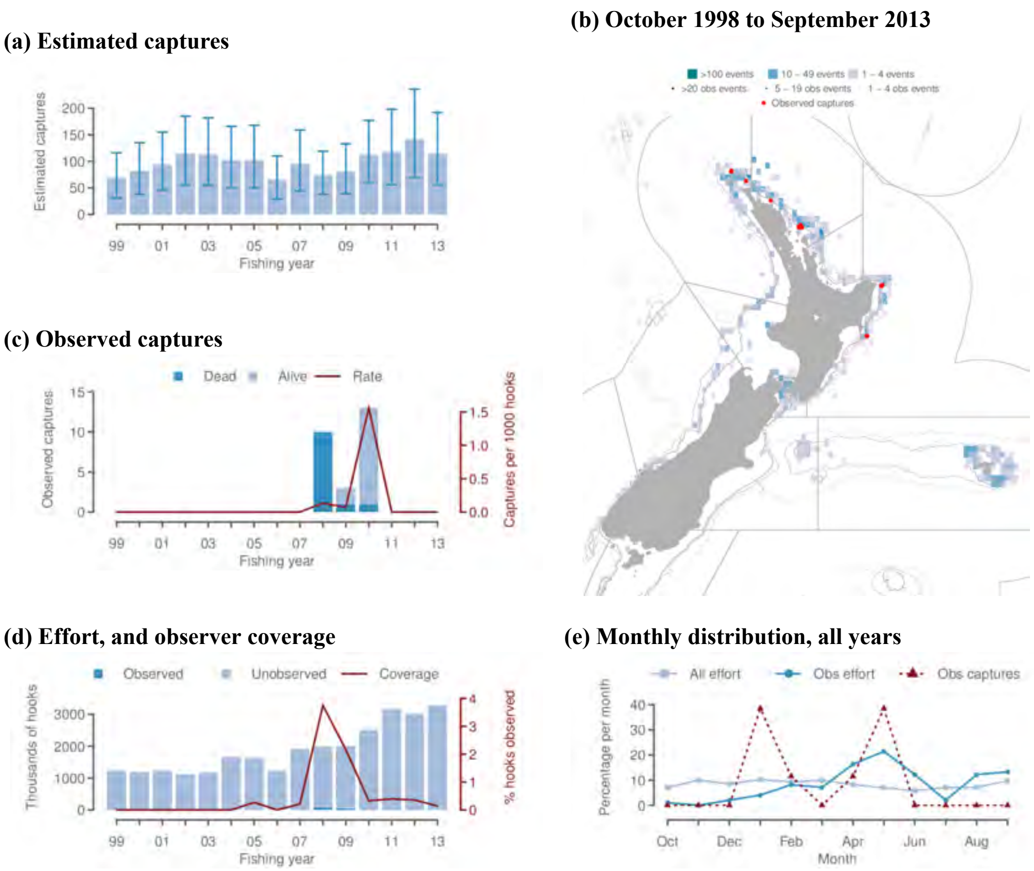


Figure B-65: All bird captures in small-vessel hapuka longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (93.8% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.14 All bird captures in small-vessel minor bottom-longline fisheries

Table B-60: Annual fishing effort and number of hooks observed in small-vessel minor bottom-longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

			Observed		Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	1 617 478	0.0	0	–	134	66–222	0.08	0.04–0.14
1999–00	966 198	0.0	0	–	101	47–171	0.10	0.05–0.18
2000–01	1 152 777	0.0	0	–	106	51–178	0.09	0.04–0.15
2001–02	793 859	0.0	0	–	84	39–141	0.11	0.05–0.18
2002–03	776 096	0.0	0	–	86	41–144	0.11	0.05–0.19
2003–04	1 018 750	0.1	0	0.000	86	40–146	0.08	0.04–0.14
2004–05	1 571 943	0.1	0	0.000	98	46–167	0.06	0.03–0.11
2005–06	1 563 060	2.6	0	0.000	92	43–157	0.06	0.03–0.10
2006–07	1 484 367	0.8	0	0.000	91	41–154	0.06	0.03–0.10
2007–08	1 706 527	0.4	0	0.000	74	33–127	0.04	0.02–0.07
2008–09	1 660 534	0.4	1	0.167	92	44–156	0.06	0.03–0.09
2009–10	1 269 156	2.8	0	0.000	63	27–111	0.05	0.02–0.09
2010–11	1 775 253	0.5	0	0.000	83	39–143	0.05	0.02–0.08
2011–12	2 113 969	2.0	1	0.023	93	43–158	0.04	0.02–0.07
2012–13	2 576 556	3.1	2	0.025	87	42–144	0.03	0.02–0.06

[s] All observed captures by species: southern black-backed gull (1), fluttering shearwater (1), flesh-footed shearwater (1), Westland petrel (1)

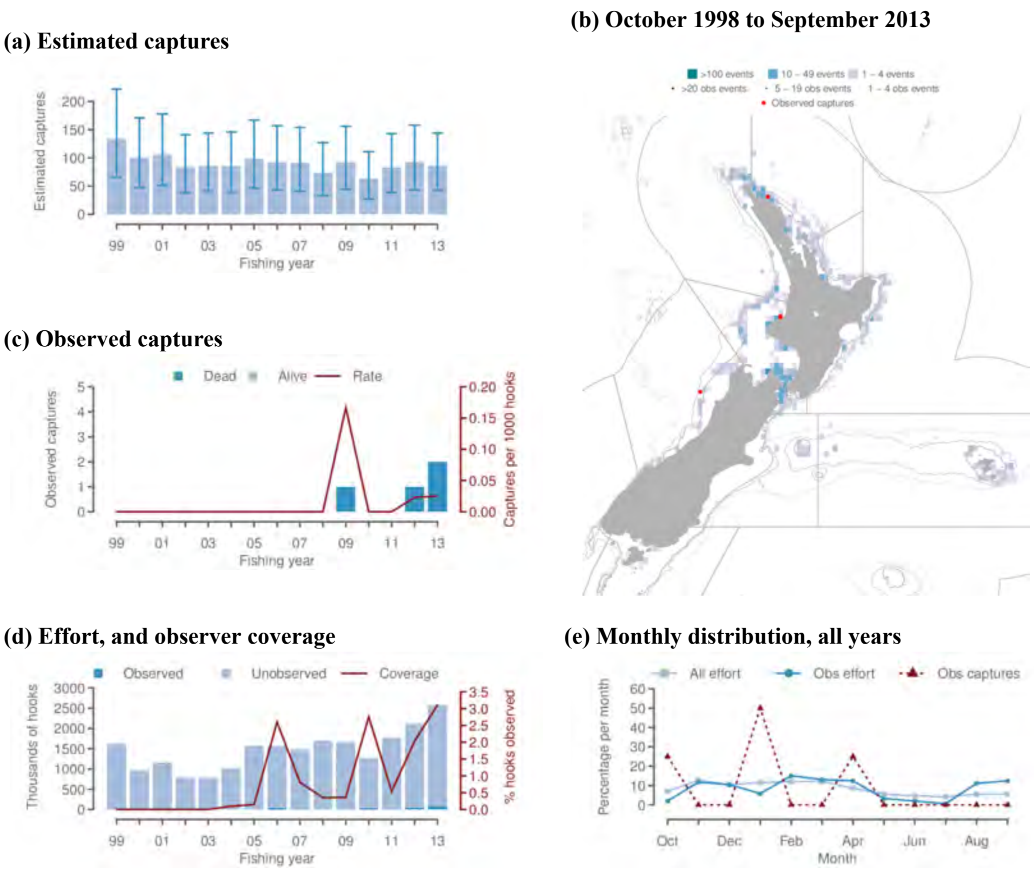


Figure B-66: All bird captures in small-vessel minor bottom-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (83.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.15 All bird captures in surface-longline fisheries

Table B-61: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	6 931 624	18.7	84	0.065	1 517	1 163–2 090	0.22	0.17–0.30
1999–00	8 271 067	10.4	74	0.086	1 759	1 348–2 384	0.21	0.16–0.29
2000–01	9 711 545	10.8	53	0.051	1 884	1 448–2 527	0.19	0.15–0.26
2001–02	10 841 737	9.1	167	0.170	2 397	1 843–3 254	0.22	0.17–0.30
2002–03	10 772 188	20.4	115	0.052	2 088	1 613–2 807	0.19	0.15–0.26
2003–04	7 386 329	21.8	71	0.044	1 395	1 086–1 851	0.19	0.15–0.25
2004–05	3 679 765	21.3	41	0.052	617	483–793	0.17	0.13–0.22
2005–06	3 690 119	19.1	37	0.052	808	611–1 132	0.22	0.17–0.31
2006–07	3 739 912	27.8	187	0.180	958	736–1 345	0.26	0.20–0.36
2007–08	2 246 189	18.8	37	0.088	524	417–676	0.23	0.19–0.30
2008–09	3 115 633	30.1	57	0.061	609	493–766	0.20	0.16–0.25
2009–10	2 995 264	22.2	135	0.203	939	749–1 216	0.31	0.25–0.41
2010–11	3 187 879	21.2	47	0.070	705	532–964	0.22	0.17–0.30
2011–12	3 100 277	23.5	64	0.088	829	617–1 161	0.27	0.20–0.37
2012–13	2 862 182	19.6	27	0.048	783	567–1 144	0.27	0.20–0.40

[s] All observed captures by species: southern Buller's albatross (481), New Zealand white-capped albatross (143), flesh-footed shearwater (141), grey petrel (58), white-chinned petrel (54), Campbell black-browed albatross (54), Antipodean albatross (41), Gibson's albatross (40), albatrosses (34), black petrel (31), grey-faced petrel (24), Salvin's albatross (16), sooty shearwater (14), Westland petrel (10), wandering albatrosses (9), southern royal albatross (8), Antipodean and Gibson's albatrosses (7), black-browed albatross (6), Cape petrels (6), wandering albatross (4), black-browed albatrosses (4), white-headed petrel (2), southern giant petrel (2), light-mantled sooty albatross (2), smaller albatrosses (1), northern royal albatross (1), northern Buller's albatross (1), large seabirds (1), gadfly petrels (1)

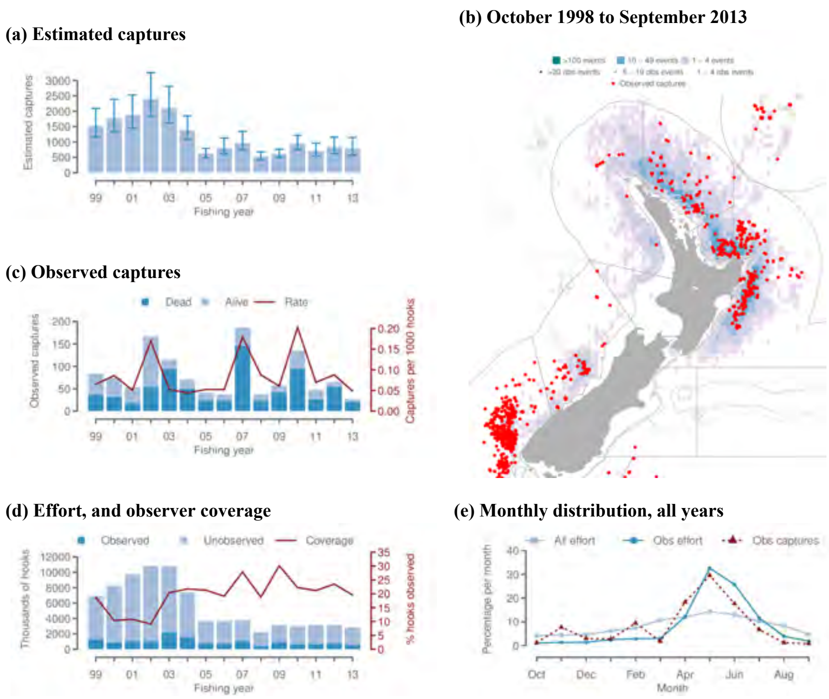


Figure B-67: All bird captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (92.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.16 All bird captures in small-vessel bigeye longline fisheries

Table B-62: Annual fishing effort and number of hooks observed in small-vessel bigeye longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	4 132 143	0.7	6	0.206	1 117	827–1 581	0.27	0.20–0.38
1999–00	5 682 409	0.6	33	0.959	1 348	1 017–1 885	0.24	0.18–0.33
2000–01	6 753 564	2.6	34	0.197	1 392	1 043–1 903	0.21	0.15–0.28
2001–02	6 798 527	1.3	80	0.878	1 639	1 222–2 284	0.24	0.18–0.34
2002–03	5 107 467	0.0	0	–	1 250	918–1 759	0.24	0.18–0.34
2003–04	3 411 185	2.0	1	0.014	857	620–1 215	0.25	0.18–0.36
2004–05	1 648 181	2.0	2	0.060	333	237–468	0.20	0.14–0.28
2005–06	1 831 766	1.9	6	0.173	466	343–656	0.25	0.19–0.36
2006–07	1 514 646	5.6	5	0.059	423	305–599	0.28	0.20–0.40
2007–08	967 829	2.5	6	0.247	270	201–367	0.28	0.21–0.38
2008–09	1 559 717	5.5	9	0.105	392	293–530	0.25	0.19–0.34
2009–10	1 247 437	6.4	20	0.250	455	319–663	0.36	0.26–0.53
2010–11	1 639 956	4.9	15	0.185	444	312–650	0.27	0.19–0.40
2011–12	1 285 123	2.5	7	0.216	375	259–568	0.29	0.20–0.44
2012–13	957 485	2.4	3	0.130	316	219–462	0.33	0.23–0.48

[s] All observed captures by species: flesh-footed shearwater (132), black petrel (21), white-chinned petrel (11), southern Buller's albatross (11), Antipodean albatross (11), Salvin's albatross (10), Gibson's albatross (8), grey-faced petrel (5), wandering albatross (3), Campbell black-browed albatross (3), wandering albatrosses (2), Antipodean and Gibson's albatrosses (2), southern royal albatross (1), northern royal albatross (1), grey petrel (1), gadfly petrels (1), black-browed albatrosses (1), black-browed albatross (1), albatrosses (1), New Zealand white-capped albatross (1)

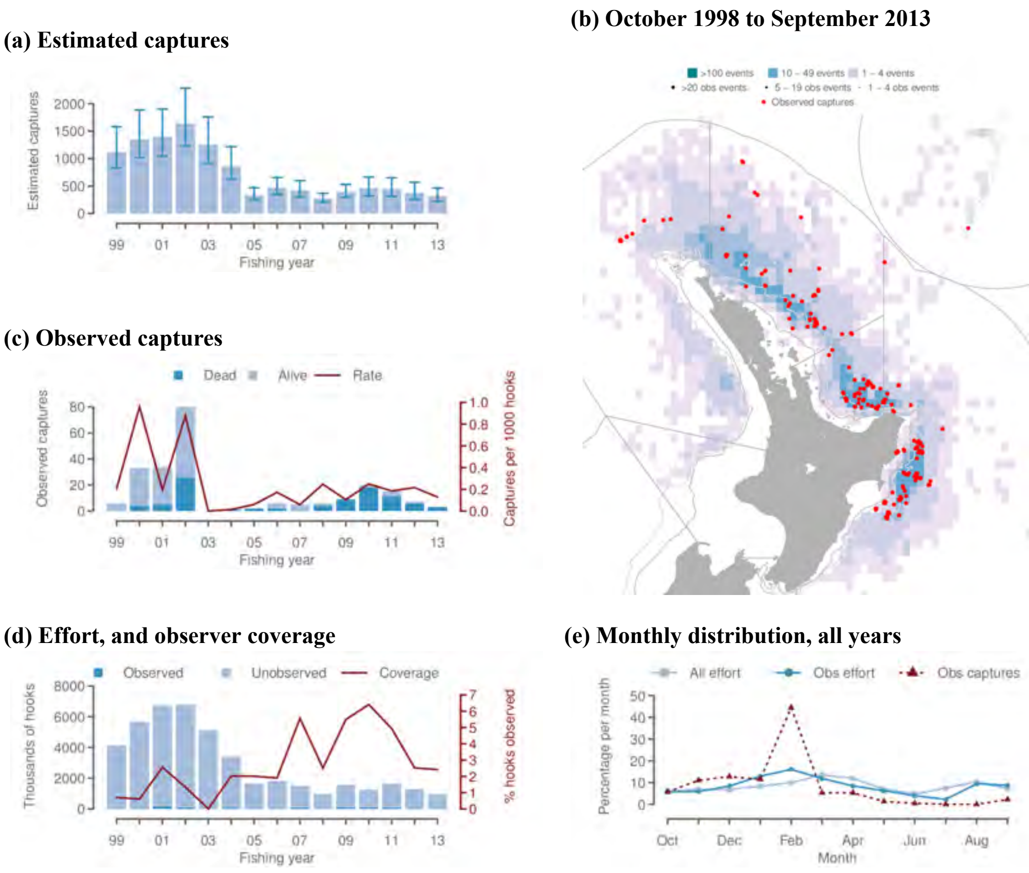


Figure B-68: All bird captures in small-vessel bigeye longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (96.5% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.17 All bird captures in small-vessel southern bluefin longline fisheries

Table B-63: Annual fishing effort and number of hooks observed in small-vessel southern bluefin longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	428 815	0.0	0	–	60	34–105	0.14	0.08–0.24
1999–00	695 415	0.5	1	0.294	129	81–212	0.19	0.12–0.30
2000–01	977 027	2.5	0	0.000	214	149–319	0.22	0.15–0.33
2001–02	1 722 853	1.7	0	0.000	306	211–459	0.18	0.12–0.27
2002–03	2 357 331	0.0	0	–	423	308–603	0.18	0.13–0.26
2003–04	1 691 526	3.1	6	0.115	293	217–402	0.17	0.13–0.24
2004–05	1 023 395	9.0	3	0.033	143	106–190	0.14	0.10–0.19
2005–06	873 938	6.5	14	0.245	123	91–166	0.14	0.10–0.19
2006–07	566 301	13.3	13	0.173	72	50–99	0.13	0.09–0.17
2007–08	536 540	16.9	6	0.066	102	74–133	0.19	0.14–0.25
2008–09	681 008	8.7	6	0.101	147	107–192	0.22	0.16–0.28
2009–10	1 081 300	9.4	56	0.550	323	256–414	0.30	0.24–0.38
2010–11	833 595	8.5	3	0.043	156	107–240	0.19	0.13–0.29
2011–12	1 049 114	9.3	17	0.175	329	222–525	0.31	0.21–0.50
2012–13	1 051 177	3.9	18	0.434	266	181–437	0.25	0.17–0.42

[s] All observed captures by species: southern Buller's albatross (45), New Zealand white-capped albatross (34), grey petrel (23), Campbell black-browed albatross (14), wandering albatrosses (4), Gibson's albatross (4), Antipodean albatross (4), Westland petrel (3), white-chinned petrel (2), black-browed albatross (2), Cape petrels (2), wandering albatross (1), southern royal albatross (1), smaller albatrosses (1), northern Buller's albatross (1), black-browed albatrosses (1), Salvin's albatross (1)

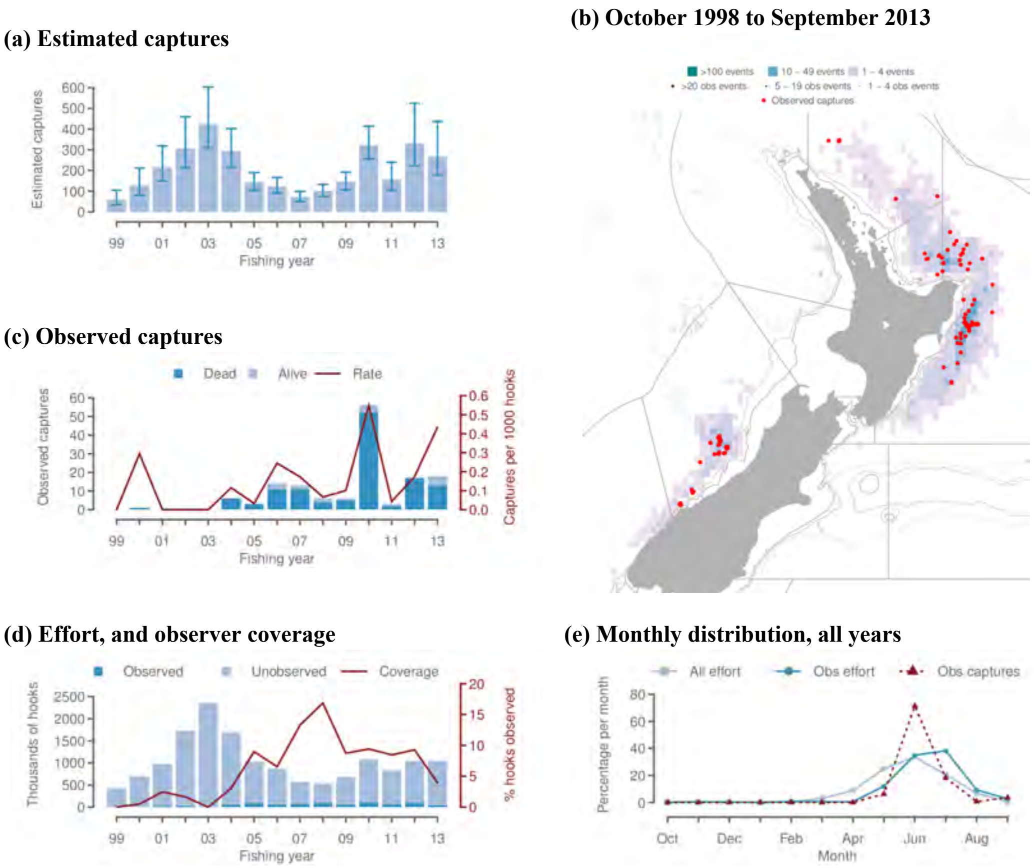


Figure B-69: All bird captures in small-vessel southern bluefin longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (94.0% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.8.18 All bird captures in small-vessel swordfish longline fisheries

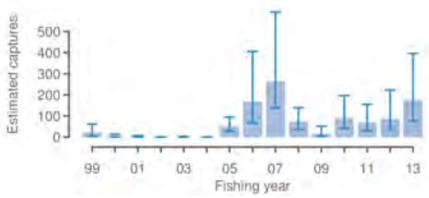
Table B-64: Annual fishing effort and number of hooks observed in small-vessel swordfish longline fisheries, number of observed captures of all birds and observed capture rate (captures per thousand hooks), estimated captures and capture rate of all birds (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks[a]	% obs.[a]	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
1998–99	19 950	0.0	0	–	20	4–61	1.00	0.20–3.06
1999–00	3 800	0.0	0	–	3	0–13	0.79	0.00–3.42
2000–01	–	–	0	–	1	0–7	0.54	0.00–3.78
2001–02	0	–	0	–	0	–		–
2002–03	–	–	0	–	0	0–3	0.00	0.00–1.25
2003–04	0	–	0	–	0	–		–
2004–05	132 503	8.7	2	0.173	52	27–95	0.39	0.20–0.72
2005–06	219 705	2.2	2	0.417	168	67–406	0.76	0.30–1.85
2006–07	192 261	15.1	58	1.999	263	138–592	1.37	0.72–3.08
2007–08	125 330	17.3	1	0.046	74	36–139	0.59	0.29–1.11
2008–09	41 700	9.6	0	0.000	16	4–51	0.38	0.10–1.22
2009–10	137 840	0.4	3	6.000	90	42–196	0.65	0.30–1.42
2010–11	177 248	10.5	0	0.000	68	30–155	0.38	0.17–0.87
2011–12	195 400	22.2	7	0.161	86	34–223	0.44	0.17–1.14
2012–13	316 390	2.6	1	0.121	175	75–396	0.55	0.24–1.25

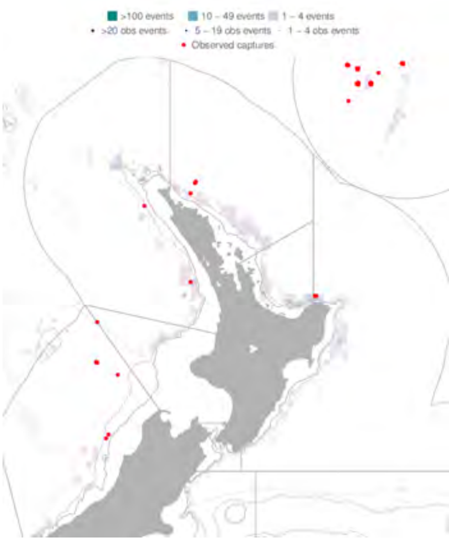
[a] Some effort not shown due to anonymity requirements (see subsection 3.2).

[s] All observed captures by species: albatrosses (33), Antipodean albatross (11), white-chinned petrel (5), Gibson's albatross (4), Antipodean and Gibson's albatrosses (4), grey petrel (3), New Zealand white-capped albatross (3), Campbell black-browed albatross (3), black petrel (2), southern Buller's albatross (1), sooty shearwater (1), grey-faced petrel (1), flesh-footed shearwater (1), black-browed albatrosses (1), Westland petrel (1)

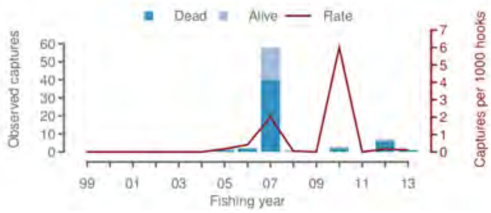
(a) Estimated captures



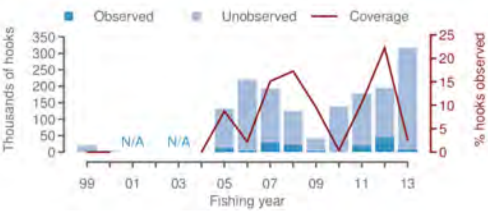
(b) October 1998 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

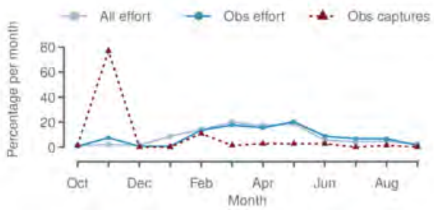


Figure B-70: All bird captures in small-vessel swordfish longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1998–99 to 2012–13 (39.8% of total effort, following confidentiality agreements), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

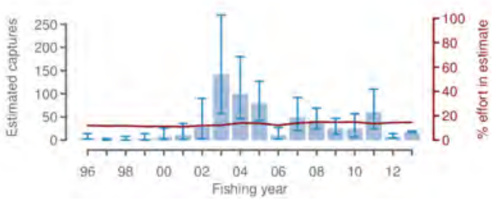
B.9 Common dolphin captures

B.9.1 Common dolphin captures in trawl fisheries

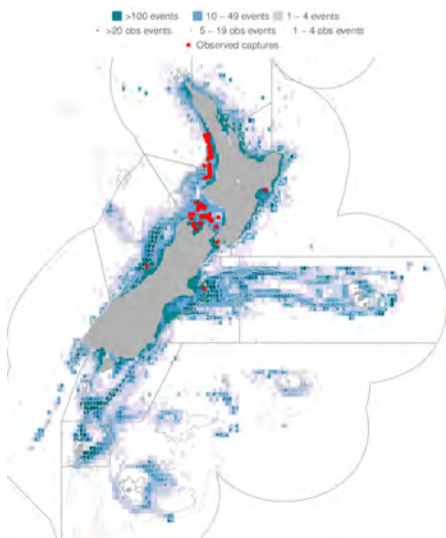
Table B-65: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of common dolphin and observed capture rate (captures per hundred tows), estimated captures and capture rate of common dolphin (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1995–96	150 265	2.9	2	0.05	4	2–14	0.00	0.00–0.01
1996–97	161 028	3.0	0	0.00	0	0–3	0.00	0.00–0.00
1997–98	158 813	4.3	0	0.00	1	0–8	0.00	0.00–0.01
1998–99	153 591	4.7	0	0.00	3	0–14	0.00	0.00–0.01
1999–00	139 003	5.5	1	0.01	7	1–26	0.01	0.00–0.02
2000–01	134 186	6.8	1	0.01	11	1–36	0.01	0.00–0.03
2001–02	127 793	6.0	1	0.01	28	2–90	0.02	0.00–0.07
2002–03	130 174	5.3	21	0.31	142	58–270	0.11	0.04–0.21
2003–04	120 868	5.4	17	0.26	100	46–180	0.08	0.04–0.15
2004–05	120 438	6.4	22	0.29	79	42–127	0.07	0.03–0.11
2005–06	109 923	6.0	4	0.06	10	2–27	0.01	0.00–0.02
2006–07	103 306	7.7	11	0.14	50	21–92	0.05	0.02–0.09
2007–08	89 524	10.1	20	0.22	42	23–69	0.05	0.03–0.08
2008–09	87 548	11.2	20	0.20	25	12–47	0.03	0.01–0.05
2009–10	92 888	9.7	4	0.04	25	6–57	0.03	0.01–0.06
2010–11	86 090	8.6	9	0.12	60	25–110	0.07	0.03–0.13
2011–12	84 429	10.8	5	0.06	7	5–14	0.01	0.01–0.02
2012–13	83 722	14.8	17	0.14	16	16–20	0.02	0.02–0.02

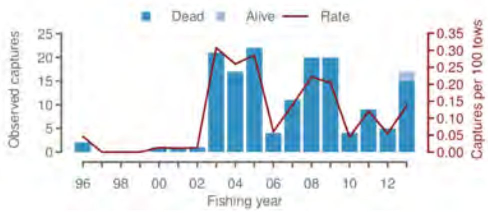
(a) Estimated captures



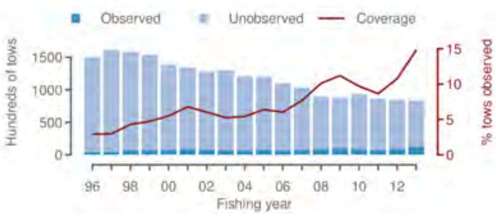
(b) October 1995 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

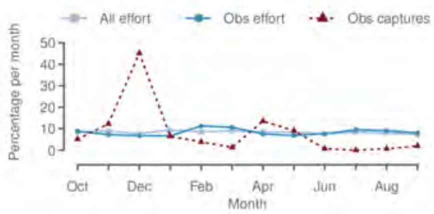


Figure B-71: Common dolphin captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.9.2 Common dolphin captures in large-vessel jack mackerel trawl fisheries, in the Taranaki and West Coast North Island areas

Table B-66: Annual fishing effort and number of tows observed in large-vessel jack mackerel trawl fisheries, in the Taranaki and West Coast North Island areas, number of observed captures of common dolphin and observed capture rate (captures per hundred tows), estimated captures and capture rate of common dolphin (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1995–96	850	14.1	2	1.67	4	2–14	0.47	0.24–1.65
1996–97	601	28.3	0	0.00	0	0–3	0.00	0.00–0.50
1997–98	1 260	17.4	0	0.00	1	0–8	0.08	0.00–0.63
1998–99	911	11.0	0	0.00	3	0–14	0.33	0.00–1.54
1999–00	422	16.8	1	1.41	7	1–26	1.66	0.24–6.16
2000–01	1 106	11.4	1	0.79	11	1–36	0.99	0.09–3.25
2001–02	1 822	6.1	1	0.90	28	2–90	1.54	0.11–4.94
2002–03	2 270	9.9	21	9.33	142	58–270	6.26	2.56–11.89
2003–04	2 246	6.2	17	12.14	99	46–180	4.41	2.05–8.01
2004–05	2 351	22.3	21	4.01	78	42–126	3.32	1.79–5.36
2005–06	2 082	30.9	2	0.31	10	2–27	0.48	0.10–1.30
2006–07	2 152	27.9	11	1.83	50	21–92	2.32	0.98–4.28
2007–08	2 194	32.5	20	2.81	41	23–69	1.87	1.05–3.14
2008–09	1 799	37.8	11	1.62	25	12–46	1.39	0.67–2.56
2009–10	2 206	32.1	4	0.56	25	6–57	1.13	0.27–2.58
2010–11	1 560	30.2	7	1.49	60	25–110	3.85	1.60–7.05
2011–12	1 643	78.6	5	0.39	7	5–14	0.43	0.30–0.85
2012–13	1 719	85.7	15	1.02	15	15–19	0.87	0.87–1.11

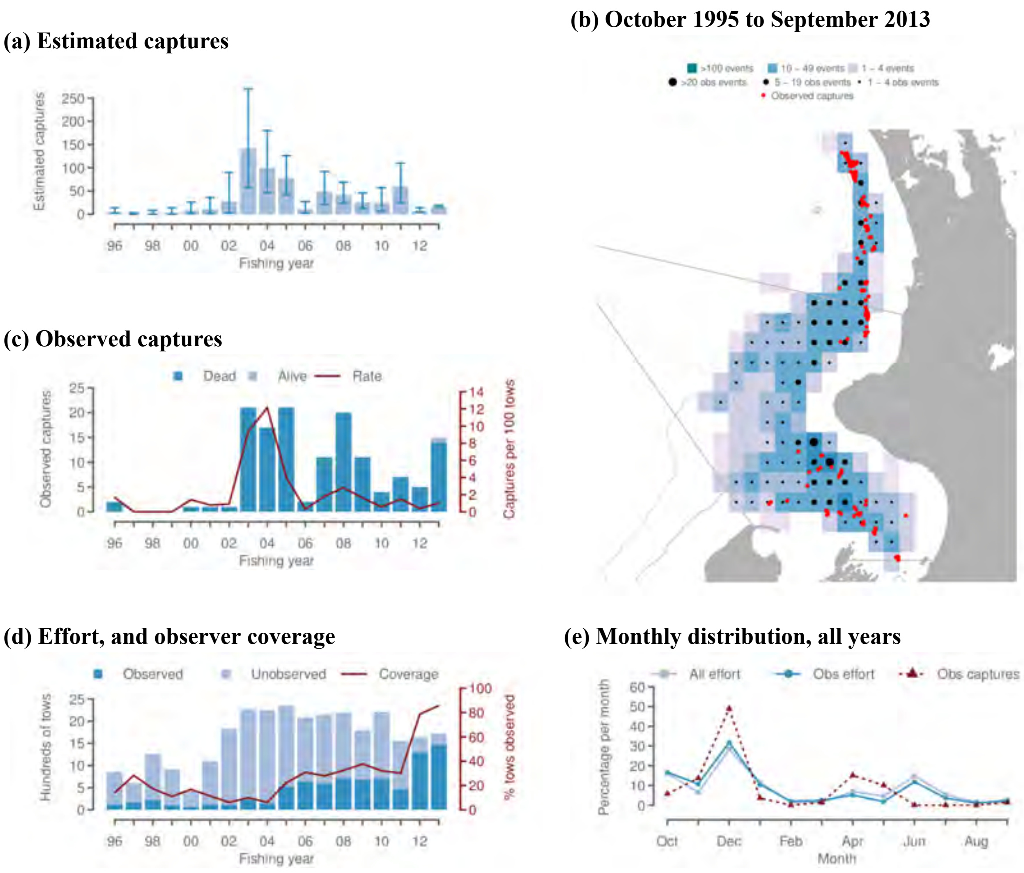


Figure B-72: Common dolphin captures in large-vessel jack mackerel trawl fisheries, in the Taranaki and West Coast North Island areas. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10 New Zealand fur seal captures

B.10.1 New Zealand fur seal captures in trawl fisheries

Table B-67: Annual fishing effort and number of tows observed in trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	130 174	5.3	68	0.99	881	525–1 461	0.68	0.40–1.12
2003–04	120 868	5.4	84	1.28	1 066	631–1 768	0.88	0.52–1.46
2004–05	120 438	6.4	200	2.59	1 443	904–2 341	1.20	0.75–1.94
2005–06	109 923	6.0	143	2.16	912	563–1 515	0.83	0.51–1.38
2006–07	103 306	7.7	73	0.92	536	322–902	0.52	0.31–0.87
2007–08	89 524	10.1	141	1.56	754	473–1 306	0.84	0.53–1.46
2008–09	87 548	11.2	72	0.73	546	307–994	0.62	0.35–1.14
2009–10	92 888	9.7	72	0.80	464	265–877	0.50	0.29–0.94
2010–11	86 090	8.6	73	0.98	414	243–728	0.48	0.28–0.85
2011–12	84 429	10.8	82	0.90	428	247–768	0.51	0.29–0.91
2012–13	83 722	14.8	114	0.92	398	236–713	0.48	0.28–0.85

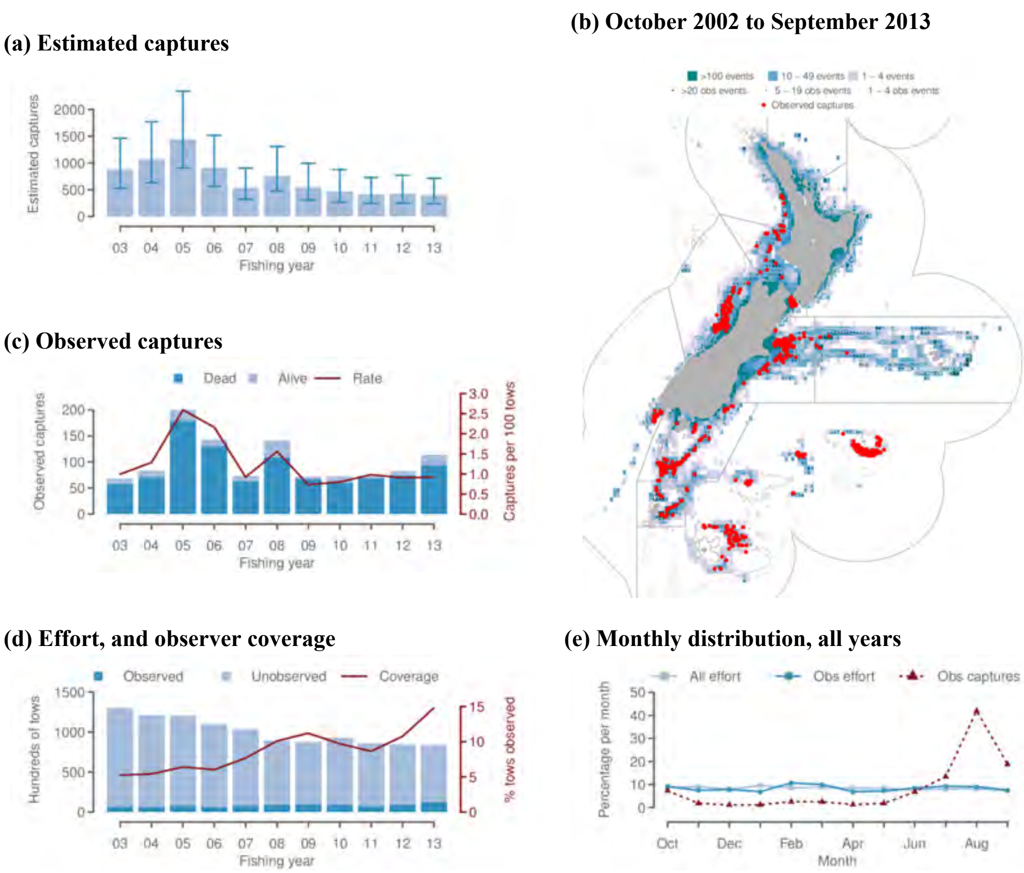


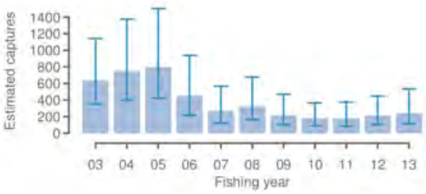
Figure B-73: New Zealand fur seal captures in trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.2 New Zealand fur seal captures in hoki trawl fisheries

Table B-68: Annual fishing effort and number of tows observed in hoki trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

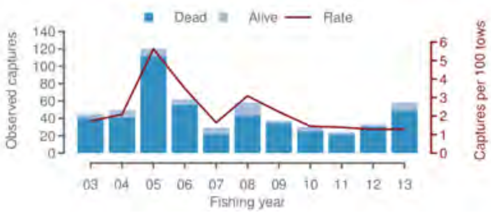
		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	27 786	9.3	45	1.74	636	352–1 142	2.29	1.27–4.11
2003–04	22 523	10.4	49	2.09	750	398–1 376	3.33	1.77–6.11
2004–05	14 545	14.7	120	5.63	797	422–1 504	5.48	2.90–10.34
2005–06	11 590	15.3	62	3.49	452	217–938	3.90	1.87–8.09
2006–07	10 602	16.6	29	1.65	269	121–567	2.54	1.14–5.35
2007–08	8 788	21.4	58	3.09	323	163–677	3.68	1.85–7.70
2008–09	8 174	20.3	37	2.23	217	99–470	2.65	1.21–5.75
2009–10	9 965	20.7	30	1.45	179	88–366	1.80	0.88–3.67
2010–11	10 404	16.6	24	1.39	180	84–375	1.73	0.81–3.60
2011–12	11 333	22.8	33	1.28	213	101–448	1.88	0.89–3.95
2012–13	11 682	38.6	58	1.28	242	114–534	2.07	0.98–4.57

(a) Estimated captures

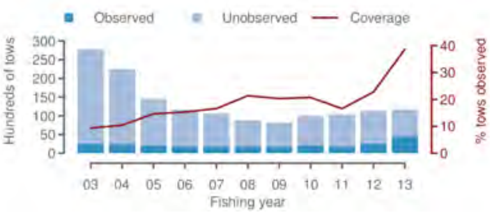


(b) October 2002 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

Figure B-74: New Zealand fur seal captures in hoki trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 98.0% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.3 New Zealand fur seal captures in middle-depth trawl fisheries

Table B-69: Annual fishing effort and number of tows observed in middle-depth trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	11 178	3.1	1	0.29	111	39–263	0.99	0.35–2.35
2003–04	9 165	2.1	0	0.00	124	43–294	1.35	0.47–3.21
2004–05	9 188	2.4	10	4.48	221	93–464	2.41	1.01–5.05
2005–06	8 402	5.8	4	0.82	162	61–383	1.93	0.73–4.56
2006–07	8 197	4.8	3	0.76	107	43–228	1.31	0.52–2.78
2007–08	7 416	6.1	9	2.00	145	64–287	1.96	0.86–3.87
2008–09	7 235	10.1	2	0.27	120	39–307	1.66	0.54–4.24
2009–10	7 217	12.3	5	0.56	93	33–240	1.29	0.46–3.33
2010–11	7 252	8.5	2	0.32	89	31–211	1.23	0.43–2.91
2011–12	6 554	11.7	8	1.05	79	31–191	1.21	0.47–2.91
2012–13	6 451	19.2	9	0.73	78	29–189	1.21	0.45–2.93

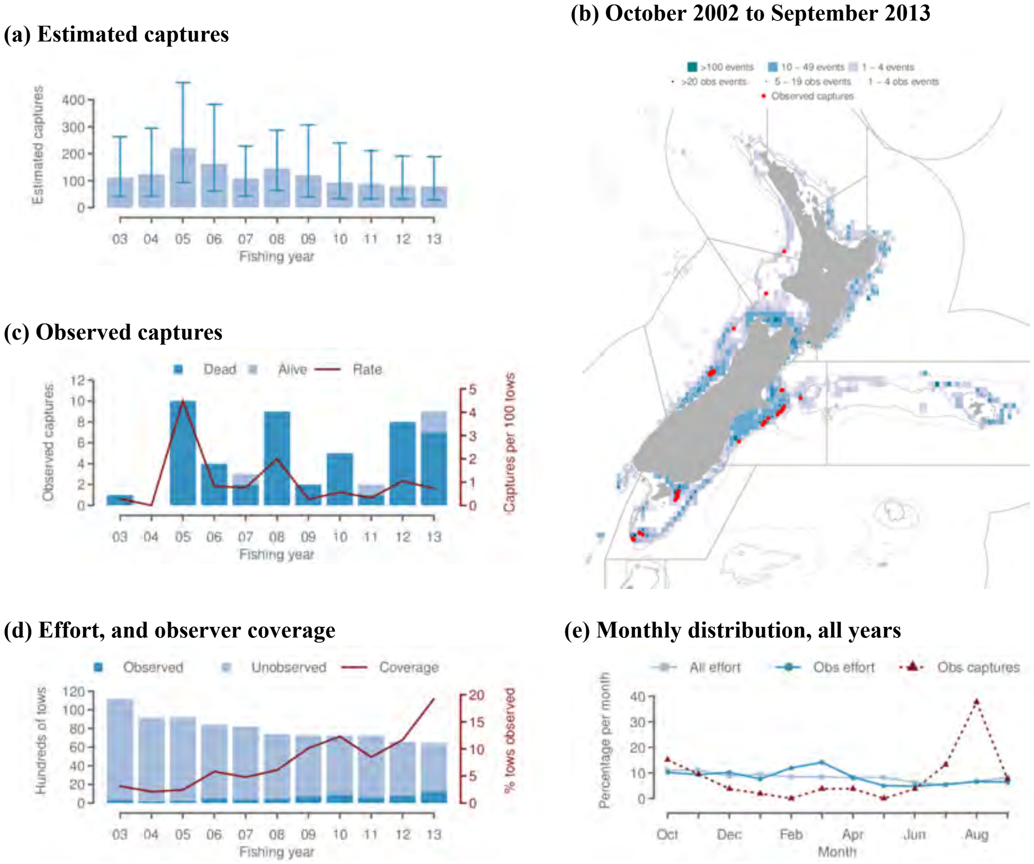


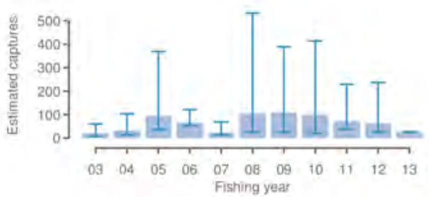
Figure B-75: New Zealand fur seal captures in middle-depth trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 95.2% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.4 New Zealand fur seal captures in southern blue whiting trawl fisheries

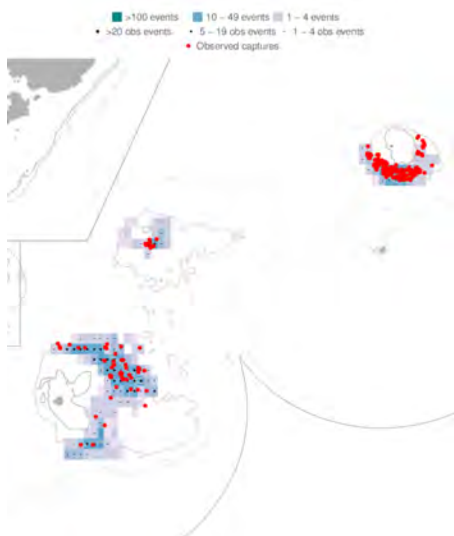
Table B-70: Annual fishing effort and number of tows observed in southern blue whiting trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	638	43.1	8	2.91	19	8–60	2.98	1.25–9.40
2003–04	740	32.6	13	5.39	33	13–103	4.46	1.76–13.92
2004–05	870	38.5	33	9.85	94	35–369	10.80	4.02–42.41
2005–06	624	34.8	52	23.96	67	52–121	10.74	8.33–19.39
2006–07	630	35.6	13	5.80	24	13–69	3.81	2.06–10.95
2007–08	818	40.5	24	7.25	104	25–533	12.71	3.06–65.16
2008–09	1 189	25.3	17	5.65	109	24–389	9.17	2.02–32.72
2009–10	1 113	35.6	16	4.04	100	20–414	8.98	1.80–37.20
2010–11	1 171	37.0	36	8.31	71	38–229	6.06	3.25–19.56
2011–12	952	70.3	25	3.74	61	25–237	6.41	2.63–24.89
2012–13	792	99.9	26	3.29	26	26–26	3.28	3.28–3.28

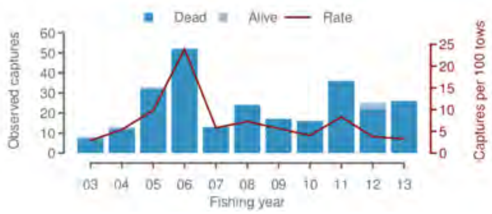
(a) Estimated captures



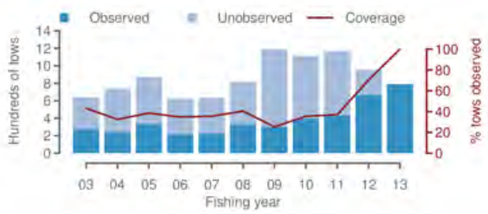
(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

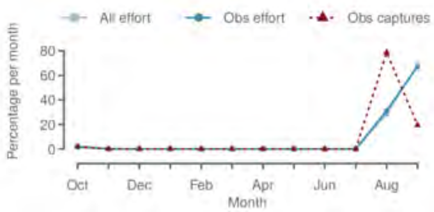


Figure B-76: New Zealand fur seal captures in southern blue whiting trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 98.6% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.5 New Zealand fur seal captures in squid trawl fisheries

Table B-71: Annual fishing effort and number of tows observed in squid trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 410	15.6	8	0.61	56	27–108	0.67	0.32–1.28
2003–04	8 336	21.2	17	0.96	89	46–166	1.07	0.55–1.99
2004–05	10 486	23.9	16	0.64	155	82–284	1.48	0.78–2.71
2005–06	8 575	12.9	4	0.36	96	43–192	1.12	0.50–2.24
2006–07	5 906	21.8	8	0.62	42	20–83	0.71	0.34–1.41
2007–08	4 236	34.4	6	0.41	33	14–67	0.78	0.33–1.58
2008–09	3 867	33.6	1	0.08	19	6–45	0.49	0.16–1.16
2009–10	3 789	28.2	8	0.75	33	15–66	0.87	0.40–1.74
2010–11	4 214	29.9	8	0.63	23	12–42	0.55	0.28–1.00
2011–12	3 505	39.4	8	0.58	23	11–48	0.66	0.31–1.37
2012–13	2 646	85.9	6	0.26	8	6–17	0.30	0.23–0.64

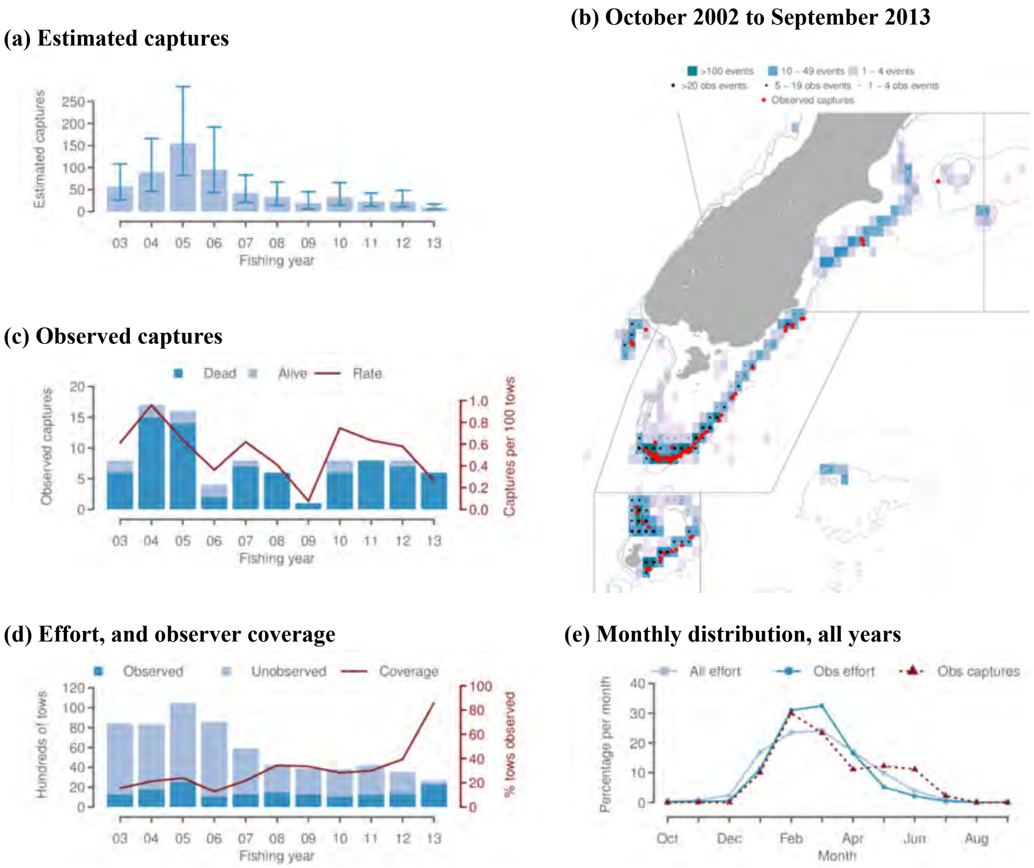


Figure B-77: New Zealand fur seal captures in squid trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 99.0% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.6 New Zealand fur seal captures in ling trawl fisheries

Table B-72: Annual fishing effort and number of tows observed in ling trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	632	2.5	0	0.00	8	0–33	1.27	0.00–5.22
2003–04	558	3.9	0	0.00	12	0–57	2.15	0.00–10.22
2004–05	990	7.7	10	13.16	49	16–145	4.95	1.62–14.65
2005–06	1 394	8.1	2	1.77	37	9–109	2.65	0.65–7.82
2006–07	1 661	9.5	12	7.64	39	18–96	2.35	1.08–5.78
2007–08	2 227	10.8	4	1.66	38	12–100	1.71	0.54–4.49
2008–09	1 409	10.3	0	0.00	24	5–64	1.70	0.35–4.54
2009–10	1 197	16.6	6	3.02	23	8–64	1.92	0.67–5.35
2010–11	1 109	9.4	2	1.92	18	4–51	1.62	0.36–4.60
2011–12	947	16.8	1	0.63	16	2–51	1.69	0.21–5.39
2012–13	1 149	23.4	4	1.49	15	5–42	1.31	0.44–3.66

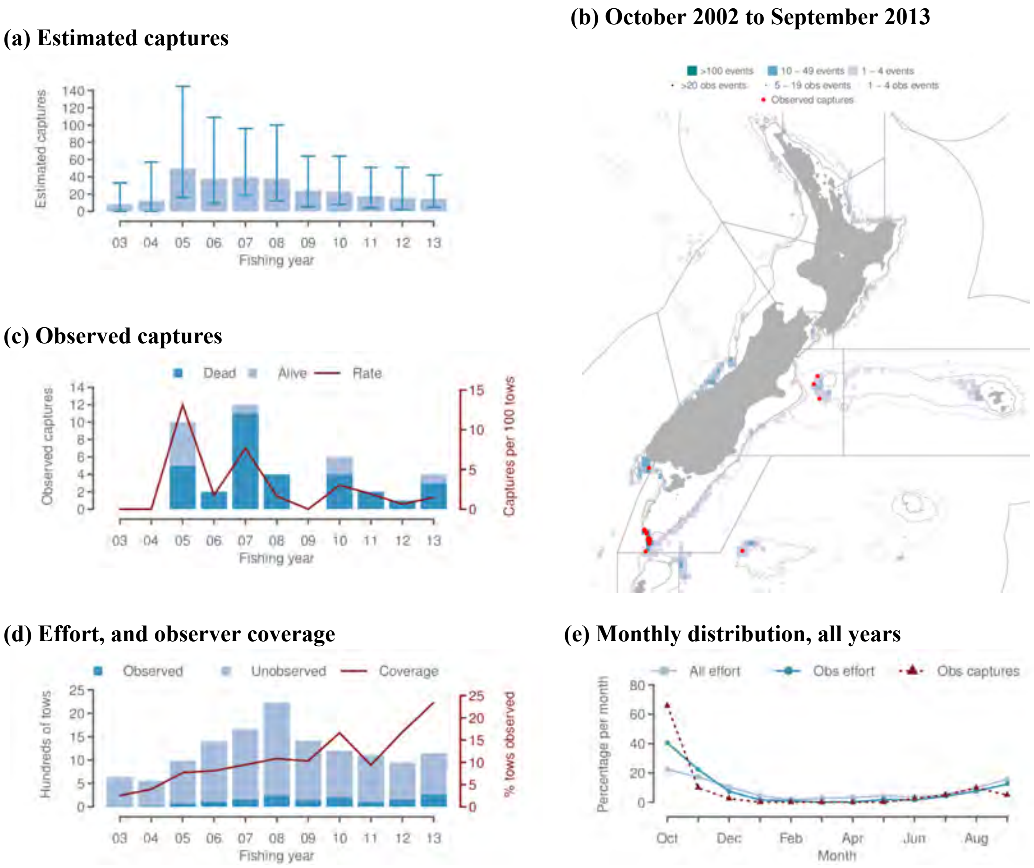


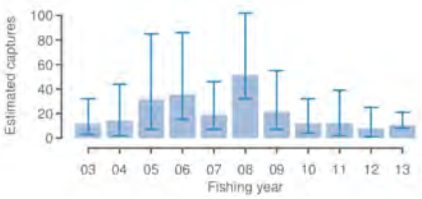
Figure B-78: New Zealand fur seal captures in ling trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 88.3% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.7 New Zealand fur seal captures in hake trawl fisheries

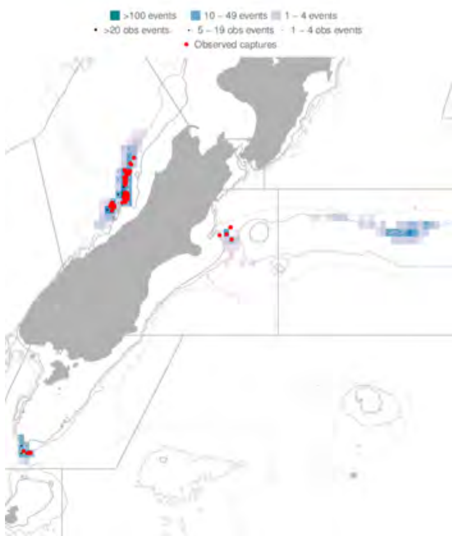
Table B-73: Annual fishing effort and number of tows observed in hake trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	945	5.2	3	6.12	12	3–32	1.27	0.32–3.39
2003–04	1 651	8.5	0	0.00	14	2–44	0.85	0.12–2.67
2004–05	1 556	6.1	2	2.11	32	7–85	2.06	0.45–5.46
2005–06	1 359	31.0	11	2.61	36	15–86	2.65	1.10–6.33
2006–07	1 606	18.4	4	1.35	19	7–46	1.18	0.44–2.86
2007–08	1 547	25.5	28	7.11	51	32–102	3.30	2.07–6.59
2008–09	1 779	19.7	5	1.42	21	7–55	1.18	0.39–3.09
2009–10	822	40.1	4	1.21	12	4–32	1.46	0.49–3.89
2010–11	869	26.1	1	0.44	12	2–39	1.38	0.23–4.49
2011–12	645	35.0	1	0.44	8	1–25	1.24	0.16–3.88
2012–13	710	74.4	8	1.52	11	8–21	1.55	1.13–2.96

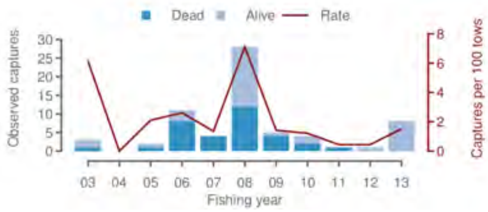
(a) Estimated captures



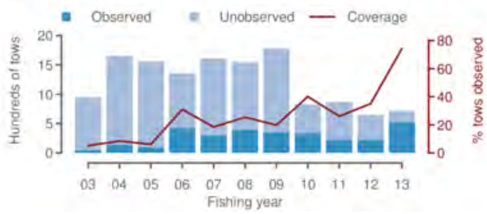
(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

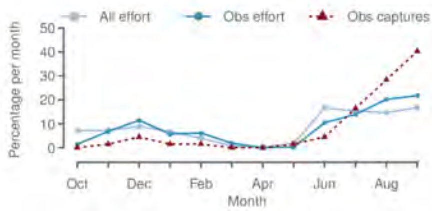


Figure B-79: New Zealand fur seal captures in hake trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 95.5% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.8 New Zealand fur seal captures in inshore trawl fisheries

Table B-74: Annual fishing effort and number of tows observed in inshore trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	36 571	0.0	0	0.00	14	0–67	0.04	0.00–0.18
2003–04	37 429	0.0	0	0.00	17	0–82	0.05	0.00–0.22
2004–05	40 829	0.0	0	0.00	35	0–164	0.09	0.00–0.40
2005–06	39 150	0.3	0	0.00	24	0–113	0.06	0.00–0.29
2006–07	35 831	0.8	0	0.00	14	0–64	0.04	0.00–0.18
2007–08	31 418	0.4	0	0.00	17	0–78	0.05	0.00–0.25
2008–09	33 102	3.5	1	0.09	13	1–57	0.04	0.00–0.17
2009–10	35 971	1.4	0	0.00	12	0–59	0.03	0.00–0.16
2010–11	34 986	1.3	0	0.00	12	0–57	0.03	0.00–0.16
2011–12	32 772	0.4	0	0.00	12	0–55	0.04	0.00–0.17
2012–13	33 263	0.5	0	0.00	11	0–49	0.03	0.00–0.15

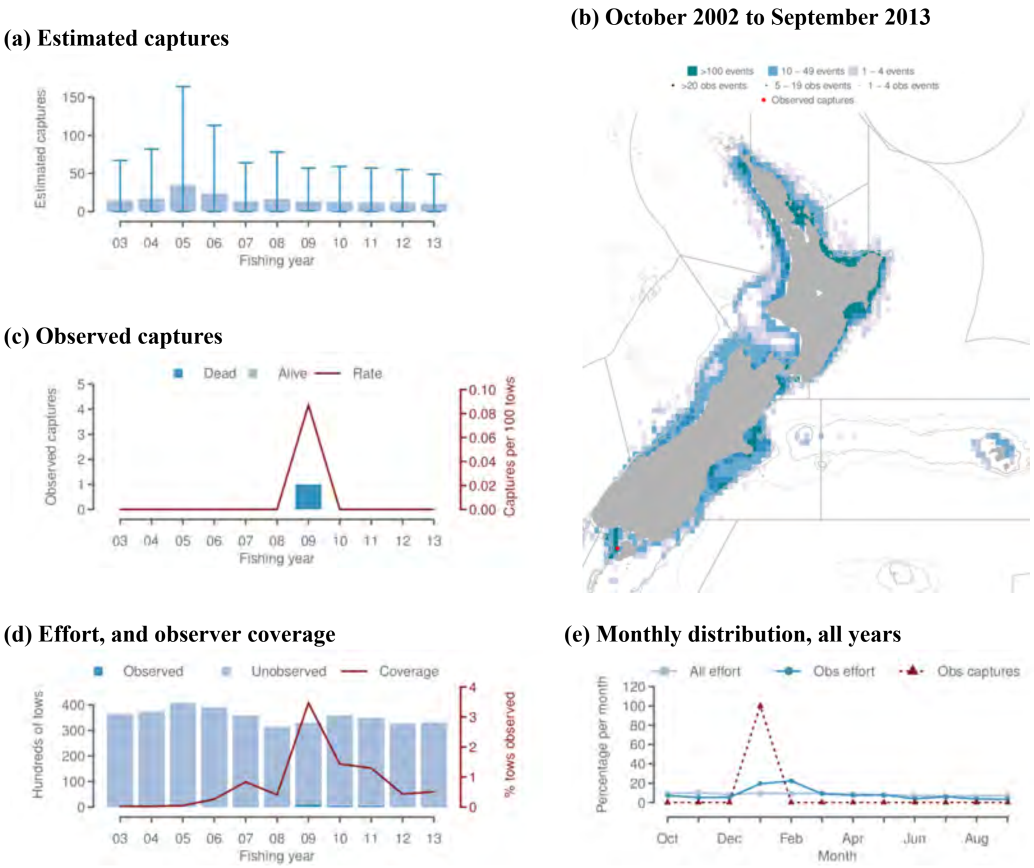


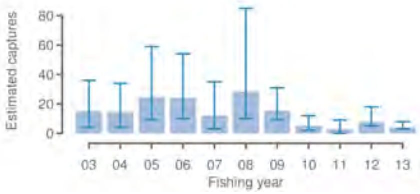
Figure B-80: New Zealand fur seal captures in inshore trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 , (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.9 New Zealand fur seal captures in jack mackerel trawl fisheries

Table B-75: Annual fishing effort and number of tows observed in jack mackerel trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

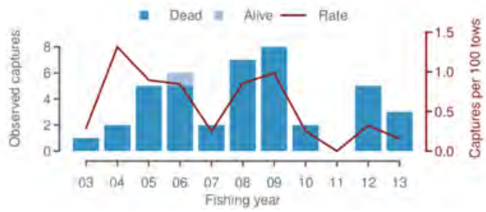
		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	3 067	11.3	1	0.29	15	4–36	0.49	0.13–1.17
2003–04	2 383	6.4	2	1.32	15	4–34	0.63	0.17–1.43
2004–05	2 509	22.2	5	0.90	25	9–59	1.00	0.36–2.35
2005–06	2 808	25.2	6	0.85	24	10–54	0.85	0.36–1.92
2006–07	2 711	29.5	2	0.25	12	3–35	0.44	0.11–1.29
2007–08	2 649	30.8	7	0.86	28	10–85	1.06	0.38–3.21
2008–09	2 170	37.5	8	0.98	15	9–31	0.69	0.41–1.43
2009–10	2 406	32.7	2	0.25	5	2–12	0.21	0.08–0.50
2010–11	1 880	31.5	0	0.00	3	0–9	0.16	0.00–0.48
2011–12	2 032	76.3	5	0.32	8	5–18	0.39	0.25–0.89
2012–13	2 208	87.6	3	0.16	4	3–8	0.18	0.14–0.36

(a) Estimated captures

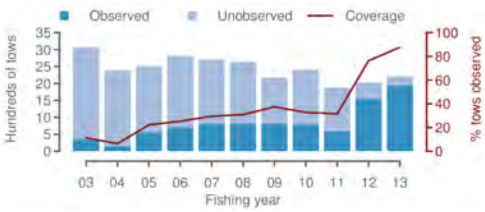


(b) October 2002 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

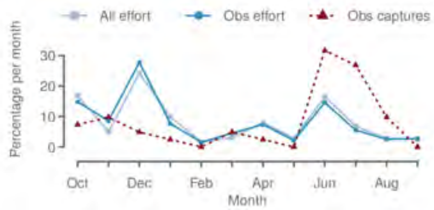


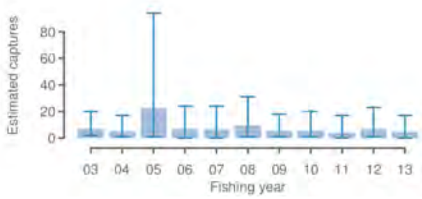
Figure B-81: New Zealand fur seal captures in jack mackerel trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 98.2% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.10 New Zealand fur seal captures in scampi trawl fisheries

Table B-76: Annual fishing effort and number of tows observed in scampi trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

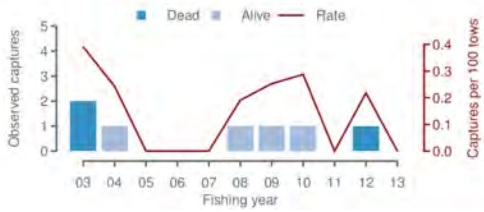
		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	5 130	10.0	2	0.39	7	2–20	0.14	0.04–0.39
2003–04	3 753	11.0	1	0.24	5	1–17	0.13	0.03–0.45
2004–05	4 648	3.1	0	0.00	22	1–94	0.47	0.02–2.02
2005–06	4 867	6.8	0	0.00	7	0–24	0.14	0.00–0.49
2006–07	5 135	7.6	0	0.00	6	0–24	0.12	0.00–0.47
2007–08	4 804	10.9	1	0.19	10	1–31	0.21	0.02–0.65
2008–09	3 975	10.0	1	0.25	6	1–18	0.15	0.03–0.45
2009–10	4 248	8.2	1	0.29	6	1–20	0.14	0.02–0.47
2010–11	4 447	12.1	0	0.00	4	0–17	0.09	0.00–0.38
2011–12	4 509	10.2	1	0.22	7	1–23	0.16	0.02–0.51
2012–13	4 566	5.9	0	0.00	4	0–17	0.09	0.00–0.37

(a) Estimated captures

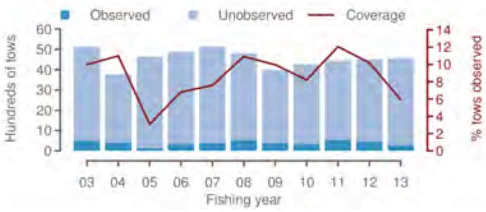


(b) October 2002 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

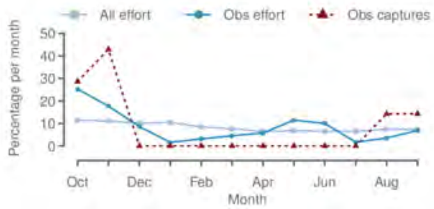


Figure B-82: New Zealand fur seal captures in scampi trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 97.8% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.11 New Zealand fur seal captures in deepwater trawl fisheries

Table B-77: Annual fishing effort and number of tows observed in deepwater trawl fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 871	15.6	0	0.00	3	0–14	0.03	0.00–0.16
2003–04	8 005	15.8	2	0.16	6	2–20	0.07	0.02–0.25
2004–05	8 408	19.2	4	0.25	14	4–53	0.17	0.05–0.63
2005–06	8 287	16.4	2	0.15	8	2–27	0.10	0.02–0.33
2006–07	7 373	31.5	2	0.09	3	2–6	0.04	0.03–0.08
2007–08	6 731	41.8	4	0.14	7	4–15	0.10	0.06–0.22
2008–09	6 133	38.7	0	0.00	3	0–13	0.05	0.00–0.21
2009–10	6 010	35.5	0	0.00	2	0–10	0.03	0.00–0.17
2010–11	4 177	28.8	0	0.00	2	0–12	0.05	0.00–0.29
2011–12	3 654	25.2	0	0.00	1	0–8	0.03	0.00–0.22
2012–13	3 098	11.2	0	0.00	0	0–1	0.00	0.00–0.03

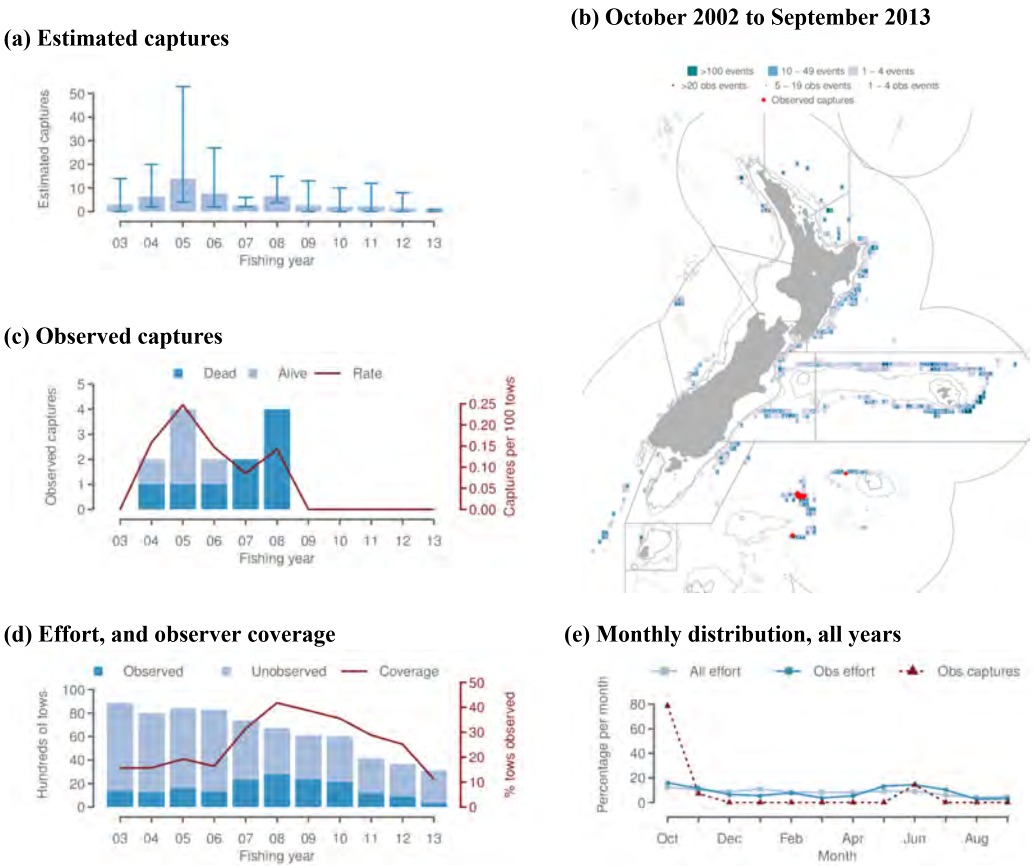


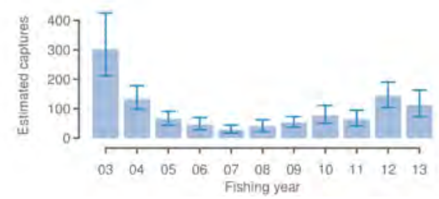
Figure B-83: New Zealand fur seal captures in deepwater trawl fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 89.7% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.10.12 New Zealand fur seal captures in surface-longline fisheries

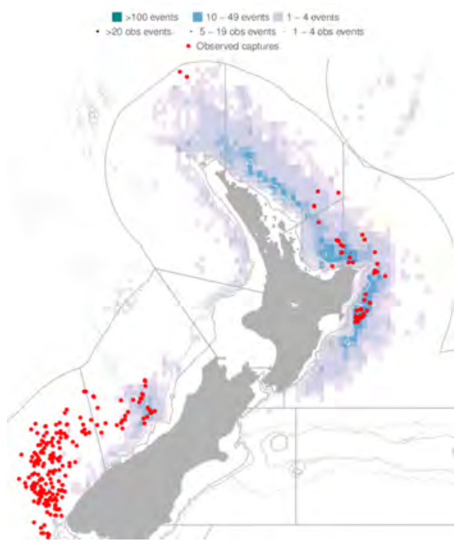
Table B-78: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of New Zealand fur seals and observed capture rate (captures per thousand hooks), estimated captures and capture rate of New Zealand fur seals (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	10 772 188	20.4	56	0.026	301	211–425	0.03	0.02–0.04
2003–04	7 386 329	21.8	40	0.025	133	98–178	0.02	0.01–0.02
2004–05	3 679 765	21.3	20	0.026	65	44–91	0.02	0.01–0.02
2005–06	3 690 119	19.1	12	0.017	45	28–70	0.01	0.01–0.02
2006–07	3 739 912	27.8	10	0.010	29	17–44	0.01	0.00–0.01
2007–08	2 246 189	18.8	10	0.024	40	23–62	0.02	0.01–0.03
2008–09	3 115 633	30.1	22	0.023	52	37–73	0.02	0.01–0.02
2009–10	2 995 264	22.2	19	0.029	77	50–111	0.03	0.02–0.04
2010–11	3 187 879	21.2	17	0.025	64	41–95	0.02	0.01–0.03
2011–12	3 100 277	23.5	40	0.055	143	104–190	0.05	0.03–0.06
2012–13	2 862 182	19.6	21	0.037	112	72–163	0.04	0.03–0.06

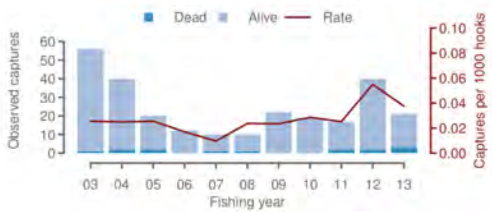
(a) Estimated captures



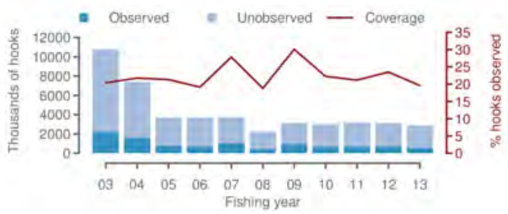
(b) October 2002 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

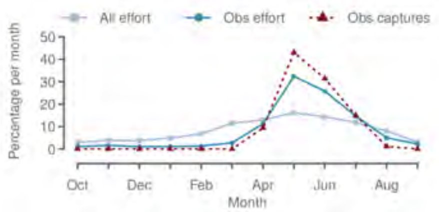


Figure B-84: New Zealand fur seal captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (Following confidentiality rules, 89.4% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

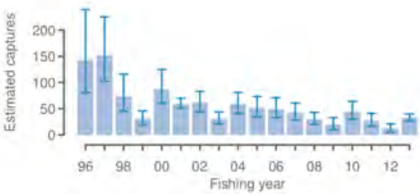
B.11 New Zealand sea lion captures

B.11.1 New Zealand sea lion captures in trawl fisheries, in the Auckland Islands, Fiordland, Stewart Snares Shelf and Subantarctic areas

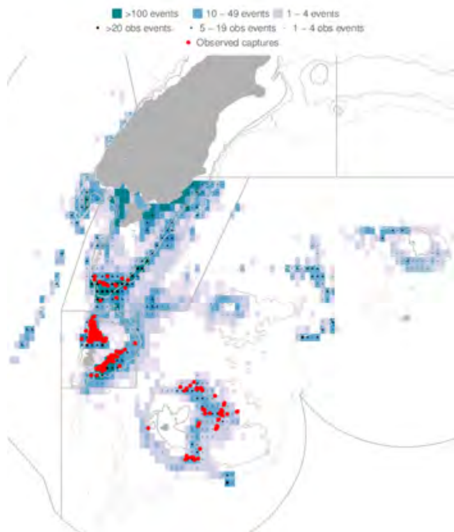
Table B-79: Annual fishing effort and number of tows observed in trawl fisheries, in the Auckland Islands, Fiordland, Stewart-Snares Shelf and Subantarctic areas, number of observed captures of New Zealand sea lions and observed capture rate (captures per hundred tows), estimated captures, interactions, and strike rate of New Zealand sea lions (mean and 95% credible interval).

		Observed			Est. captures		Est. interactions		Est. strike rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.	Mean	95% c.i.
1995–96	27 765	5.0	16	1.15	143	81–239	143	81–234	0.52	0.29–0.84
1996–97	29 682	7.5	29	1.30	152	102–225	152	101–224	0.51	0.34–0.75
1997–98	27 595	9.2	16	0.63	74	45–116	74	43–118	0.27	0.16–0.43
1998–99	27 083	9.7	6	0.23	31	19–46	31	17–48	0.11	0.06–0.18
1999–00	25 049	13.7	28	0.82	87	60–125	87	58–129	0.35	0.23–0.51
2000–01	26 504	17.7	47	1.00	59	51–70	82	58–111	0.31	0.22–0.42
2001–02	28 242	12.3	23	0.66	62	44–83	92	60–137	0.33	0.21–0.49
2002–03	27 305	10.2	12	0.43	31	21–44	59	35–90	0.22	0.13–0.33
2003–04	25 298	11.6	21	0.71	59	41–81	221	120–384	0.87	0.47–1.52
2004–05	25 816	14.0	14	0.39	51	34–73	187	93–339	0.72	0.36–1.31
2005–06	22 624	10.6	15	0.63	49	33–71	172	85–332	0.76	0.38–1.47
2006–07	20 662	15.7	12	0.37	42	28–61	116	55–237	0.56	0.27–1.15
2007–08	18 640	19.7	11	0.30	30	20–43	137	38–514	0.73	0.20–2.76
2008–09	17 839	20.1	3	0.08	20	10–33	114	24–478	0.64	0.13–2.68
2009–10	18 034	19.7	15	0.42	45	30–64	160	51–563	0.89	0.28–3.12
2010–11	16 947	18.1	6	0.20	27	16–41	87	25–316	0.51	0.15–1.86
2011–12	16 621	21.1	1	0.03	12	5–21	55	11–227	0.33	0.07–1.37
2012–13	15 395	34.1	25	0.48	33	27–40	83	35–288	0.54	0.23–1.87

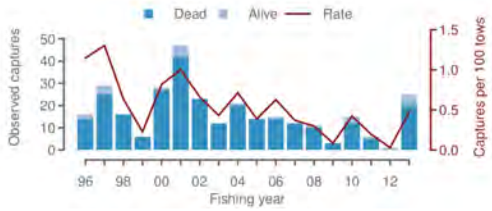
(a) Estimated captures



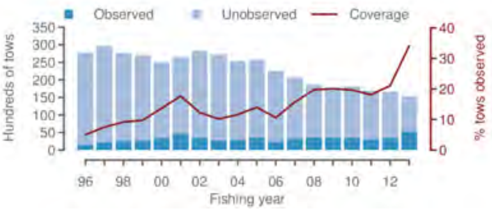
(b) October 1995 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

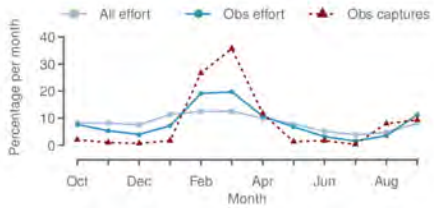


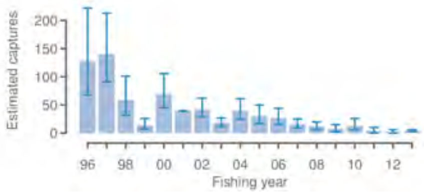
Figure B-85: New Zealand sea lion captures in trawl fisheries, in the Auckland Islands, Fiordland, Stewart-Snares Shelf and Subantarctic areas. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13 (Following confidentiality rules, 98.9% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.11.2 New Zealand sea lion captures in squid trawl fisheries, in the Auckland Islands area

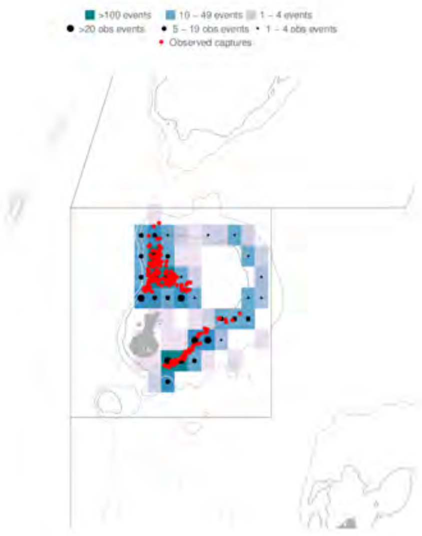
Table B-80: Annual fishing effort and number of tows observed in squid trawl fisheries, in the Auckland Islands area, number of observed captures of New Zealand sea lions and observed capture rate (captures per hundred tows), estimated captures, interactions, and strike rate of New Zealand sea lions (mean and 95% credible interval).

		Observed			Est. captures		Est. interactions		Est. strike rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.	Mean	95% c.i.
1995–96	4 469	12.5	13	2.33	128	67–222	128	66–218	2.86	1.48–4.88
1996–97	3 721	19.8	28	3.81	140	91–213	140	89–212	3.76	2.39–5.70
1997–98	1 442	23.2	15	4.48	59	32–101	59	30–102	4.09	2.08–7.07
1998–99	403	38.7	5	3.21	14	7–26	14	4–28	3.47	0.99–6.95
1999–00	1 206	36.3	25	5.71	69	45–106	70	42–110	5.80	3.48–9.12
2000–01	583	99.1	39	6.75	39	39–40	62	39–89	10.63	6.69–15.27
2001–02	1 647	34.2	21	3.73	42	29–62	73	42–116	4.43	2.55–7.04
2002–03	1 466	28.4	11	2.64	18	12–27	46	23–76	3.14	1.57–5.18
2003–04	2 594	30.6	16	2.02	40	25–61	202	101–366	7.79	3.89–14.11
2004–05	2 693	29.9	9	1.12	30	17–50	166	73–319	6.16	2.71–11.85
2005–06	2 459	22.4	10	1.82	27	15–44	149	63–307	6.06	2.56–12.48
2006–07	1 317	40.7	7	1.31	15	9–25	89	30–209	6.76	2.28–15.87
2007–08	1 265	46.7	5	0.85	11	6–20	119	20–495	9.41	1.58–39.13
2008–09	1 925	39.6	2	0.26	7	2–15	102	12–464	5.30	0.62–24.10
2009–10	1 188	25.5	3	0.99	12	5–26	128	21–535	10.77	1.77–45.03
2010–11	1 583	34.4	0	0.00	4	0–10	64	4–291	4.04	0.25–18.38
2011–12	1 281	44.6	0	0.00	2	0–6	45	2–216	3.51	0.16–16.86
2012–13	1 027	86.2	3	0.34	4	3–6	54	7–261	5.26	0.68–25.41

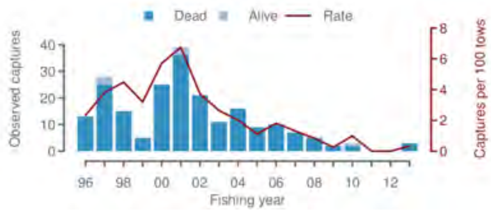
(a) Estimated captures



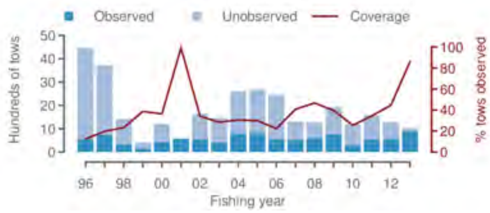
(b) October 1995 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

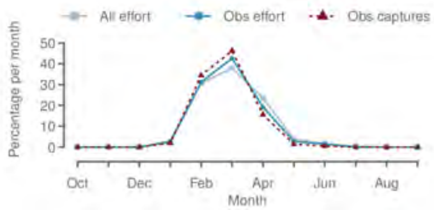


Figure B-86: New Zealand sea lion captures in squid trawl fisheries, in the Auckland Islands area. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.11.3 New Zealand sea lion captures in scampi trawl fisheries, in the Auckland Islands area

Table B-81: Annual fishing effort and number of tows observed in scampi trawl fisheries, in the Auckland Islands area, number of observed captures of New Zealand sea lions and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand sea lions (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows[a]	% obs.[a]	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1995–96	1 312	5.1	2	2.99	10	4–18	0.76	0.30–1.37
1996–97	1 224	16.2	1	0.51	6	1–14	0.49	0.08–1.14
1997–98	1 109	12.3	0	0.00	6	1–13	0.54	0.09–1.17
1998–99	1 255	1.8	0	0.00	8	2–16	0.64	0.16–1.27
1999–00	1 383	5.4	0	0.00	8	2–16	0.58	0.14–1.16
2000–01	1 419	5.9	4	4.76	12	6–21	0.85	0.42–1.48
2001–02	1 603	9.6	0	0.00	9	3–18	0.56	0.19–1.12
2002–03	1 351	11.1	0	0.00	7	2–15	0.52	0.15–1.11
2003–04	1 363	12.4	3	1.78	10	5–18	0.73	0.37–1.32
2004–05	1 275	0.0	0	–	8	2–16	0.63	0.16–1.25
2005–06	1 331	8.9	1	0.85	9	3–16	0.68	0.23–1.20
2006–07	1 328	7.6	1	0.99	9	3–16	0.68	0.23–1.20
2007–08	1 327	7.0	0	0.00	8	2–15	0.60	0.15–1.13
2008–09	1 457	4.2	1	1.64	10	3–18	0.69	0.21–1.24
2009–10	–	–	0	0.00	5	1–11	0.53	0.11–1.17
2010–11	1 401	14.8	0	0.00	7	2–15	0.50	0.14–1.07
2011–12	–	–	0	0.00	7	2–15	0.56	0.16–1.20
2012–13	1 093	12.4	0	0.00	6	1–13	0.55	0.09–1.19

[a] Some effort not shown due to anonymity requirements (see subsection 3.2).

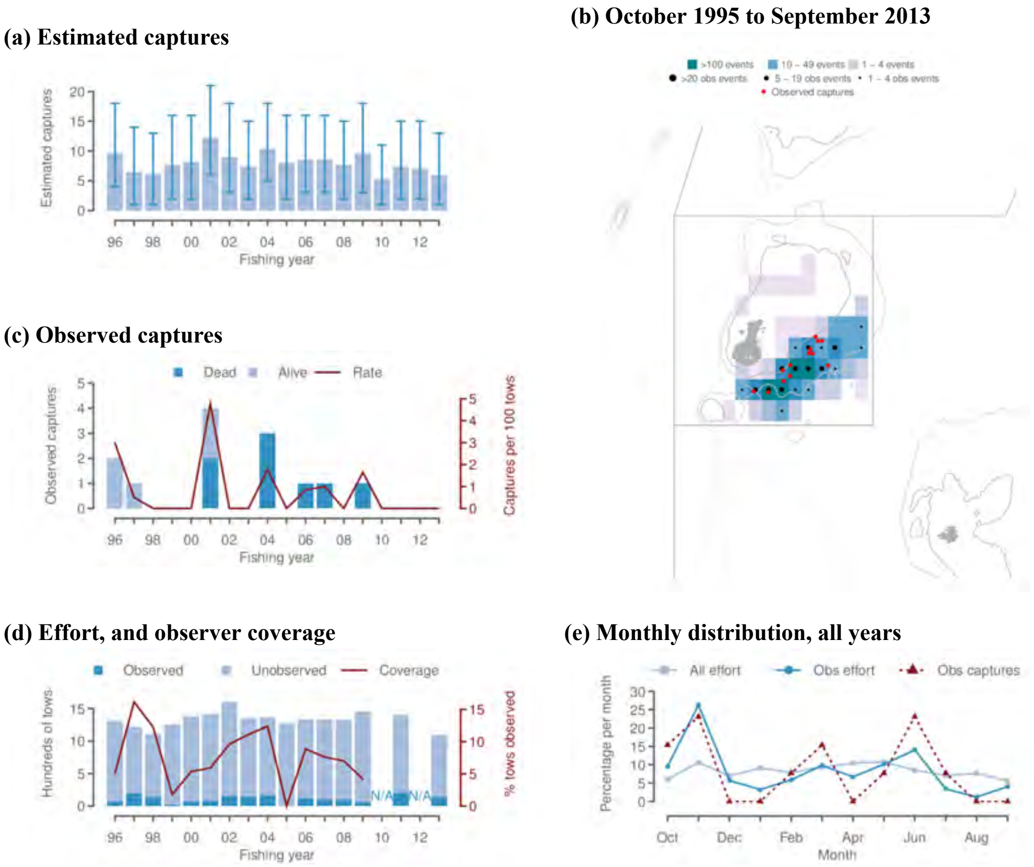


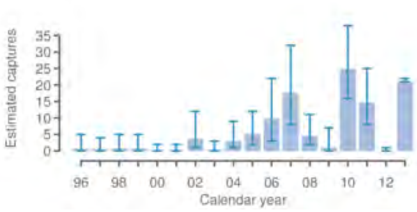
Figure B-87: New Zealand sea lion captures in scampi trawl fisheries, in the Auckland Islands area. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.11.4 New Zealand sea lion captures in southern blue whiting trawl fisheries, in the Subantarctic area

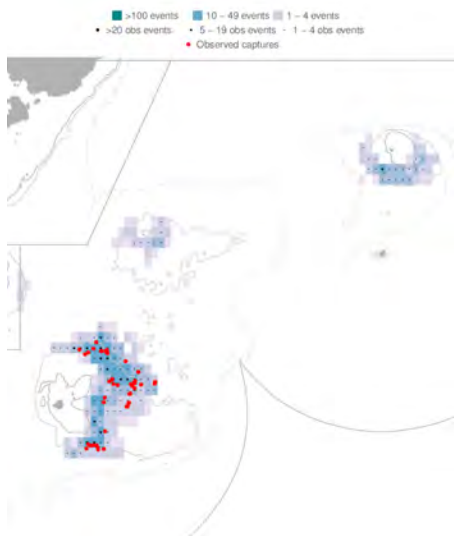
Table B-82: Annual fishing effort and number of tows observed in southern blue whiting trawl fisheries, in the Subantarctic area, number of observed captures of New Zealand sea lions and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand sea lions (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1996	564	28.9	0	0.00	1	0–5	0.18	0.00–0.89
1997	749	38.6	0	0.00	1	0–4	0.13	0.00–0.53
1998	1 141	34.8	0	0.00	1	0–5	0.09	0.00–0.44
1999	1 114	29.6	0	0.00	1	0–5	0.09	0.00–0.45
2000	603	47.3	0	0.00	0	0–2	0.00	0.00–0.33
2001	720	61.1	0	0.00	0	0–2	0.00	0.00–0.28
2002	1 105	26.0	1	0.35	4	1–12	0.36	0.09–1.09
2003	629	42.1	0	0.00	0	0–3	0.00	0.00–0.48
2004	731	33.5	1	0.41	3	1–9	0.41	0.14–1.23
2005	859	38.3	2	0.61	5	2–12	0.58	0.23–1.40
2006	634	35.8	3	1.32	10	3–22	1.58	0.47–3.47
2007	615	35.1	6	2.78	18	8–32	2.93	1.30–5.20
2008	814	40.4	2	0.61	5	2–11	0.61	0.25–1.35
2009	1 205	24.6	0	0.00	1	0–7	0.08	0.00–0.58
2010	1 114	36.4	11	2.72	25	16–38	2.24	1.44–3.41
2011	1 223	36.5	6	1.34	15	8–25	1.23	0.65–2.04
2012	893	74.2	0	0.00	0	0–1	0.00	0.00–0.11
2013	773	99.9	21	2.72	21	21–22	2.72	2.72–2.85

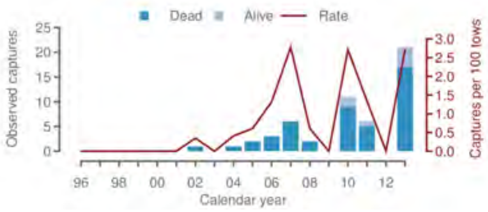
(a) Estimated captures



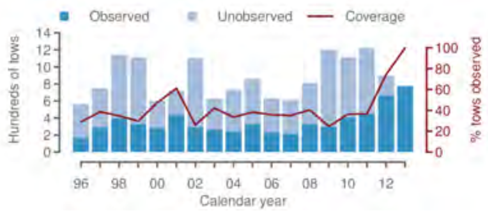
(b) October 1995 to September 2013



(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

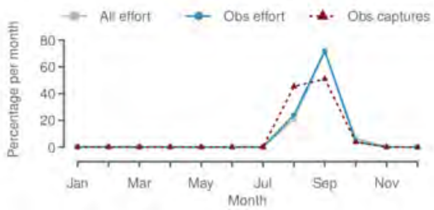


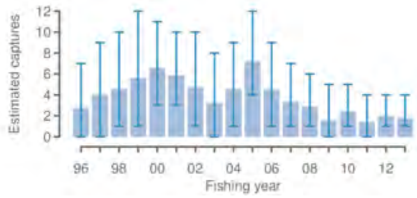
Figure B-88: New Zealand sea lion captures in southern blue whiting trawl fisheries, in the Subantarctic area. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1996 to 2013 (Following confidentiality rules, 98.7% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.11.5 New Zealand sea lion captures in trawl fisheries, in the Stewart-Snares Shelf area

Table B-83: Annual fishing effort and number of tows observed in trawl fisheries, in the Stewart-Snares Shelf area, number of observed captures of New Zealand sea lions and observed capture rate (captures per hundred tows), estimated captures and capture rate of New Zealand sea lions (mean and 95% credible interval).

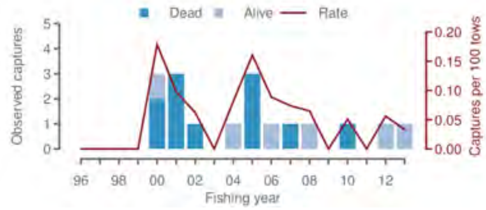
		Observed			Est. captures		Est. capture rate	
Year	Tows	% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
1995–96	18 462	2.5	0	0.00	3	0–7	0.02	0.00–0.04
1996–97	20 732	3.8	0	0.00	4	0–9	0.02	0.00–0.04
1997–98	20 411	6.1	0	0.00	5	1–10	0.02	0.00–0.05
1998–99	20 236	8.4	0	0.00	6	1–12	0.03	0.00–0.06
1999–00	16 733	10.0	3	0.18	7	3–11	0.04	0.02–0.07
2000–01	17 970	17.0	3	0.10	6	3–10	0.03	0.02–0.06
2001–02	18 213	8.8	1	0.06	5	1–10	0.03	0.01–0.05
2002–03	17 083	6.7	0	0.00	3	0–8	0.02	0.00–0.05
2003–04	16 444	7.5	1	0.08	5	1–9	0.03	0.01–0.05
2004–05	17 300	10.8	3	0.16	7	4–12	0.04	0.02–0.07
2005–06	15 627	7.2	1	0.09	5	1–9	0.03	0.01–0.06
2006–07	15 023	9.0	1	0.07	3	1–7	0.02	0.01–0.05
2007–08	12 488	12.3	1	0.06	3	1–6	0.02	0.01–0.05
2008–09	11 054	15.4	0	0.00	2	0–5	0.02	0.00–0.05
2009–10	12 434	15.9	1	0.05	2	1–5	0.02	0.01–0.04
2010–11	10 753	12.4	0	0.00	1	0–4	0.01	0.00–0.04
2011–12	11 834	15.0	1	0.06	2	1–4	0.02	0.01–0.03
2012–13	11 581	26.3	1	0.03	2	1–4	0.02	0.01–0.03

(a) Estimated captures

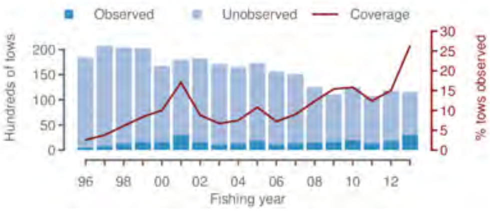


(b) October 1995 to September 2013

(c) Observed captures



(d) Effort, and observer coverage



(e) Monthly distribution, all years

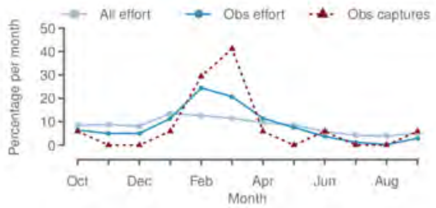


Figure B-89: New Zealand sea lion captures in trawl fisheries, in the Stewart-Snares Shelf area. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 1995–96 to 2012–13, (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

B.12 Turtles captures

B.12.1 Turtle captures in surface-longline fisheries

Table B-84: Annual fishing effort and number of hooks observed in surface-longline fisheries, number of observed captures of turtles and observed capture rate (captures per thousand hooks), estimated captures and capture rate of turtles (mean and 95% credible interval).

		Observed			Est. captures		Est. capture rate	
Year	Hooks	% obs.	Cap.[s]	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	10 772 188	20.4	0	0.000	43	20–74	0.00	0.00–0.01
2003–04	7 386 329	21.8	1	0.001	28	13–48	0.00	0.00–0.01
2004–05	3 679 765	21.3	2	0.003	16	7–29	0.00	0.00–0.01
2005–06	3 690 119	19.1	1	0.001	15	6–28	0.00	0.00–0.01
2006–07	3 739 912	27.8	2	0.002	13	6–24	0.00	0.00–0.01
2007–08	2 246 189	18.8	1	0.002	9	3–16	0.00	0.00–0.01
2008–09	3 115 633	30.1	2	0.002	12	5–22	0.00	0.00–0.01
2009–10	2 995 264	22.2	0	0.000	11	4–21	0.00	0.00–0.01
2010–11	3 187 879	21.2	4	0.006	16	8–27	0.01	0.00–0.01
2011–12	3 100 277	23.5	0	0.000	10	3–19	0.00	0.00–0.01
2012–13	2 862 182	19.6	2	0.004	11	5–20	0.00	0.00–0.01

[s] All observed captures by species: Leatherback turtle (11), Turtle (3), Green turtle (1)

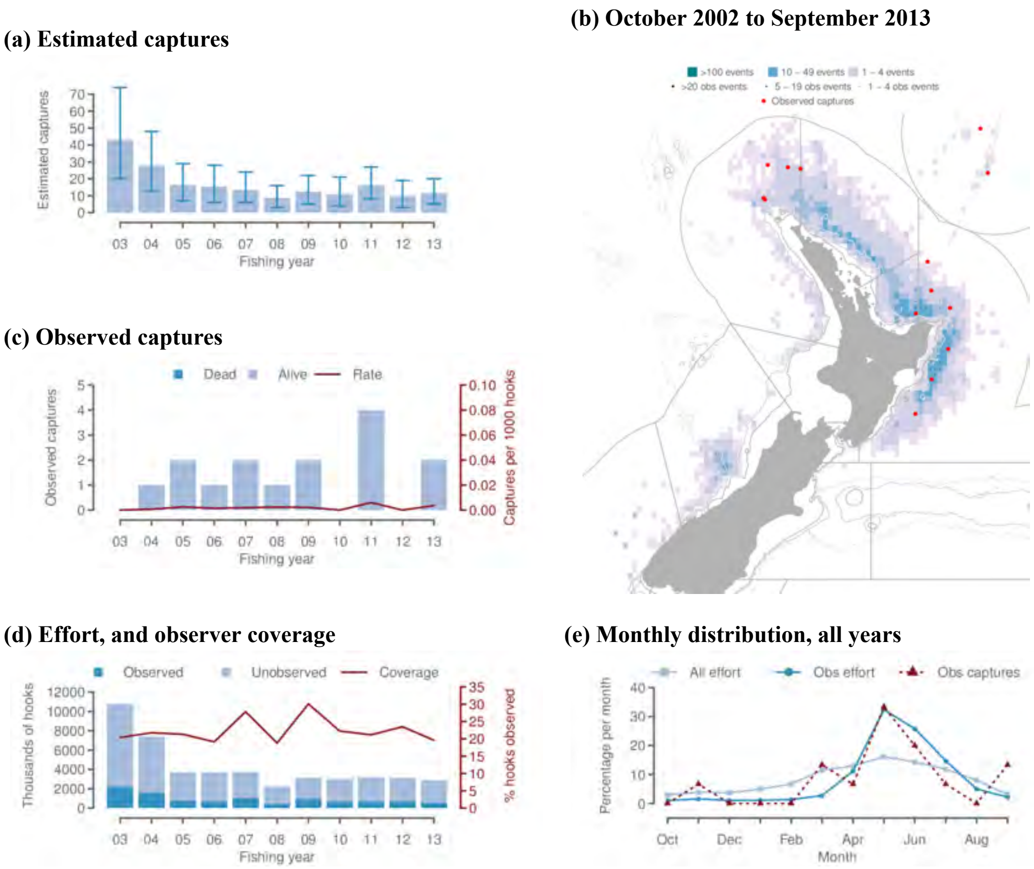


Figure B-90: Turtle captures in surface-longline fisheries. (a) Estimated captures, with 95% bootstrap credible intervals, (b) Mapped effort and captures from 2002–03 to 2012–13 (following confidentiality rules, 89.4% of total effort is shown, see subsection 3.2), (c) Observed captures, (d) Effort and observed effort, and (e) Monthly distribution of fishing effort, observed effort, and observed captures.

APPENDIX C Summaries of models used for estimation

C.1 White-capped albatross, trawl fisheries

Table C-85: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-capped albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	119	1	454	(337–611)
Squid	Stewart Snares Shelf	1 532	87.9	62	4.6	69	(63–78)
Inshore	Stewart Snares Shelf	1 855	0	0		62	(24–125)
Inshore	West Coast South Island	3 106	1	0	0	55	(25–102)
Middle depths	Stewart Snares Shelf	829	73.7	24	3.9	31	(25–42)
Inshore	East Coast South Island	4 650	2.2	0	0	24	(9–48)
Middle depths	West Coast South Island	1 052	5.3	0	0	23	(8–49)
Flatfish	Stewart Snares Shelf	5 420	0	0		19	(2–54)
Squid	Auckland Islands	1 027	86.2	12	1.4	19	(13–30)

Table C-86: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			3052.5
Mandatory mitigation	1	83.1	2969.4
Area	4	1122.2	1847.2
Fishery	7	157.6	1689.6
Annual sine exponent	1	36.1	1653.6
Log(fishing duration)	1	16.6	1637.0

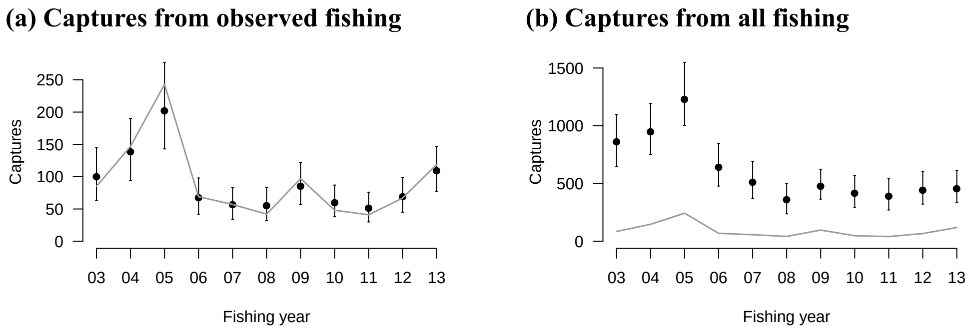


Figure C-91: Estimated captures of white-capped albatross in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-87: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Auckland-Snares" (Area), "Squid" (Fishery), and "False" (Mandatory mitigation).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.118	0.120	0.080	0.169
Fishing year, 2004	0.119	0.122	0.081	0.175
Fishing year, 2005	0.131	0.134	0.091	0.199
Fishing year, 2006	0.119	0.121	0.082	0.170
Fishing year, 2007	0.119	0.121	0.082	0.169
Fishing year, 2008	0.108	0.109	0.068	0.154
Fishing year, 2009	0.129	0.131	0.090	0.186
Fishing year, 2010	0.119	0.120	0.081	0.167
Fishing year, 2011	0.113	0.114	0.075	0.158
Fishing year, 2012	0.127	0.130	0.089	0.184
Fishing year, 2013	0.127	0.129	0.089	0.179
Area, Stewart-Snares	0.823	0.834	0.600	1.126
Area, West Coast South Island	0.373	0.385	0.231	0.589
Area, East coast and Chatham	0.110	0.114	0.066	0.177
Area, Northern	0.051	0.055	0.023	0.107
Fishery, Hoki-Hake-Ling	0.427	0.438	0.280	0.647
Fishery, Mid-depths	1.235	1.255	0.841	1.792
Fishery, Inshore	0.984	1.038	0.489	1.873
Fishery, Scampi	0.295	0.310	0.149	0.572
Fishery, Mackerel	0.335	0.363	0.145	0.730
Fishery, Deepwater-SBW	0.137	0.159	0.038	0.402
Fishery, Flatfish	0.085	0.103	0.019	0.287
Annual sine exponent	2.105	2.124	1.663	2.703
Mandatory mitigation, True	0.445	0.452	0.341	0.598
Log(fishing duration)	1.938	1.952	1.508	2.479
Vessel effect s.d., $\exp(\sigma_\eta)$	1.430	1.445	1.209	1.762
Overdispersion, θ	0.037	0.037	0.030	0.047

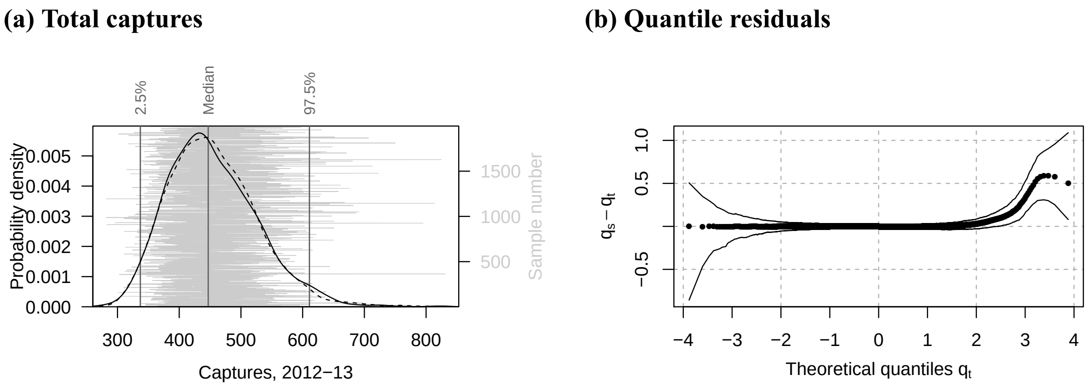


Figure C-92: Diagnostic plots for captures of white-capped albatross in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.2 White-capped albatross, large-vessel bottom-longline fisheries

Table C-88: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-capped albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	2	(0–6)
Ling	Chatham Rise	625	8.3	0	0	1	(0–5)
Ling	East Coast South Island	145	0	0		1	(0–3)
Ling	Stewart Snares Shelf	138	0	0		0	(0–0)
Minor targets	Fiordland	52	0	0		0	(0–0)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-89: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			98.2
Integrated weight line	1	10.2	88.0
Moon phase	1	8.0	79.9
Log(hooks)	1	2.5	77.4
Half year to September	1	2.7	74.7
Half year to July	1	6.4	68.3

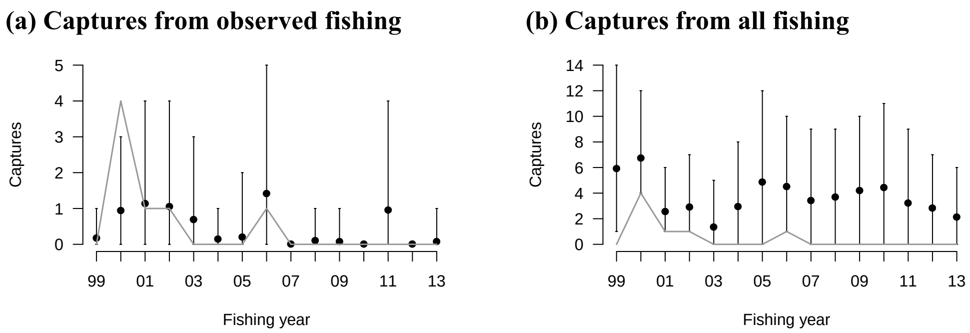


Figure C-93: Estimated captures of white-capped albatross in all large-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-90: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "False" (Integrated weight line) and "Second half" (Half year to September).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.000	0.002	0.000	0.014
Integrated weight line, True	0.000	0.007	0.000	0.071
Moon phase exponent	0.017	0.052	0.000	0.316
Log(hooks)	3.498	4.529	1.611	13.728
Half year to September, First half	0.165	0.263	0.005	1.090

(a) Total captures **(b) Quantile residuals**

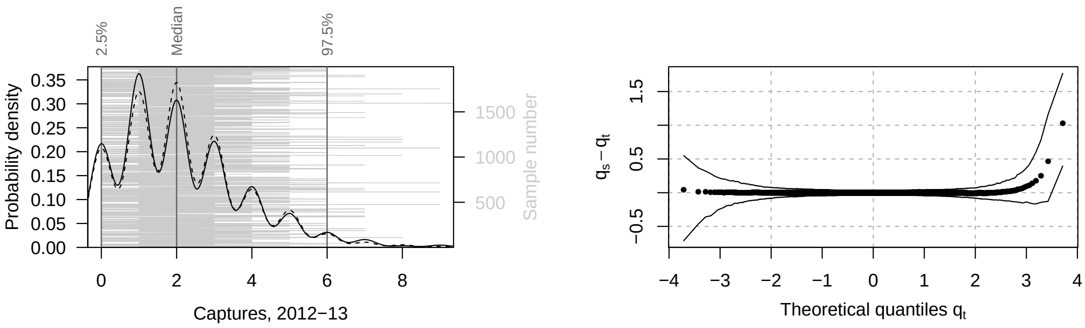


Figure C-94: Diagnostic plots for captures of white-capped albatross in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.3 White-capped albatross, small-vessel bottom-longline fisheries

Table C-91: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-capped albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	18	(3–46)
Ling	Chatham Rise	687	0	0		5	(0–13)
Ling	East Coast South Island	579	0	0		4	(0–12)
Ling	West Coast South Island	446	0	0		3	(0–9)
Ling	East Coast North Island	868	0	0		2	(0–7)
Bluenose	Chatham Rise	106	0	0		1	(0–3)
Bluenose	East Coast North Island	564	0	0		1	(0–4)
Ling	Cook Strait	78	0	0		1	(0–3)
Ling	Fiordland	194	0	0		1	(0–5)

Table C-92: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			32.6
Half year to July	1	8.8	23.8

Table C-93: Summary of the posterior distributions of the model parameters.

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.618	0.691	0.146	1.676

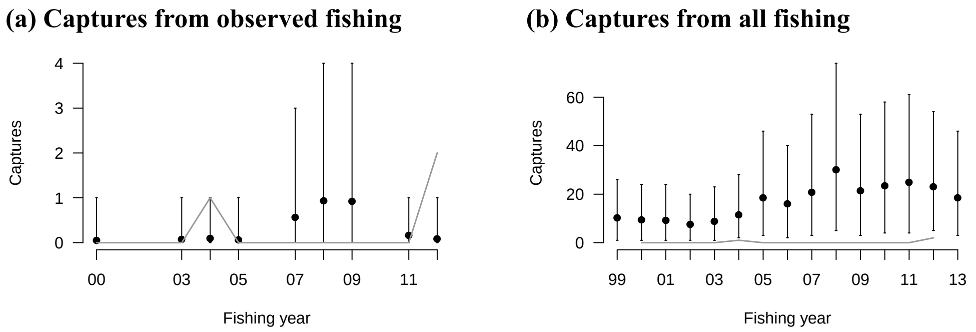


Figure C-95: Estimated captures of white-capped albatross in all small-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

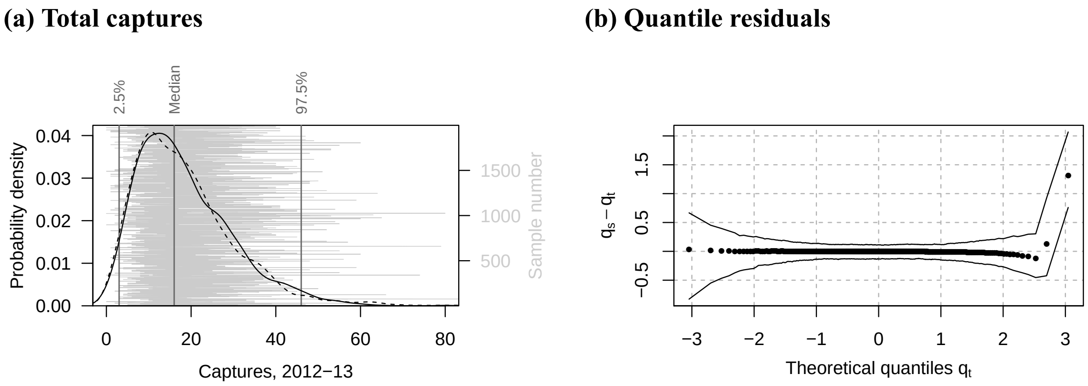


Figure C-96: Diagnostic plots for captures of white-capped albatross in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.4 White-capped albatross, large-vessel surface-longline fisheries

Table C-94: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-capped albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
Southern bluefin	Fiordland	137	100	2	1.5	2	(2–2)

Table C-95: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			464.8
Half year to April	1	47.1	417.7
Set time (day, night, full moon)	2	24.1	393.7
Half year to May	1	10.5	383.2
Fishing year	1	4.3	378.9

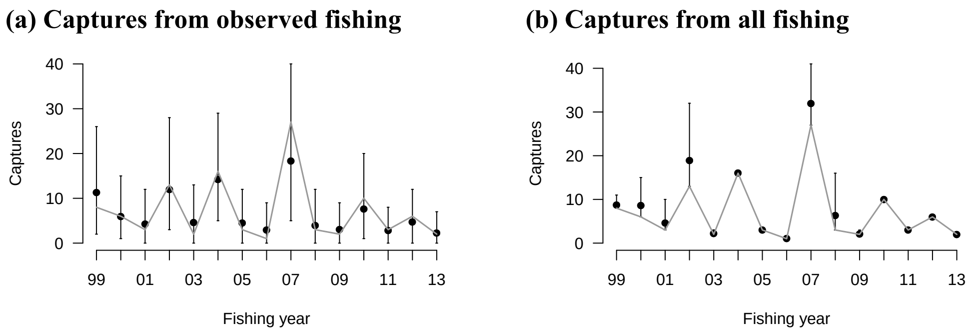


Figure C-97: Estimated captures of white-capped albatross in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-96: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "First half" (Half year to April) and "Night" (Set time).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	1.490	1.568	0.692	2.904
Fishing year, 2000	1.601	1.690	0.668	3.285
Fishing year, 2001	1.316	1.425	0.483	2.986
Fishing year, 2002	3.080	3.257	1.571	6.020
Fishing year, 2003	0.860	0.922	0.252	2.020
Fishing year, 2004	2.127	2.218	1.097	3.854
Fishing year, 2005	1.282	1.405	0.452	3.009
Fishing year, 2006	1.042	1.145	0.291	2.527
Fishing year, 2007	3.406	3.632	1.656	6.831
Fishing year, 2008	1.781	1.965	0.601	4.615
Fishing year, 2009	1.256	1.362	0.393	2.911
Fishing year, 2010	4.569	4.963	1.921	10.631
Fishing year, 2011	1.842	2.029	0.656	4.464
Fishing year, 2012	2.473	2.716	1.066	5.709
Fishing year, 2013	1.563	1.702	0.487	3.787
Half year to April, Second half	0.214	0.223	0.124	0.366
Set time, Full moon	3.229	3.336	1.960	5.319
Set time, Daylight	2.454	9.914	0.066	48.211
Vessel effect s.d., $\exp(\sigma_\eta)$	1.299	1.361	1.056	2.022
Overdispersion, θ	0.165	0.175	0.073	0.331

(a) Total captures **(b) Quantile residuals**

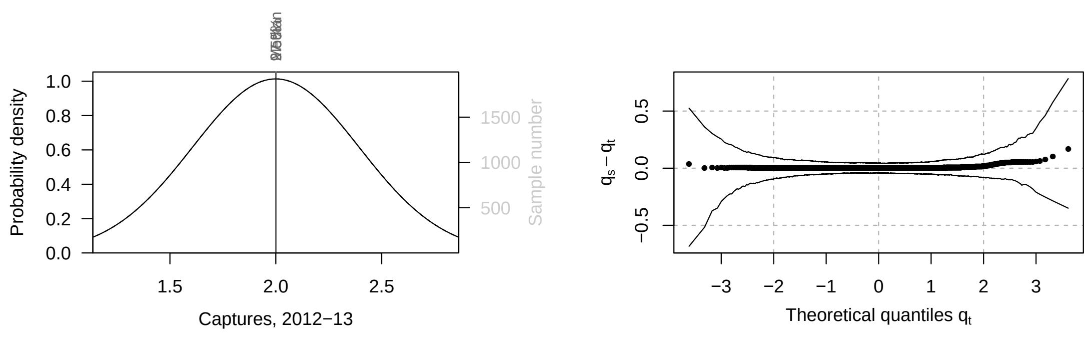


Figure C-98: Diagnostic plots for captures of white-capped albatross in all large-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.5 White-capped albatross, small-vessel surface-longline fisheries

Table C-97: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-capped albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	10	12.3	81	(52–119)
Southern bluefin	West Coast South Island	393	1	9	225	65	(41–97)
Swordfish	West Coast South Island	93	0	0		6	(1–17)
Southern bluefin	Fiordland	4	0	0		3	(0–8)
Bigeye	Northland and Hauraki	499	2.8	0	0	1	(0–4)
Southern bluefin	Bay of Plenty	235	13.2	0	0	1	(0–5)
Southern bluefin	East Coast North Island	381	2.4	0	0	1	(0–5)
Southern bluefin	Northland and Hauraki	88	8	0	0	1	(0–2)
Swordfish	West Coast North Island	85	2.4	1	50	1	(1–2)

Table C-98: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			232.0
Area	1	125.3	106.6
Half year to April	1	9.1	97.5
Half year to June	1	12.2	85.3
Set time (day, night, full moon)	2	16.3	69.0
Half year to August	1	5.2	63.8

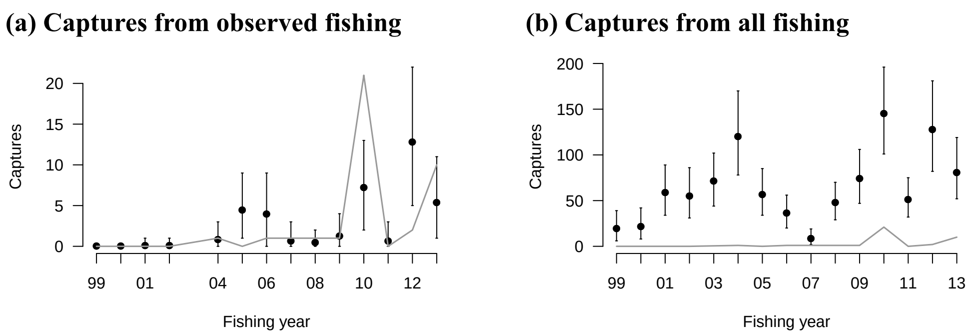


Figure C-99: Estimated captures of white-capped albatross in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-99: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Southern" (Area), "Full moon" (Set time), and "Second half" (Half year to April).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, 100 × λ	0.097	0.111	0.023	0.274
Area, Northern	0.011	0.012	0.004	0.024
Set time, Night	0.075	0.080	0.032	0.159
Set time, Daylight	0.172	0.208	0.024	0.593
Half year to April, First half	0.062	0.092	0.003	0.340

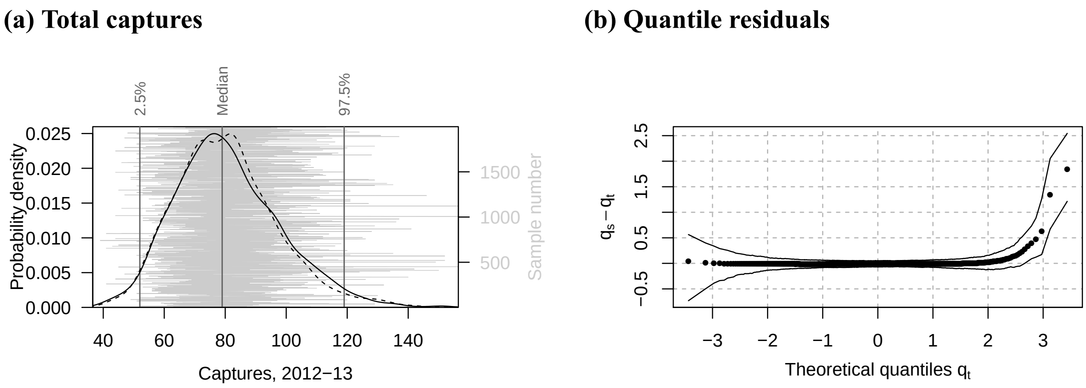


Figure C-100: Diagnostic plots for captures of white-capped albatross in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.6 Salvin's albatross, trawl fisheries

Table C-100: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated Salvin's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	47	0.4	387	(212–685)
Inshore	East Coast South Island	4 650	2.2	0	0	104	(34–236)
Middle depths	East Coast South Island	2 189	18	11	2.8	59	(23–138)
Inshore	Cook Strait	2 150	0	0		38	(9–102)
Scampi	Chatham Rise	2 106	5.6	1	0.8	33	(10–77)
Hoki	Chatham Rise	1 961	40.2	14	1.8	23	(16–35)
Hoki	East Coast South Island	2 710	30.4	6	0.7	16	(9–29)
Flatfish	East Coast South Island	5 191	0.6	0	0	14	(0–64)
Hoki	Cook Strait	1 792	11.2	0	0	13	(3–32)

Table C-101: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1126.2
Mandatory mitigation	1	14.8	1111.4
Area	1	220.0	891.4
Annual sine exponent	1	64.3	827.1
Annual cosine exponent	1	45.8	781.3
Fishery	6	43.5	737.8
Log(catch weight)	1	8.7	729.1
Processing type	3	10.4	718.7

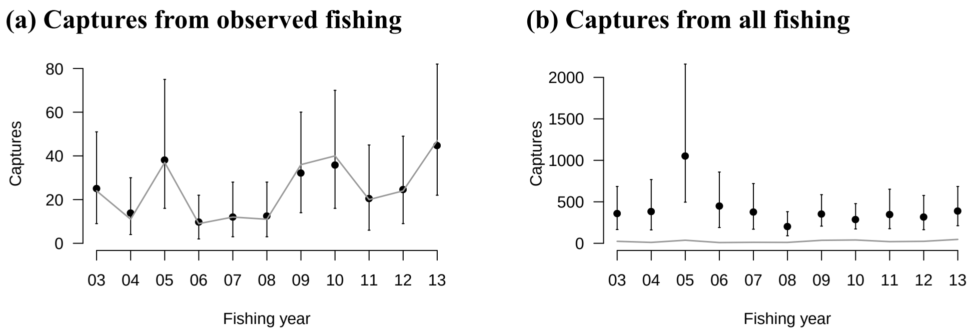


Figure C-101: Estimated captures of Salvin's albatross in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-102: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "True" (Mandatory mitigation), "East coast and Chatham" (Area), "Hoki-Hake-Ling" (Fishery), and "No meal plant" (Processing type).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.044	0.047	0.019	0.088
Fishing year, 2004	0.051	0.054	0.021	0.101
Fishing year, 2005	0.142	0.152	0.070	0.288
Fishing year, 2006	0.068	0.072	0.032	0.133
Fishing year, 2007	0.067	0.071	0.033	0.130
Fishing year, 2008	0.060	0.063	0.030	0.115
Fishing year, 2009	0.099	0.102	0.055	0.174
Fishing year, 2010	0.078	0.080	0.043	0.135
Fishing year, 2011	0.085	0.088	0.045	0.156
Fishing year, 2012	0.084	0.089	0.046	0.155
Fishing year, 2013	0.097	0.101	0.055	0.168
Mandatory mitigation, False	1.901	2.021	0.961	3.889
Area, Other	0.072	0.074	0.044	0.117
Annual sine exponent	0.308	0.310	0.217	0.424
Annual cosine exponent	2.564	2.602	1.876	3.554
Fishery, Mid-depths	2.186	2.298	1.226	3.940
Fishery, Scampi	2.754	3.320	0.832	9.433
Fishery, Deepwater-SBW	0.793	0.848	0.380	1.658
Fishery, Squid	3.028	3.295	1.414	6.550
Fishery, Inshore	2.984	3.594	0.960	9.634
Fishery, Flatfish	0.505	0.996	0.012	4.899
Processing type, Meal plant	0.711	0.753	0.376	1.370
Processing type, Small vessel	0.828	0.973	0.280	2.516
Processing type, Fresher	0.083	0.109	0.010	0.373
Log(catch)	2.903	3.095	1.586	5.621
Vessel effect s.d., $\exp(\sigma_\eta)$	2.103	2.140	1.694	2.798
Overdispersion, θ	0.020	0.020	0.013	0.030

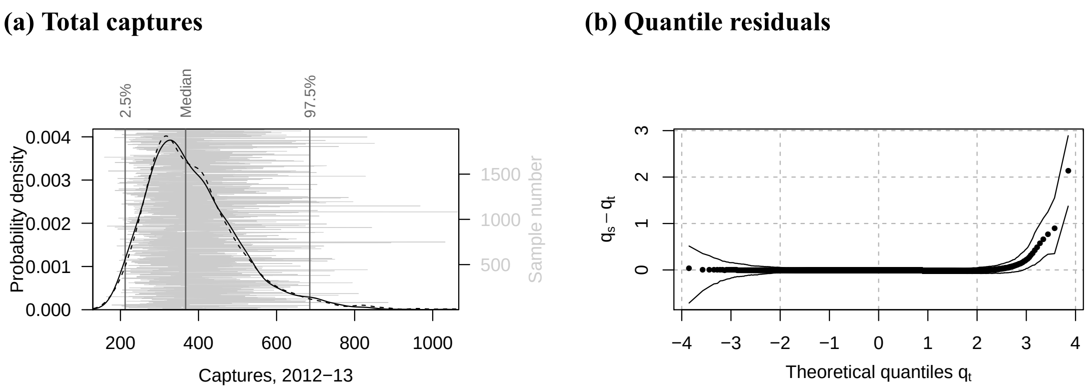


Figure C-102: Diagnostic plots for captures of Salvin's albatross in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.7 Salvin's albatross, large-vessel bottom-longline fisheries

Table C-103: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated Salvin's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	9	(3–17)
Ling	Chatham Rise	625	8.3	0	0	5	(1–11)
Ling	East Coast South Island	145	0	0		4	(1–9)
Ling	Stewart Snares Shelf	138	0	0		0	(0–0)
Minor targets	Fiordland	52	0	0		0	(0–0)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-104: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			582.5
Half year to April	1	224.6	357.9
Integrated weight line	1	92.3	265.7
Log(hooks)	1	43.3	222.4
Half year to June	1	16.7	205.7
Half year to May	1	18.3	187.3
Half year to August	1	3.5	183.9

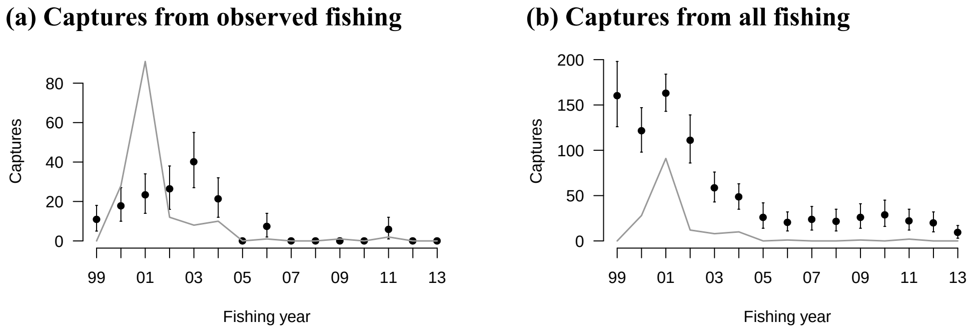


Figure C-103: Estimated captures of Salvin's albatross in all large-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-105: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "False" (Integrated weight line) and "First half" (Half year to April).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.000	0.003	0.000	0.027
Integrated weight line, True	0.000	0.002	0.000	0.026
Log(hooks)	0.806	0.807	0.686	0.932
Half year to April, Second half	0.005	0.007	0.000	0.025

(a) Total captures **(b) Quantile residuals**

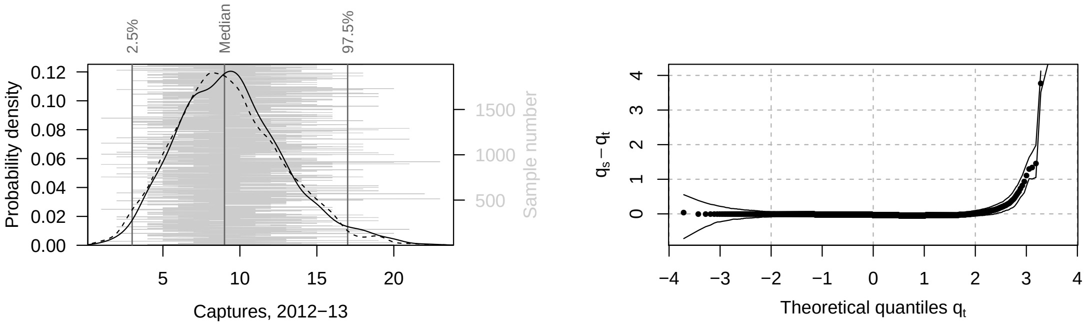


Figure C-104: Diagnostic plots for captures of Salvin's albatross in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.8 Salvin's albatross, small-vessel bottom-longline fisheries

Table C-106: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated Salvin's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	79	(24–180)
Ling	Chatham Rise	687	0	0		19	(3–50)
Ling	East Coast South Island	579	0	0		18	(2–48)
Ling	West Coast South Island	446	0	0		14	(1–40)
Ling	East Coast North Island	868	0	0		11	(1–32)
Ling	Fiordland	194	0	0		5	(0–18)
Bluenose	East Coast North Island	564	0	0		4	(0–17)
Bluenose	West Coast South Island	55	0	0		2	(0–11)
Ling	Cook Strait	78	0	0		2	(0–11)

Table C-107: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			234.7
Half year to August	1	43.6	191.1

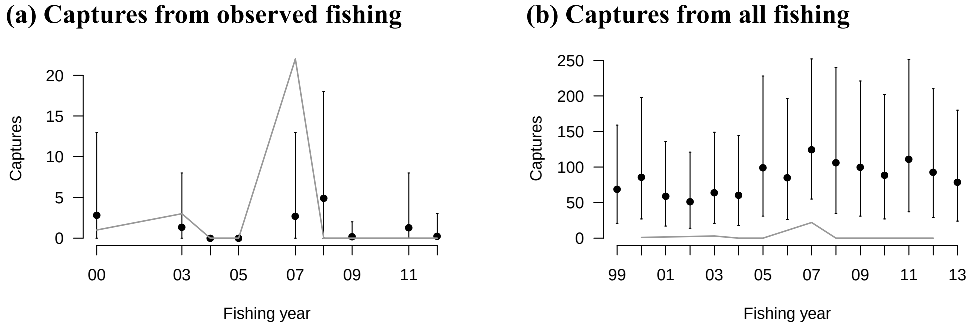


Figure C-105: Estimated captures of Salvin's albatross in all small-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-108: Summary of the posterior distributions of the model parameters. The base level of "Half year to August" is "Second half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.000	0.052	0.000	0.506
Half year to August, First half	0.000	0.002	0.000	0.019
Overdispersion, θ	0.018	0.020	0.010	0.046

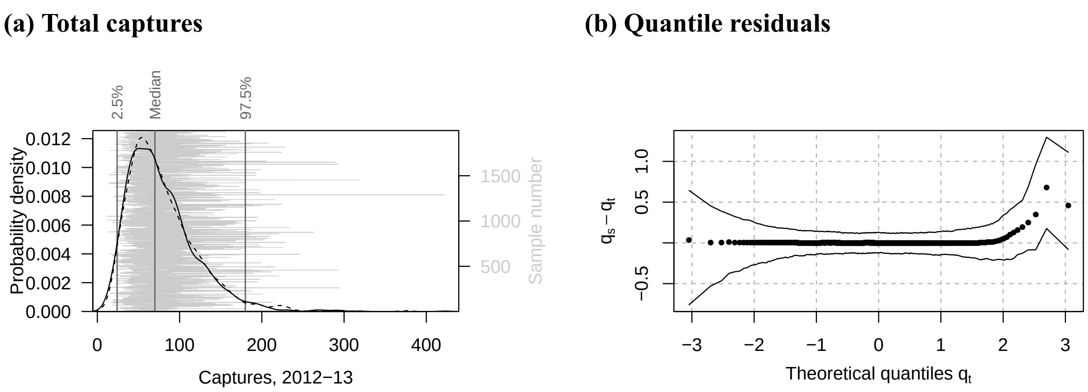


Figure C-106: Diagnostic plots for captures of Salvin's albatross in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.9 Salvin's albatross, large-vessel surface-longline fisheries

Table C-109: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated Salvin's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	0	0	0	(0–0)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)
Southern bluefin	Fiordland	137	100	0	0	0	(0–0)

Table C-110: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			66.0
Set time (day, night, full moon)	2	14.6	51.4
Half year to June	1	7.7	43.8
Half year to April	1	6.6	37.2
Fishing year	1	2.9	34.2

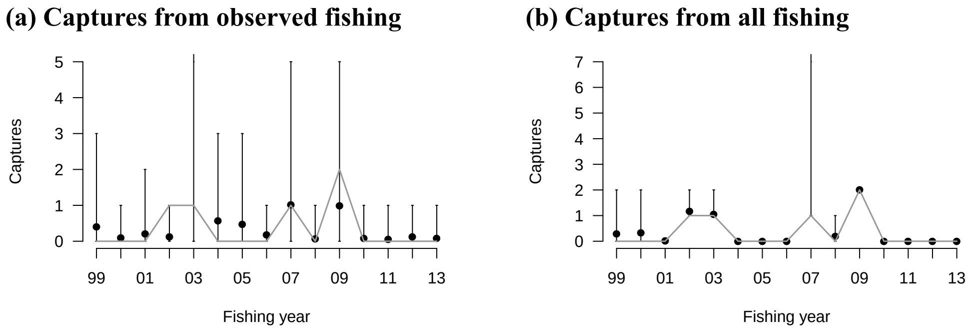


Figure C-107: Estimated captures of Salvin's albatross in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-111: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Second half" (Half year to June) and "Full moon" (Set time).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	0.000	0.002	0.000	0.023
Fishing year, 2000	0.000	0.002	0.000	0.028
Fishing year, 2001	0.000	0.003	0.000	0.025
Fishing year, 2002	0.000	0.005	0.000	0.036
Fishing year, 2003	0.000	0.003	0.000	0.027
Fishing year, 2004	0.000	0.002	0.000	0.024
Fishing year, 2005	0.000	0.002	0.000	0.025
Fishing year, 2006	0.000	0.002	0.000	0.024
Fishing year, 2007	0.000	0.003	0.000	0.027
Fishing year, 2008	0.000	0.003	0.000	0.027
Fishing year, 2009	0.000	0.003	0.000	0.035
Fishing year, 2010	0.000	0.002	0.000	0.024
Fishing year, 2011	0.000	0.002	0.000	0.025
Fishing year, 2012	0.000	0.002	0.000	0.025
Fishing year, 2013	0.000	0.003	0.000	0.024
Half year to June, First half	0.066	0.118	0.005	0.540
Set time, Daylight	2.017	2724.091	0.042	66.762
Set time, Night	0.000	0.006	0.000	0.049
Vessel effect s.d., $\exp(\sigma_\eta)$	2.489	130.536	1.208	53.029
Overdispersion, θ	1.794	7.429	0.043	61.891

(a) Total captures **(b) Quantile residuals**

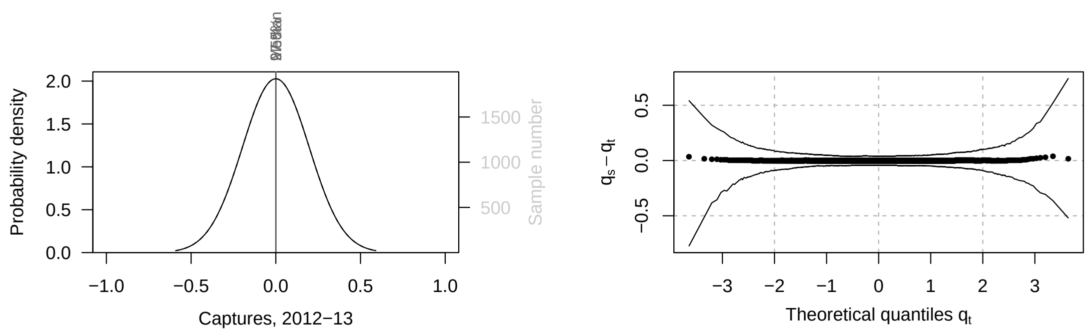


Figure C-108: Diagnostic plots for captures of Salvin's albatross in all large-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.10 Salvin's albatross, small-vessel surface-longline fisheries

Table C-112: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated Salvin's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	0	0	11	(3–23)
Bigeye	Northland and Hauraki	499	2.8	0	0	4	(0–10)
Bigeye	Bay of Plenty	193	0	0		2	(0–5)
Bigeye	East Coast North Island	209	0	0		2	(0–5)
Southern bluefin	East Coast North Island	381	2.4	0	0	1	(0–3)
Swordfish	East Coast North Island	48	0	0		1	(0–2)
Swordfish	West Coast North Island	85	2.4	0	0	1	(0–2)
Southern bluefin	Bay of Plenty	235	13.2	0	0	0	(0–2)
Southern bluefin	Northland and Hauraki	88	8	0	0	0	(0–2)

Table C-113: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			67.8
Half year to August	1	9.6	58.2
Half year to July	1	8.4	49.8

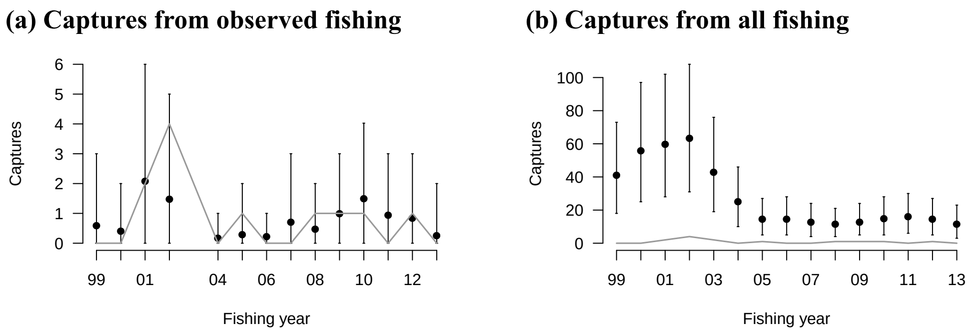


Figure C-109: Estimated captures of Salvin's albatross in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-114: Summary of the posterior distributions of the model parameters. The base level of "Half year to August" is "Second half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.346	0.373	0.095	0.783
Half year to August, First half	0.103	0.130	0.014	0.408

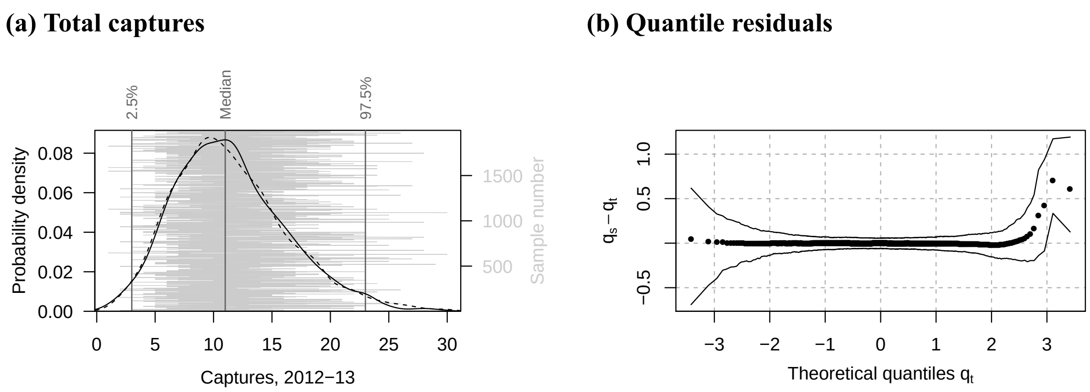


Figure C-110: Diagnostic plots for captures of Salvin's albatross in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.11 Southern Buller's albatross, trawl fisheries

Table C-115: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated southern Buller's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	57	0.5	112	(80–174)
Squid	Stewart Snares Shelf	1 532	87.9	22	1.6	24	(22–29)
Hoki	West Coast South Island	3 357	54.4	11	0.6	19	(12–31)
Hoki	Stewart Snares Shelf	930	64.8	9	1.5	11	(9–15)
Middle depths	East Coast South Island	2 189	18	0	0	9	(0–29)
Scampi	Auckland Islands	1 093	12.4	1	0.7	9	(2–22)
Middle depths	Stewart Snares Shelf	829	73.7	6	1	8	(6–16)
Hoki	East Coast South Island	2 710	30.4	1	0.1	5	(1–10)
Middle depths	Cook Strait	895	0	0		5	(0–20)

Table C-116: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1067.1
Annual cosine exponent	1	90.9	970.6
Fishery	5	154.4	816.3
Annual sine exponent	1	23.1	793.1
Area	2	15.7	777.5
Net type	1	9.6	767.9
Processing type	3	12.1	755.8

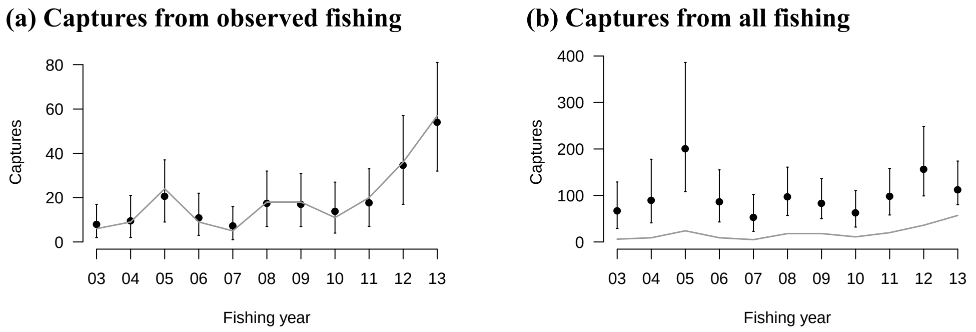


Figure C-111: Estimated captures of southern Buller's albatross in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-117: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Squid" (Fishery), "True" (Mandatory mitigation), "Meal plant" (Processing type), "Bottom" (Gear type), and "Auckland-Stewart-Snares" (Area).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.009	0.015	0.000	0.061
Fishing year, 2004	0.011	0.019	0.000	0.077
Fishing year, 2005	0.028	0.047	0.001	0.192
Fishing year, 2006	0.010	0.015	0.000	0.060
Fishing year, 2007	0.007	0.011	0.000	0.044
Fishing year, 2008	0.014	0.021	0.000	0.076
Fishing year, 2009	0.010	0.017	0.000	0.062
Fishing year, 2010	0.008	0.012	0.000	0.047
Fishing year, 2011	0.012	0.019	0.000	0.071
Fishing year, 2012	0.019	0.030	0.000	0.109
Fishing year, 2013	0.016	0.024	0.000	0.088
Annual cosine exponent	0.161	0.164	0.104	0.240
Annual sine exponent	1.651	1.691	1.088	2.519
Fishery, Hoki-Hake-Ling	0.651	0.687	0.334	1.233
Fishery, Mid-depths	1.211	1.259	0.676	2.104
Fishery, Scampi	0.748	1.039	0.166	3.845
Fishery, Deepwater-SBW	0.080	0.093	0.020	0.250
Fishery, Mackerel	0.087	0.110	0.011	0.348
Six month sine exponent	0.644	0.656	0.464	0.923
Mandatory mitigation, False	0.590	0.626	0.209	1.237
Processing type, No meal plant	1.140	1.204	0.587	2.139
Processing type, Small vessel	1.642	2.179	0.333	7.272
Processing type, Fresher	0.000	0.002	0.000	0.011
Gear type, Midwater	2.152	2.241	1.193	3.849
Area, Southern	0.344	0.362	0.183	0.647
Area, East coast and Chatham	0.503	0.528	0.285	0.892
Vessel effect s.d., $\exp(\sigma_\eta)$	1.608	1.635	1.247	2.195
Overdispersion, θ	0.042	0.045	0.023	0.089

(a) Total captures **(b) Quantile residuals**

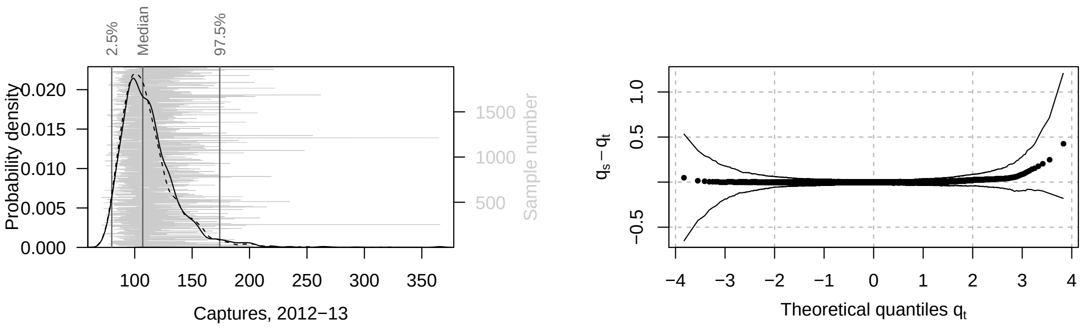


Figure C-112: Diagnostic plots for captures of southern Buller's albatross in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.12 Southern Buller's albatross, large-vessel bottom longline fisheries

Table C-118: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated southern Buller's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	1	(0–3)
Ling	Chatham Rise	625	8.3	0	0	0	(0–2)
Ling	East Coast South Island	145	0	0		0	(0–1)
Ling	Stewart Snares Shelf	138	0	0		0	(0–0)
Minor targets	Fiordland	52	0	0		0	(0–0)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-119: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			59.6
Integrated weight line	1	5.9	53.8
Half year to July	1	5.0	48.7

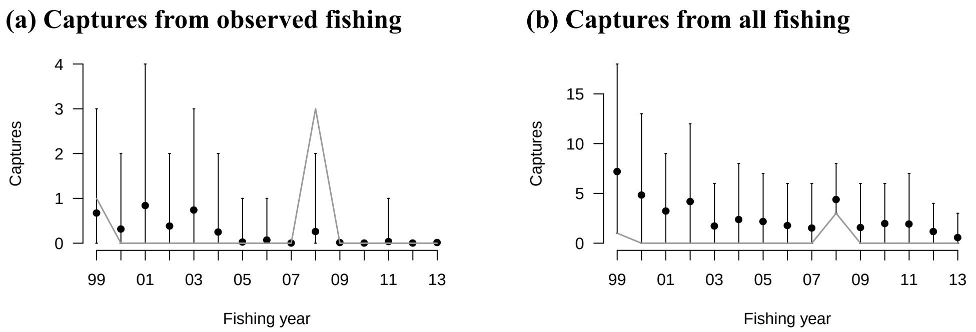


Figure C-113: Estimated captures of southern Buller's albatross in all large-vessel bottom longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-120: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "False" (Integrated weight line) and "First half" (Half year to July).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.000	0.002	0.000	0.017
Integrated weight line, True	0.000	0.014	0.000	0.136
Half year to July, Second half	0.075	0.143	0.003	0.660
Overdispersion, θ	0.125	0.374	0.012	2.887

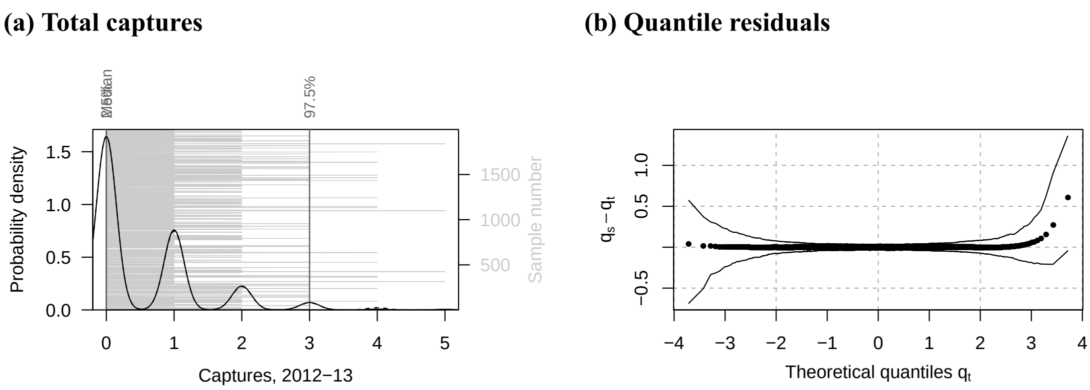


Figure C-114: Diagnostic plots for captures of southern Buller's albatross in all large-vessel bottom longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.13 Southern Buller's albatross, small-vessel bottom-longline fisheries

Table C-121: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated southern Buller's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	49	(15–100)
Ling	West Coast South Island	446	0	0		13	(3–29)
Ling	Chatham Rise	687	0	0		8	(1–19)
Ling	East Coast South Island	579	0	0		8	(1–20)
Bluenose	Chatham Rise	106	0	0		5	(0–13)
Ling	East Coast North Island	868	0	0		5	(0–12)
Bluenose	East Coast North Island	564	0	0		3	(0–9)
Bluenose	West Coast South Island	55	0	0		2	(0–6)
Ling	Stewart Snares Shelf	34	0	0		2	(0–6)

Table C-122: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			60.4
Half year to June	1	17.8	42.7

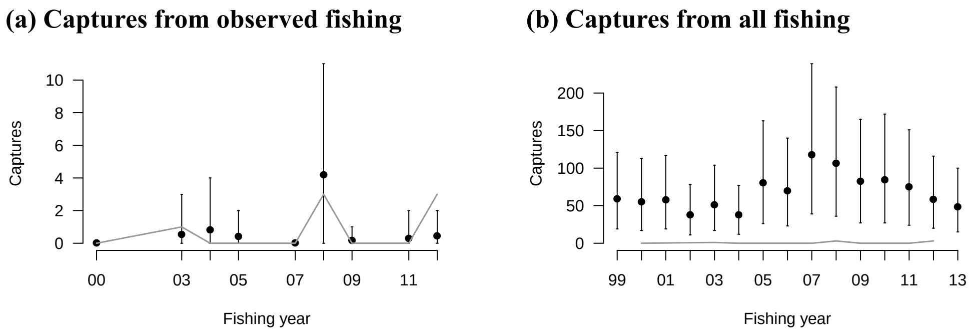


Figure C-115: Estimated captures of southern Buller's albatross in all small-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-123: Summary of the posterior distributions of the model parameters. The base level of "Half year to June" is "First half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.000	0.030	0.000	0.325
Half year to June, Second half	0.000	0.002	0.000	0.025
Overdispersion, θ	0.529	2.047	0.038	13.780

(a) Total captures (b) Quantile residuals

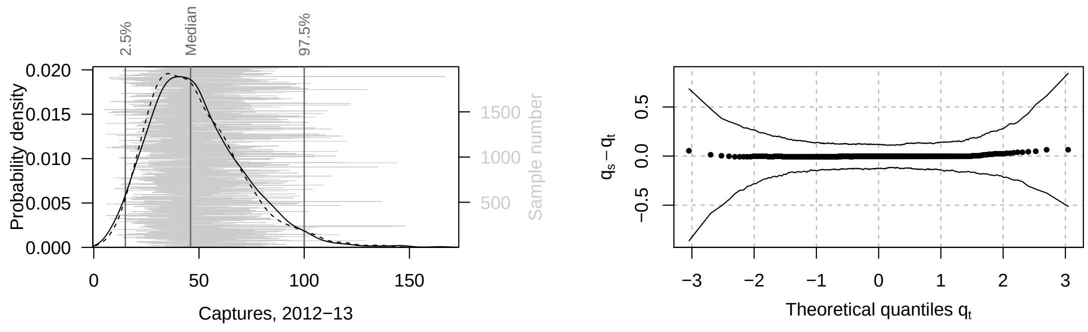


Figure C-116: Diagnostic plots for captures of southern Buller's albatross in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.14 Southern Buller's albatross, large-vessel surface-longline fisheries

Table C-124: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated southern Buller's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	2	1.4	2	(2–2)
Southern bluefin	Fiordland	137	100	2	1.5	2	(2–2)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)

Table C-125: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1248.2
Half year to May	1	67.2	1181.0
Set time (day, night, full moon)	2	36.8	1144.2
Half year to June	1	15.7	1128.5

(a) Captures from observed fishing (b) Captures from all fishing

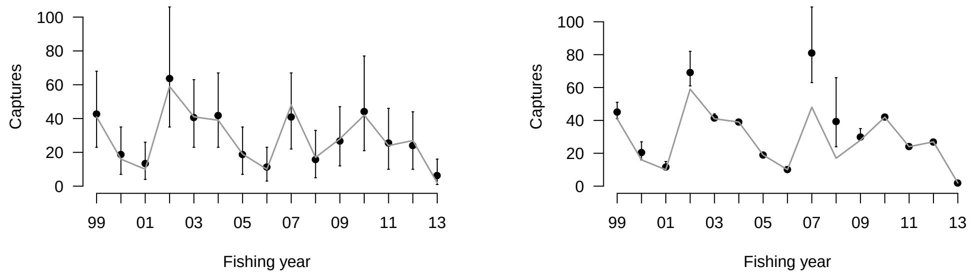


Figure C-117: Estimated captures of southern Buller's albatross in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-126: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Night" (Set time) and "First half" (Half year to May).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	8.719	8.909	5.913	12.989
Fishing year, 2000	5.650	5.800	3.235	9.178
Fishing year, 2001	4.021	4.172	2.119	7.157
Fishing year, 2002	17.128	17.416	11.689	24.805
Fishing year, 2003	8.006	8.163	5.359	11.818
Fishing year, 2004	8.272	8.425	5.591	12.235
Fishing year, 2005	8.482	8.717	4.934	13.908
Fishing year, 2006	5.755	5.950	2.893	10.434
Fishing year, 2007	16.456	16.880	10.405	25.984
Fishing year, 2008	13.662	14.355	7.137	26.009
Fishing year, 2009	9.591	9.813	5.842	15.258
Fishing year, 2010	19.271	19.828	11.938	30.989
Fishing year, 2011	11.746	12.112	6.860	19.519
Fishing year, 2012	9.465	9.798	5.829	15.318
Fishing year, 2013	2.760	2.956	0.979	6.102
Set time, Full moon	2.379	2.398	1.789	3.110
Set time, Daylight	0.838	0.957	0.298	2.383
Half year to May, Second half	0.350	0.354	0.257	0.465
Log(set duration)	0.166	0.295	0.019	1.315
Vessel effect s.d., $\exp(\sigma_\eta)$	1.382	1.422	1.116	1.977
Overdispersion, θ	0.301	0.306	0.229	0.412

(a) Total captures (b) Quantile residuals

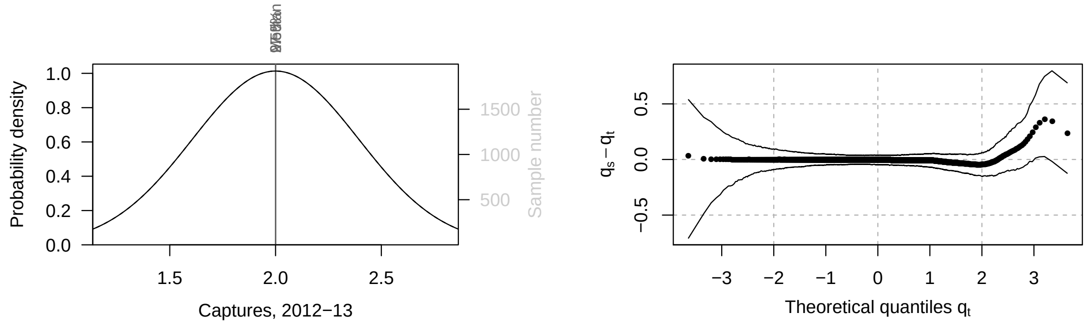


Figure C-118: Diagnostic plots for captures of southern Buller's albatross in all large-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.15 Southern Buller's albatross, small-vessel surface-longline fisheries

Table C-127: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated southern Buller's albatross captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	8	9.9	95	(68–128)
Southern bluefin	West Coast South Island	393	1	6	150	22	(14–32)
Bigeye	Northland and Hauraki	499	2.8	2	14.3	19	(10–29)
Southern bluefin	East Coast North Island	381	2.4	0	0	16	(8–26)
Bigeye	East Coast North Island	209	0	0		11	(4–18)
Bigeye	Bay of Plenty	193	0	0		6	(2–12)
Southern bluefin	Bay of Plenty	235	13.2	0	0	4	(0–9)
Bigeye	West Coast North Island	119	8.4	0	0	3	(0–7)
Swordfish	West Coast South Island	93	0	0		3	(0–7)

Table C-128: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			196.6
Set time (day, night, full moon)	2	28.6	168.0
Fishing year	1	13.7	154.3
Half year to June	1	17.0	137.3
Half year to May	1	4.7	132.6

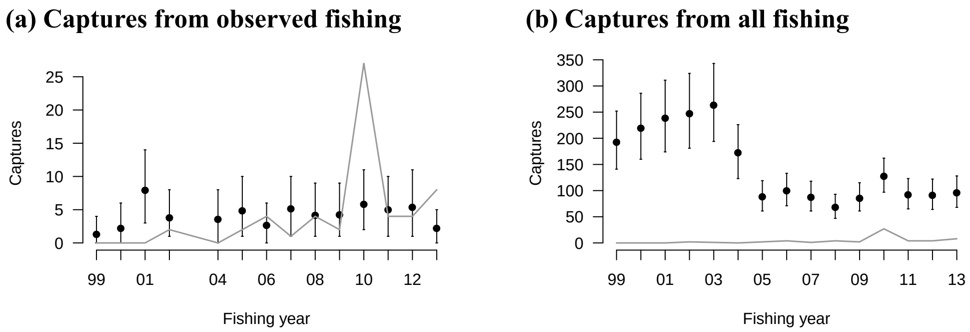


Figure C-119: Estimated captures of southern Buller's albatross in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-129: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Full moon" (Set time) and "First half" (Half year to June).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	1.624	1.650	0.998	2.420
Set time, Night	0.157	0.163	0.092	0.263
Set time, Daylight	0.061	0.090	0.002	0.337
Half year to June, Second half	0.176	0.187	0.072	0.362

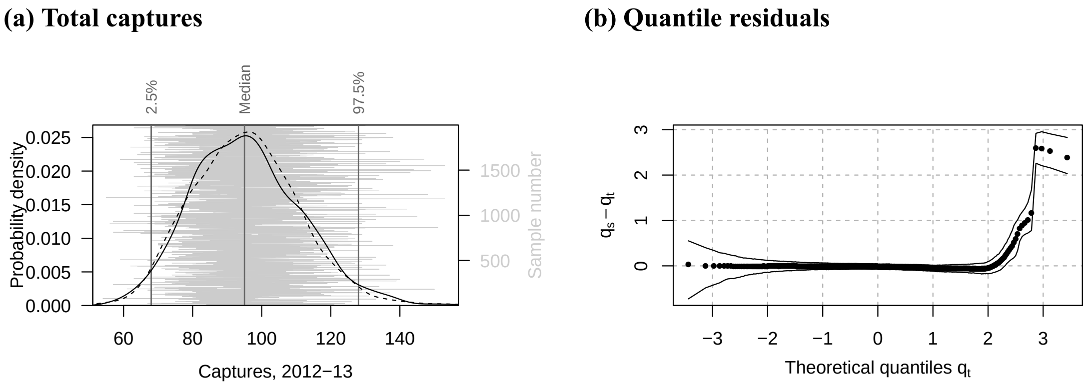


Figure C-120: Diagnostic plots for captures of southern Buller's albatross in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.16 Other albatrosses, trawl fisheries

Table C-130: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other albatrosses captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	18	0.1	94	(48–172)
Inshore	East Coast North Island	7 315	0	0		12	(2–28)
Inshore	East Coast South Island	4 650	2.2	0	0	7	(1–17)
Inshore	Northland and Hauraki	4 140	0.4	0	0	6	(1–16)
Inshore	Taranaki	3 490	0.1	0	0	6	(0–15)
Inshore	West Coast North Island	3 566	0.5	0	0	5	(0–12)
Inshore	West Coast South Island	3 106	1	0	0	5	(0–12)
Scampi	Chatham Rise	2 106	5.6	0	0	5	(0–12)
Middle depths	Stewart Snares Shelf	829	73.7	4	0.7	4	(4–5)

Table C-131: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			430.1
Processing type	3	10.6	419.5
Inshore	1	4.1	403.8

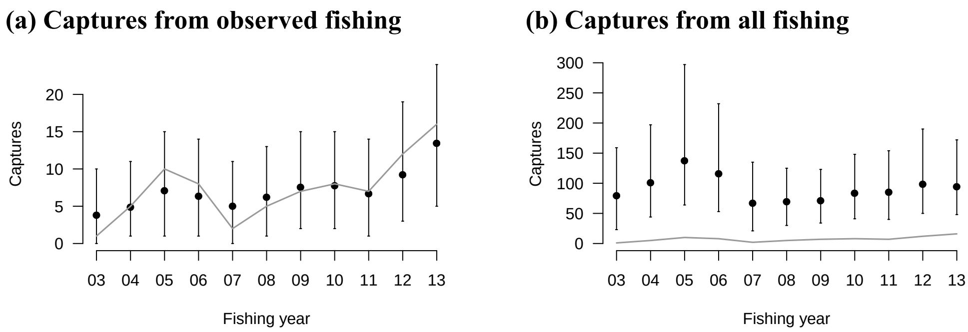


Figure C-121: Estimated captures of other albatrosses in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-132: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Meal plant" (Processing type), "False" (Inshore), and "True" (Mandatory mitigation).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.014	0.022	0.000	0.079
Fishing year, 2004	0.020	0.029	0.001	0.102
Fishing year, 2005	0.025	0.037	0.001	0.140
Fishing year, 2006	0.023	0.033	0.001	0.115
Fishing year, 2007	0.014	0.022	0.000	0.079
Fishing year, 2008	0.017	0.025	0.000	0.088
Fishing year, 2009	0.018	0.027	0.000	0.090
Fishing year, 2010	0.020	0.029	0.001	0.098
Fishing year, 2011	0.020	0.029	0.001	0.099
Fishing year, 2012	0.024	0.035	0.001	0.121
Fishing year, 2013	0.023	0.033	0.001	0.112
Processing type, No meal plant	1.233	1.311	0.628	2.430
Processing type, Small vessel	1.928	2.218	0.692	5.420
Processing type, Fresher	0.000	0.006	0.000	0.067
Inshore, True	0.615	0.634	0.352	1.038
Moon phase exponent	0.384	0.427	0.162	0.942
Mandatory mitigation, False	0.834	0.900	0.376	1.785
Fraction of fishing at night	0.609	0.684	0.238	1.551
Vessel effect s.d., $\exp(\sigma_\eta)$	1.815	1.865	1.268	2.807
Overdispersion, θ	0.030	1.707	0.011	18.110

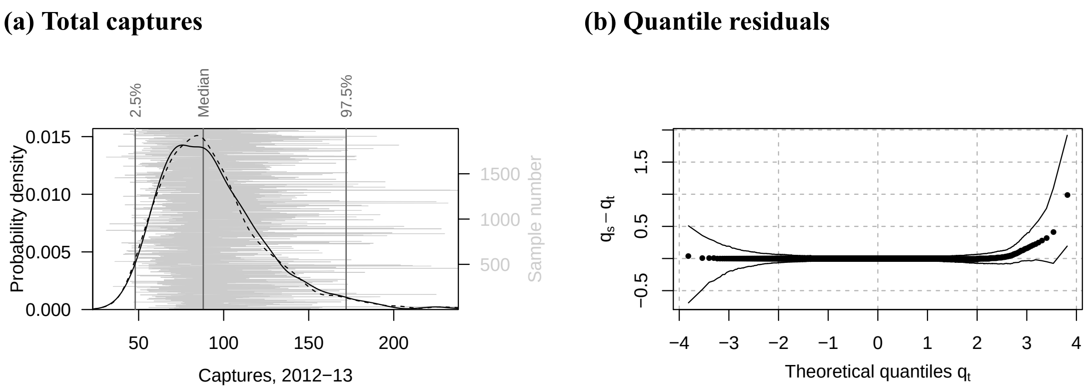


Figure C-122: Diagnostic plots for captures of other albatrosses in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.17 Other albatrosses, large-vessel bottom-longline fisheries

Table C-133: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other albatrosses captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	2	(0–6)
Ling	Chatham Rise	625	8.3	0	0	1	(0–5)
Ling	East Coast South Island	145	0	0		0	(0–2)
Ling	Stewart Snares Shelf	138	0	0		0	(0–1)
Minor targets	Fiordland	52	0	0		0	(0–1)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-134: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			124.8
Integrated weight line	1	11.4	113.4

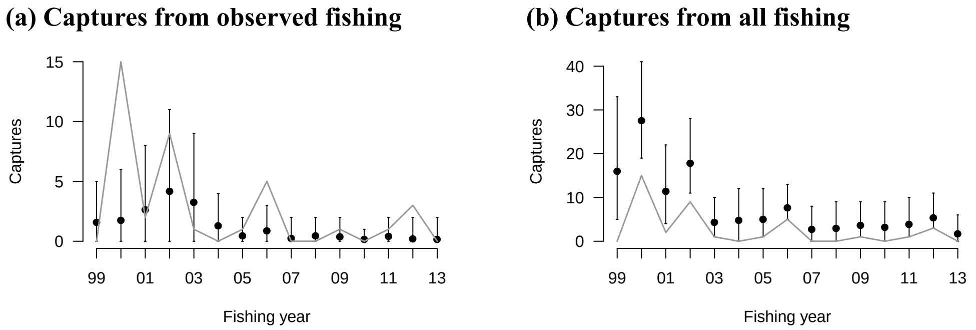


Figure C-123: Estimated captures of other albatrosses in all large-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-135: Summary of the posterior distributions of the model parameters. The base level of "Integrated weight line" is "False" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.170	0.184	0.091	0.355
Integrated weight line, True	0.305	0.341	0.105	0.778
Vessel effect s.d., $\exp(\sigma_\eta)$	1.663	1.859	1.170	3.661
Overdispersion, θ	0.014	0.016	0.010	0.035

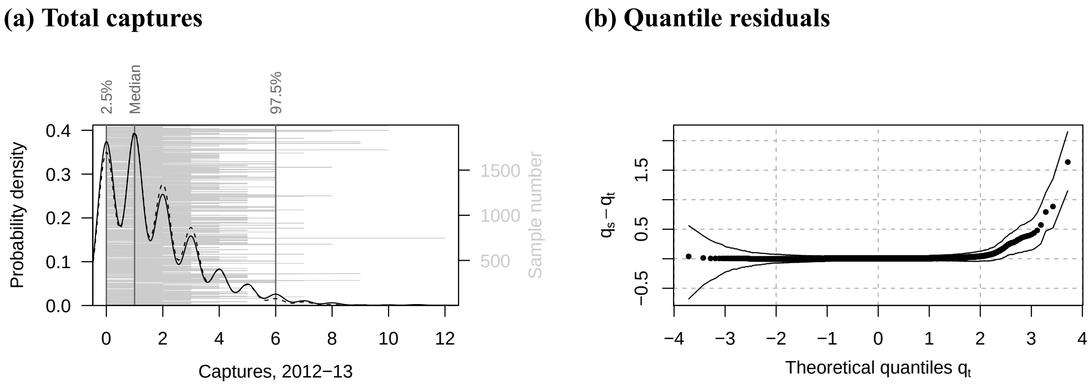


Figure C-124: Diagnostic plots for captures of other albatrosses in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.18 Other albatrosses, small-vessel bottom longline fisheries

Table C-136: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other albatrosses captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	75	(30–153)
Snapper	Northland and Hauraki	4 537	0	0		23	(7–48)
Ling	East Coast North Island	868	0	0		5	(0–12)
Snapper	Bay of Plenty	1 080	1.5	0	0	5	(0–12)
Hāpuku	Chatham Rise	737	0	0		4	(0–12)
Bluenose	East Coast North Island	564	0	0		3	(0–10)
Ling	Chatham Rise	687	0	0		3	(0–10)
Ling	East Coast South Island	579	0	0		3	(0–9)
Minor targets	Taranaki	555	11.7	0	0	3	(0–8)

Table C-137: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			77.8
Half year to August	1	4.7	73.1
Half year to September	1	23.7	49.5

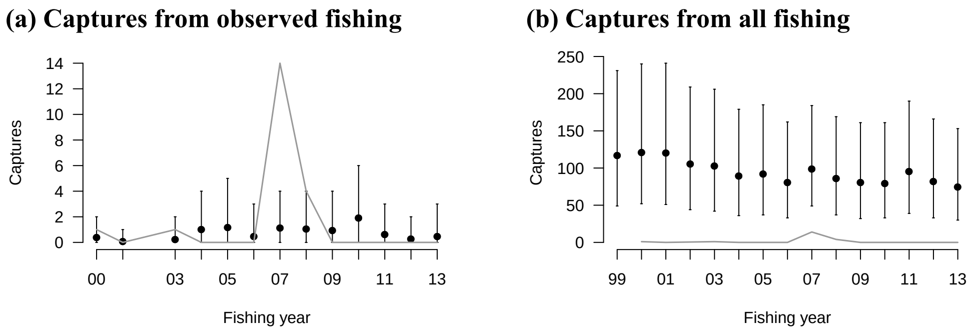


Figure C-125: Estimated captures of other albatrosses in all small-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-138: Summary of the posterior distributions of the model parameters. The base level of "Half year to August" is "Second half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.353	0.384	0.159	0.790
Half year to August, First half	0.286	0.329	0.083	0.809
Overdispersion, θ	0.019	0.023	0.010	0.057

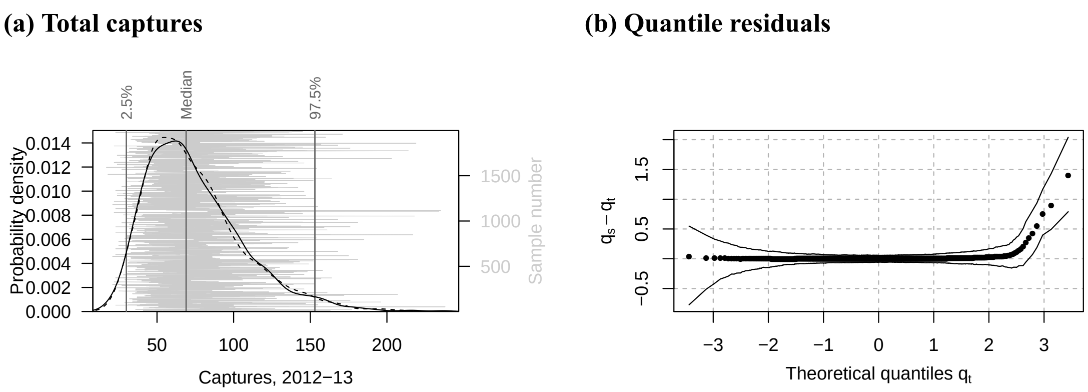


Figure C-126: Diagnostic plots for captures of other albatrosses in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.19 Other albatrosses, large-vessel surface-longline fisheries

Table C-139: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other albatrosses captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	0	0	0	(0–0)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)
Southern bluefin	Fiordland	137	100	0	0	0	(0–0)

Table C-140: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			464.7
Area	1	131.2	333.5
Half year to April	1	18.3	315.2
Set time (day, night, full moon)	2	16.2	299.0
Fishing year	1	6.3	292.7
Half year to June	1	4.0	288.6
Half year to May	1	3.0	285.7

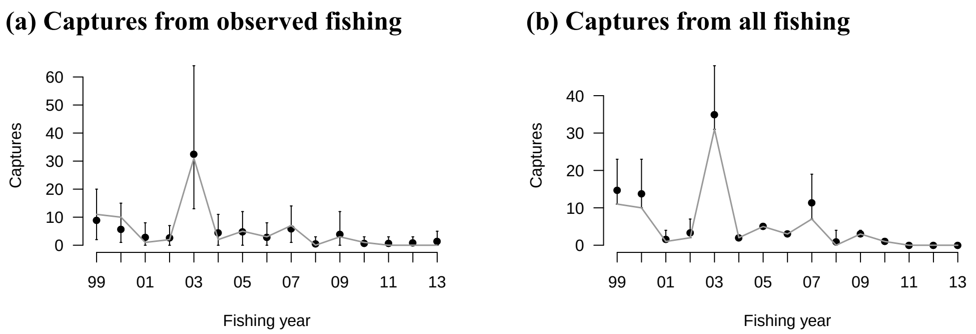


Figure C-127: Estimated captures of other albatrosses in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-141: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Daylight" (Set time), "Northern" (Area), and "Second half" (Half year to April).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	0.804	0.857	0.403	1.654
Fishing year, 2000	0.919	1.031	0.449	2.273
Fishing year, 2001	0.672	0.701	0.224	1.385
Fishing year, 2002	0.729	0.781	0.288	1.601
Fishing year, 2003	0.775	0.823	0.383	1.556
Fishing year, 2004	0.654	0.687	0.234	1.362
Fishing year, 2005	0.757	0.822	0.333	1.739
Fishing year, 2006	0.783	0.857	0.320	1.835
Fishing year, 2007	0.810	0.897	0.371	1.925
Fishing year, 2008	0.705	0.766	0.229	1.698
Fishing year, 2009	0.754	0.814	0.312	1.726
Fishing year, 2010	0.764	0.846	0.307	1.927
Fishing year, 2011	0.715	0.765	0.230	1.585
Fishing year, 2012	0.703	0.747	0.218	1.576
Fishing year, 2013	0.685	0.723	0.206	1.502
Set time, Full moon	1.844	2.478	0.442	8.637
Set time, Night	0.521	0.701	0.132	2.271
Area, Southern	0.043	0.046	0.019	0.090
Half year to April, First half	4.448	4.789	2.078	9.360
Vessel effect s.d., $\exp(\sigma_\eta)$	1.936	2.331	1.342	4.897
Overdispersion, θ	0.362	0.403	0.142	0.957

(a) Total captures **(b) Quantile residuals**

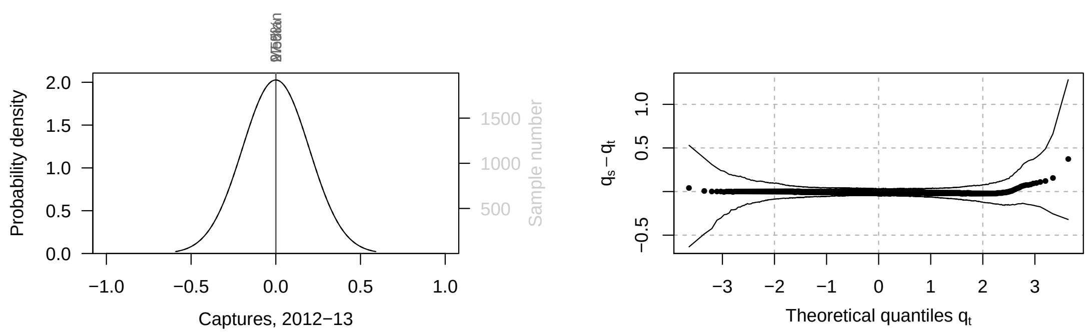


Figure C-128: Diagnostic plots for captures of other albatrosses in all large-vessel surface-longline fisheries (a) Posterior distribution of total captures during the 2012–13 fishing year. (b) Randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.20 Other albatrosses, small-vessel surface-longline fisheries

Table C-142: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other albatrosses captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	4	4.9	184	(84–406)
Swordfish	West Coast North Island	85	2.4	0	0	31	(1–163)
Swordfish	West Coast South Island	93	0	0		25	(2–100)
Bigeye	Northland and Hauraki	499	2.8	1	7.1	20	(8–41)
Southern bluefin	West Coast South Island	393	1	2	50	19	(7–45)
Swordfish	Northland and Hauraki	40	10	0	0	16	(0–74)
Swordfish	East Coast North Island	48	0	0		15	(0–65)
Southern bluefin	East Coast North Island	381	2.4	0	0	13	(4–29)
Southern bluefin	Northland and Hauraki	88	8	1	14.3	11	(2–37)

Table C-143: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			368.2
Set time (day, night, full moon)	2	35.9	332.3
Half year to August	1	12.7	319.6
Fishery	2	19.3	300.3
Fishing year	1	10.1	290.2

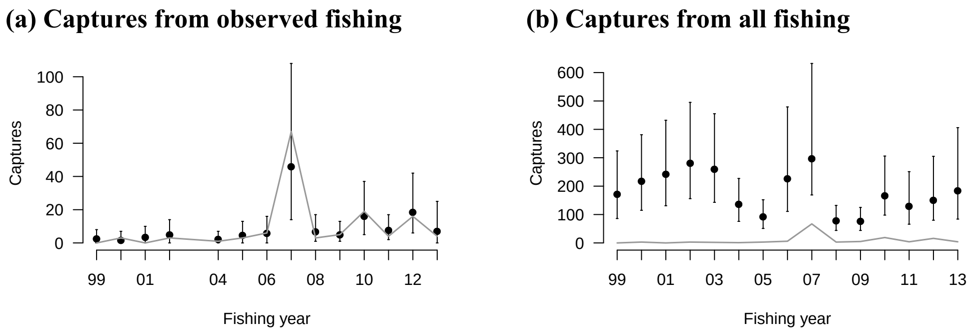


Figure C-129: Estimated captures of other albatrosses in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-144: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Night" (Set time), "Second half" (Half year to August), and "Swordfish" (Fishery).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	2.651	2.706	1.697	4.048
Set time, Full moon	3.364	3.534	1.771	6.343
Set time, Daylight	1.691	1.903	0.637	4.373
Half year to August, First half	0.088	0.097	0.030	0.215
Fishery, Bigeye	0.064	0.073	0.021	0.177
Fishery, Bluefin	0.523	0.626	0.183	1.697
Vessel effect s.d., $\exp(\sigma_\eta)$	3.163	3.571	2.060	7.585
Overdispersion, θ	0.262	0.278	0.139	0.506

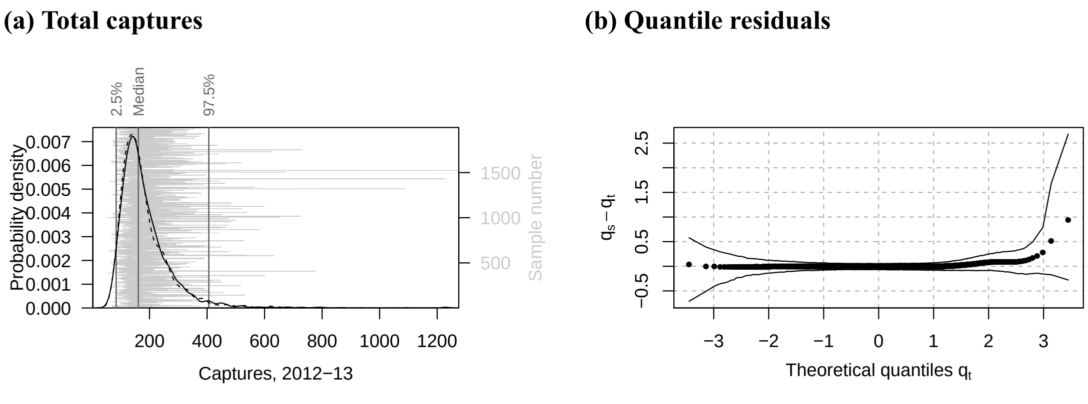


Figure C-130: Diagnostic plots for captures of other albatrosses in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.21 Sooty shearwater, trawl fisheries

Table C-145: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated sooty shearwater captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	110	0.9	321	(212–518)
Middle depths	East Coast South Island	2 189	18	6	1.5	80	(21–224)
Squid	Stewart Snares Shelf	1 532	87.9	56	4.2	63	(56–83)
Hoki	East Coast South Island	2 710	30.4	12	1.5	40	(21–80)
Squid	Auckland Islands	1 027	86.2	12	1.4	19	(12–39)
Middle depths	Stewart Snares Shelf	829	73.7	6	1	11	(6–29)
Inshore	East Coast South Island	4 650	2.2	0	0	10	(1–28)
Hoki	Stewart Snares Shelf	930	64.8	4	0.7	9	(4–19)
Mackerel	Stewart Snares Shelf	89	100	9	10.1	9	(9–9)

Table C-146: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			2491.9
Fishery-area	6	920.9	1571.0
Six month cosine exponent	1	169.4	1401.6
Net type	1	34.3	1367.3
Annual sine exponent	1	30.6	1336.8
Processing type	3	17.7	1319.1
Fishing year	1	22.8	1296.3
Annual cosine exponent	1	20.5	1265.7
Log(catch weight)	1	12.9	1252.8

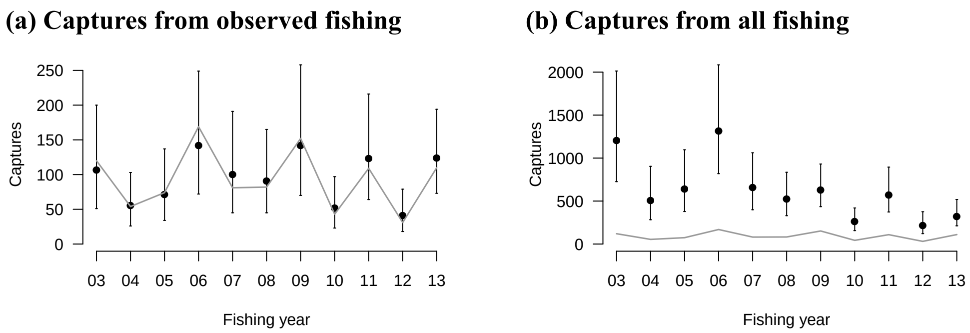
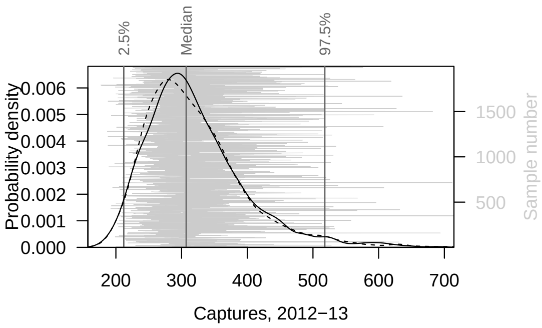


Figure C-131: Estimated captures of sooty shearwater in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-147: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Squid all areas" (Fishery-area), "Bottom" (Gear type), "False" (Inshore), "No meal plant" (Processing type), and "True" (Mandatory mitigation).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.154	0.168	0.071	0.346
Fishing year, 2004	0.070	0.075	0.031	0.149
Fishing year, 2005	0.084	0.090	0.039	0.181
Fishing year, 2006	0.161	0.168	0.087	0.291
Fishing year, 2007	0.094	0.097	0.049	0.170
Fishing year, 2008	0.105	0.110	0.057	0.186
Fishing year, 2009	0.131	0.137	0.070	0.233
Fishing year, 2010	0.058	0.061	0.030	0.106
Fishing year, 2011	0.115	0.120	0.062	0.209
Fishing year, 2012	0.045	0.048	0.022	0.089
Fishing year, 2013	0.069	0.072	0.037	0.119
Fishery-area, Mid-depths south and east	1.060	1.083	0.729	1.559
Fishery-area, Mid-depths Chatham	0.172	0.181	0.089	0.326
Fishery-area, Inshore all areas	0.102	0.127	0.026	0.372
Fishery-area, Deepwater-SBW all areas	0.014	0.016	0.003	0.041
Fishery-area, Mid-depths north and west	0.023	0.026	0.006	0.063
Fishery-area, Inshore flatfish all areas	0.050	0.092	0.002	0.426
Six month cosine exponent	0.265	0.267	0.205	0.340
Gear type, Midwater	0.507	0.534	0.255	0.985
Annual sine exponent	2.250	2.269	1.758	2.913
Inshore, True	1.178	1.191	0.866	1.598
Processing type, Meal plant	1.010	1.109	0.496	2.277
Processing type, Small vessel	2.174	2.625	0.663	7.183
Processing type, Fresher	0.193	0.338	0.007	1.549
Mandatory mitigation, False	0.822	0.873	0.406	1.583
Log(catch)	2.939	3.047	1.776	4.889
Six month sine exponent	0.565	0.570	0.437	0.732
Annual cosine exponent	2.465	2.516	1.705	3.651
Moon phase exponent	1.498	1.534	0.933	2.349
Vessel effect s.d., exp(σ_η)	2.549	2.634	1.971	3.781
Overdispersion, θ	0.017	0.017	0.014	0.021

(a) Total captures



(b) Quantile residuals

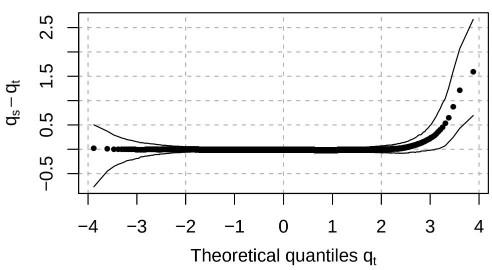


Figure C-132: Diagnostic plots for captures of sooty shearwater in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.22 Sooty shearwater, large-vessel bottom-longline fisheries

Table C-148: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated sooty shearwater captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	11	(0–44)
Ling	Stewart Snares Shelf	138	0	0		9	(0–38)
Ling	Chatham Rise	625	8.3	0	0	1	(0–5)
Ling	East Coast South Island	145	0	0		0	(0–3)
Minor targets	Fiordland	52	0	0		0	(0–1)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-149: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			521.2
Area	1	247.3	273.9
Breeding season	2	18.2	255.7
Integrated weight line	1	10.4	245.3
Half year to May	1	7.1	238.2

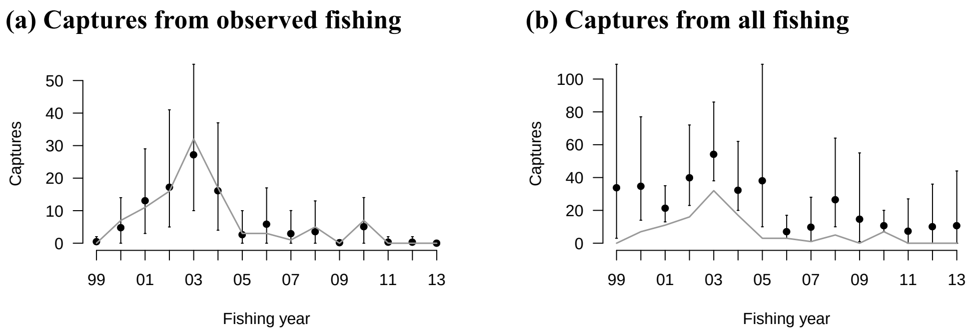


Figure C-133: Estimated captures of sooty shearwater in all large-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-150: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are “False” (Integrated weight line), “Keyhole” (Area), “Shoulder” (Season), and “Second half” (Half year to May).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	0.002	0.014	0.000	0.101
Fishing year, 2000	0.004	0.023	0.000	0.145
Fishing year, 2001	0.002	0.012	0.000	0.076
Fishing year, 2002	0.004	0.023	0.000	0.145
Fishing year, 2003	0.005	0.027	0.000	0.171
Fishing year, 2004	0.003	0.020	0.000	0.132
Fishing year, 2005	0.003	0.021	0.000	0.142
Fishing year, 2006	0.001	0.007	0.000	0.049
Fishing year, 2007	0.001	0.009	0.000	0.064
Fishing year, 2008	0.003	0.021	0.000	0.141
Fishing year, 2009	0.002	0.018	0.000	0.125
Fishing year, 2010	0.004	0.026	0.000	0.177
Fishing year, 2011	0.002	0.015	0.000	0.114
Fishing year, 2012	0.002	0.016	0.000	0.112
Fishing year, 2013	0.002	0.020	0.000	0.137
Integrated weight line, True	0.621	0.727	0.186	1.906
Area, Southern	0.035	0.039	0.011	0.089
Season, Breeding	0.533	0.561	0.270	1.023
Season, Off	0.000	0.007	0.000	0.072
Half year to May, First half	0.183	0.222	0.038	0.634
Vessel effect s.d., $\exp(\sigma_\eta)$	1.223	1.298	1.040	1.994
Overdispersion, θ	0.089	0.095	0.050	0.175

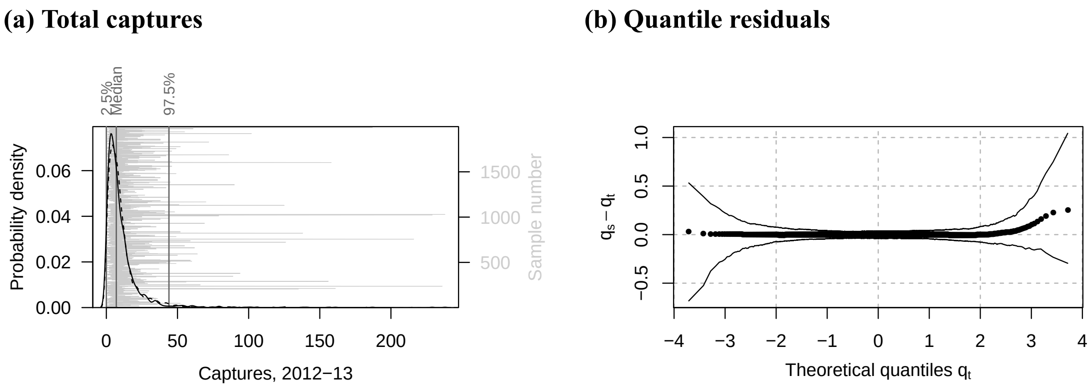


Figure C-134: Diagnostic plots for captures of sooty shearwater in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year;. (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.23 Sooty shearwater, small-vessel bottom-longline fisheries

Table C-151: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated sooty shearwater captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area			Observed		Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	35	(0–127)
Hāpuku	Chatham Rise	737	0	0		11	(0–42)
Minor targets	Taranaki	555	11.7	0	0	4	(0–17)
Hāpuku	Cook Strait	198	0	0		3	(0–12)
Hāpuku	West Coast South Island	219	0.9	0	0	3	(0–13)
Minor targets	Cook Strait	215	0	0		3	(0–12)
Minor targets	Chatham Rise	148	0	0		2	(0–9)
Minor targets	East Coast South Island	140	0	0		2	(0–9)
Hāpuku	East Coast South Island	84	0	0		1	(0–6)

Table C-152: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			8.3

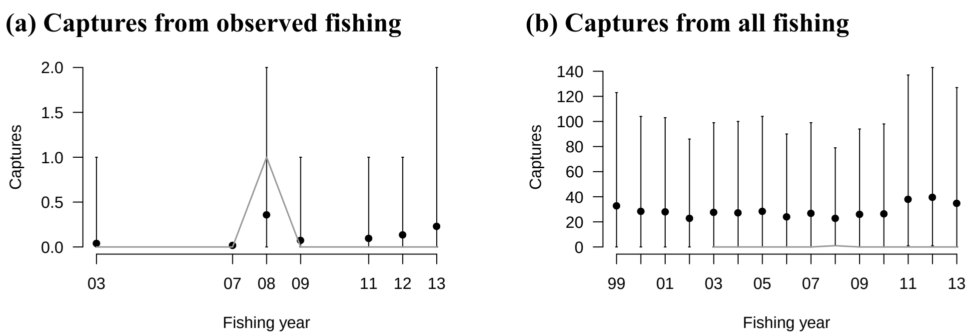


Figure C-135: Estimated captures of sooty shearwater in all small-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-153: Summary of the posterior distributions of the model parameters.

Parameter		Statistic		
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	1.044	1.512	0.042	5.490

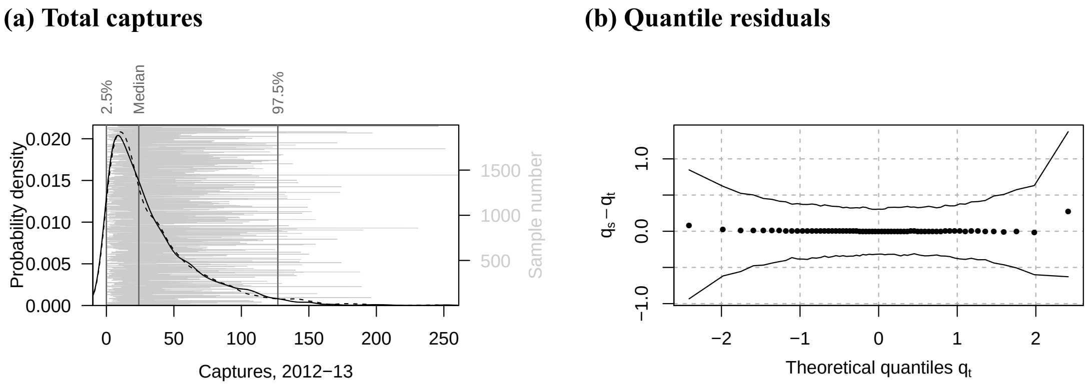


Figure C-136: Diagnostic plots for captures of sooty shearwater in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.24 Sooty shearwater, large-vessel surface-longline fisheries

Table C-154: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated sooty shearwater captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area		Observed			Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	0	0	0	(0–0)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)
Southern bluefin	Fiordland	137	100	0	0	0	(0–0)

Table C-155: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			143.8
Set time (day, night, full moon)	2	45.7	98.0
Half year to April	1	27.2	70.8
Log(fishing duration)	1	6.2	64.6
Half year to May	1	2.5	62.1

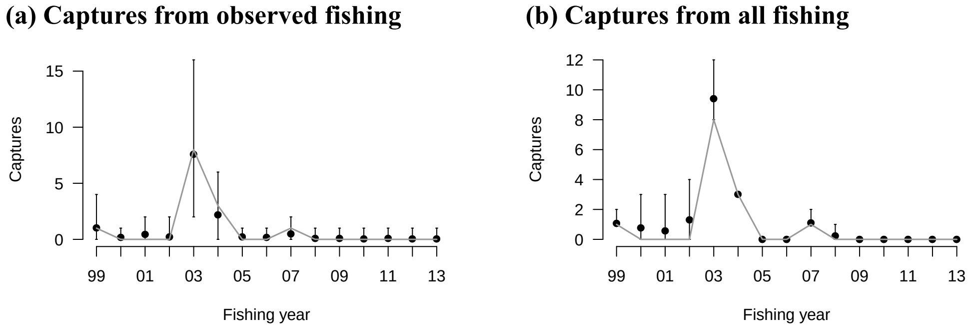


Figure C-137: Estimated captures of sooty shearwater in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-156: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "First half" (Half year to April) and "Daylight" (Set time).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.001	0.006	0.000	0.041
Half year to April, Second half	0.031	0.040	0.004	0.128
Set time, Night	0.126	0.179	0.021	0.635
Set time, Full moon	0.000	0.005	0.000	0.054
Log(fishing duration)	0.031	0.067	0.003	0.347

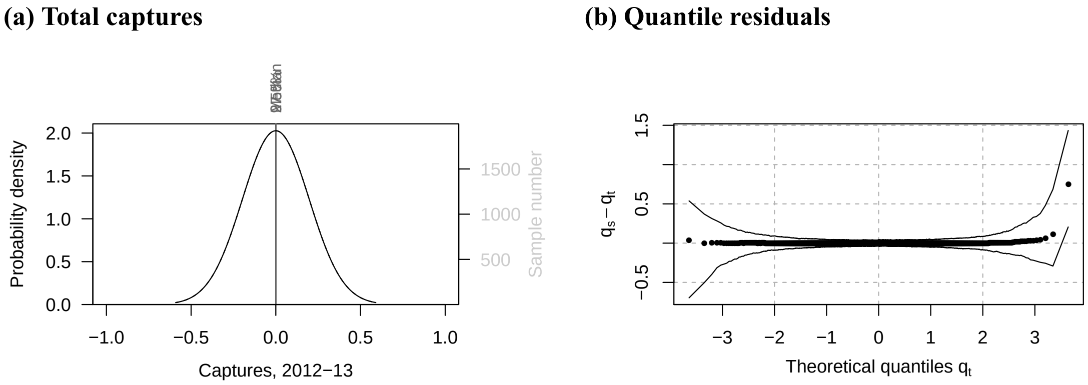


Figure C-138: Diagnostic plots for captures of sooty shearwater in all large-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.25 Sooty shearwater, small-vessel surface-longline fisheries

Table C-157: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated sooty shearwater captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	0	0	1	(0–6)
Bigeye	Bay of Plenty	193	0	0		0	(0–1)
Bigeye	East Coast North Island	209	0	0		0	(0–2)
Bigeye	Northland and Hauraki	499	2.8	0	0	0	(0–3)
Bigeye	West Coast North Island	119	8.4	0	0	0	(0–1)
Swordfish	Bay of Plenty	36	0	0		0	(0–1)
Swordfish	East Coast North Island	48	0	0		0	(0–1)
Swordfish	West Coast North Island	85	2.4	0	0	0	(0–1)
Swordfish	West Coast South Island	93	0	0		0	(0–1)

Table C-158: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			0.0

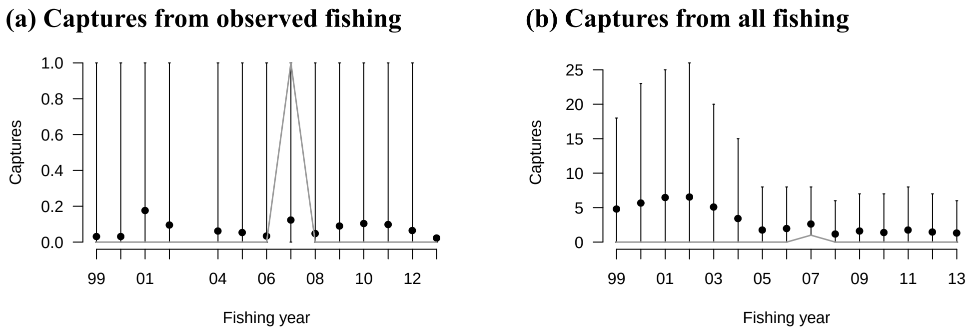


Figure C-139: Estimated captures of sooty shearwater in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-159: Summary of the posterior distributions of the model parameters.

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.067	0.097	0.002	0.360

(a) Total captures **(b) Quantile residuals**

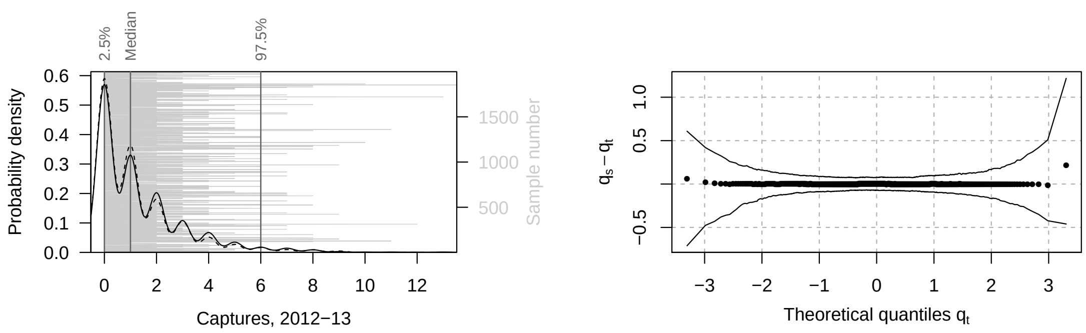


Figure C-140: Diagnostic plots for captures of sooty shearwater in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.26 White-chinned petrel, trawl fisheries

Table C-160: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-chinned petrel captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	276	2.2	372	(328–437)
Squid	Auckland Islands	1 027	86.2	115	13	128	(116–157)
Squid	Stewart Snares Shelf	1 532	87.9	106	7.9	112	(106–125)
Scampi	Chatham Rise	2 106	5.6	0	0	29	(9–69)
Middle depths	Stewart Snares Shelf	829	73.7	24	3.9	25	(25–27)
Hoki	Chatham Rise	1 961	40.2	4	0.5	12	(6–22)
Hoki	East Coast South Island	2 710	30.4	2	0.2	12	(4–25)
Mackerel	Stewart Snares Shelf	89	100	11	12.4	10	(10–10)
Scampi	Auckland Islands	1 093	12.4	0	0	10	(2–26)

Table C-161: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1944.2
Fishery	5	548.8	1395.4
Fishing year	1	86.9	1308.5
Area	3	53.7	1254.9
Annual cosine exponent	1	34.3	1220.6
Annual sine exponent	1	43.5	1177.1
Processing type	3	21.2	1155.9

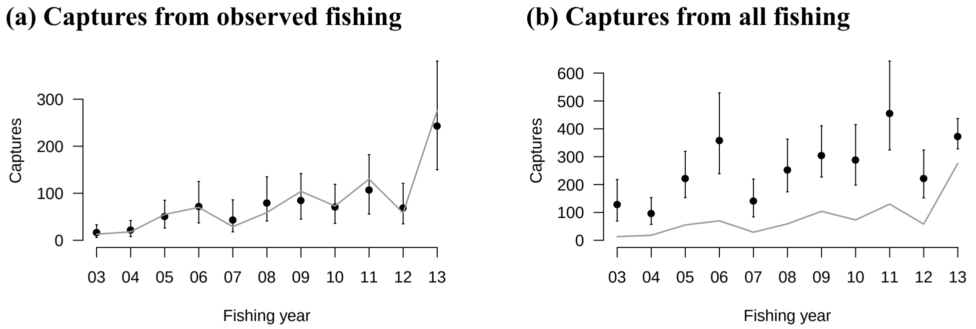


Figure C-141: Estimated captures of white-chinned petrel in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-162: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Squid" (Fishery), "True" (Mandatory mitigation), "Auckland-Snares" (Area), and "No meal plant" (Processing type).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.044	0.065	0.002	0.227
Fishing year, 2004	0.035	0.052	0.002	0.184
Fishing year, 2005	0.068	0.099	0.003	0.360
Fishing year, 2006	0.042	0.059	0.002	0.197
Fishing year, 2007	0.024	0.035	0.001	0.118
Fishing year, 2008	0.049	0.069	0.002	0.230
Fishing year, 2009	0.060	0.083	0.002	0.273
Fishing year, 2010	0.059	0.083	0.003	0.272
Fishing year, 2011	0.086	0.120	0.004	0.399
Fishing year, 2012	0.055	0.079	0.002	0.259
Fishing year, 2013	0.087	0.124	0.004	0.403
Fishery, Mid-depths	0.966	0.995	0.564	1.603
Fishery, Scampi	2.037	2.685	0.554	8.889
Fishery, Hoki-Hake-Ling	0.373	0.389	0.207	0.679
Fishery, Mackerel	0.920	1.018	0.374	2.263
Fishery, Deepwater-SBW	0.010	0.017	0.000	0.078
Mandatory mitigation, False	0.274	0.298	0.135	0.615
Log(fishing duration)	1.636	1.675	1.193	2.341
Area, Stewart-Snares	0.440	0.451	0.285	0.670
Area, East coast and Chatham	0.385	0.398	0.238	0.628
Area, Southern	1.070	1.194	0.391	2.746
Annual sine exponent	2.849	2.891	2.062	3.911
Annual cosine exponent	3.026	3.054	2.232	4.059
Processing type, Meal plant	0.759	0.792	0.436	1.318
Processing type, Small vessel	0.367	0.489	0.061	1.668
Processing type, Fresher	0.000	0.007	0.000	0.041
Fraction of fishing at night	1.838	1.975	0.845	3.923
Vessel effect s.d., $\exp(\sigma_\eta)$	2.103	2.148	1.686	2.881
Overdispersion, θ	0.021	0.022	0.017	0.027

(a) Total captures (b) Quantile residuals

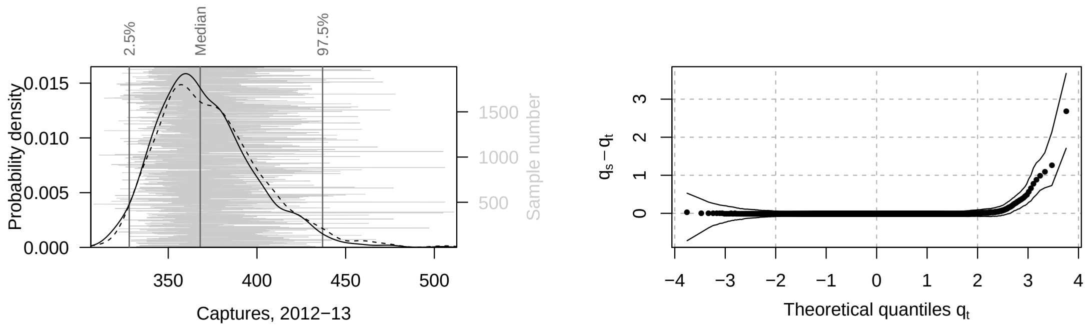


Figure C-142: Diagnostic plots for captures of white-chinned petrel in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.27 White-chinned petrel, large-vessel bottom-longline fisheries

Table C-163: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-chinned petrel captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	30	(1–145)
Ling	East Coast South Island	145	0	0		12	(0–63)
Ling	Chatham Rise	625	8.3	0	0	9	(0–47)
Ling	Stewart Snares Shelf	138	0	0		7	(0–36)
Minor targets	Fiordland	52	0	0		1	(0–9)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–1)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-164: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1659.7
Breeding season	2	727.5	932.2
Integrated weight line	1	108.6	823.6
Log(hooks)	1	38.8	784.8
Area	2	26.5	758.3

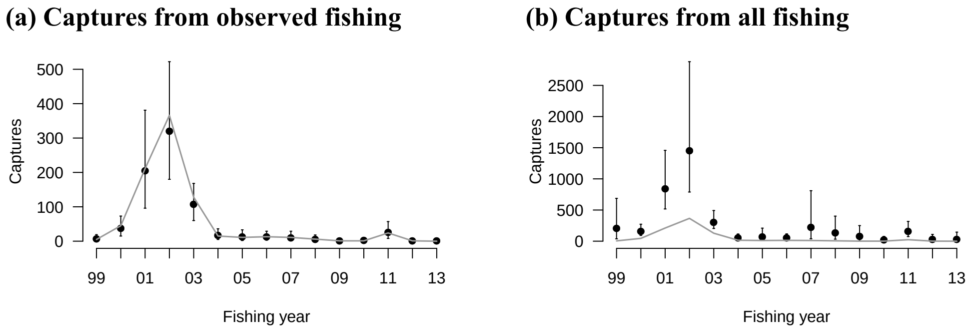


Figure C-143: Estimated captures of white-chinned petrel in all large-vessel bottom longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-165: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Chatham" (Area), "Breeding" (Season), and "False" (Integrated weight line).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	0.007	0.055	0.000	0.365
Fishing year, 2000	0.017	0.107	0.000	0.670
Fishing year, 2001	0.119	0.748	0.000	4.573
Fishing year, 2002	0.185	1.051	0.000	6.231
Fishing year, 2003	0.055	0.354	0.000	2.194
Fishing year, 2004	0.012	0.079	0.000	0.504
Fishing year, 2005	0.019	0.172	0.000	1.139
Fishing year, 2006	0.022	0.141	0.000	0.910
Fishing year, 2007	0.077	0.707	0.000	4.629
Fishing year, 2008	0.045	0.341	0.000	2.027
Fishing year, 2009	0.017	0.173	0.000	1.209
Fishing year, 2010	0.005	0.052	0.000	0.357
Fishing year, 2011	0.073	0.416	0.000	2.477
Fishing year, 2012	0.010	0.109	0.000	0.759
Fishing year, 2013	0.007	0.142	0.000	1.120
Area, Keyhole	12.092	14.479	4.402	37.602
Area, Southern	3.114	3.451	1.480	7.246
Season, Shoulder	0.127	0.131	0.080	0.198
Season, Off	0.000	0.000	0.000	0.002
Integrated weight line, True	0.991	1.206	0.251	3.405
Log(hooks)	1.125	1.154	0.725	1.781
Moon phase exponent	2.465	2.543	1.580	3.928
Vessel effect s.d., $\exp(\sigma_\eta)$	3.271	3.977	1.740	11.166
Overdispersion, θ	0.076	0.076	0.058	0.099

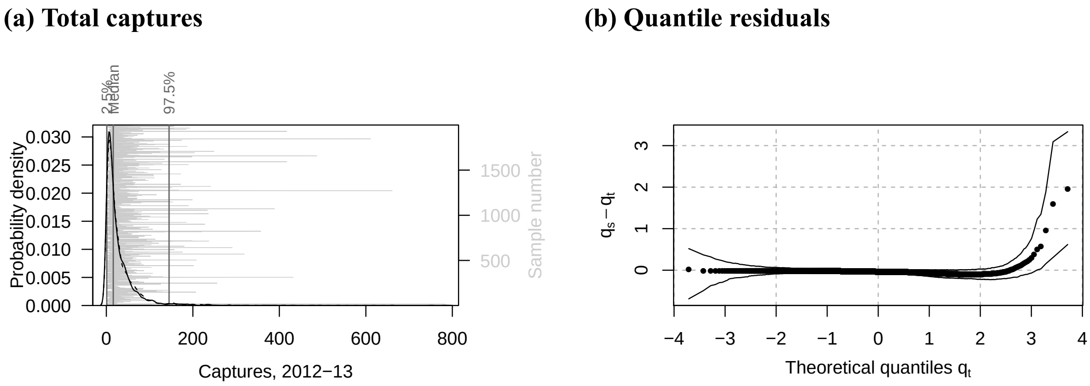


Figure C-144: Diagnostic plots for captures of white-chinned petrel in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.28 White-chinned petrel, small-vessel bottom longline fisheries

Table C-166: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-chinned petrel captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	0	0	160	(72–283)
Bluenose	East Coast North Island	564	0	0		28	(10–55)
Ling	East Coast North Island	868	0	0		24	(8–47)
Ling	West Coast South Island	446	0	0		19	(6–39)
Ling	East Coast South Island	579	0	0		18	(5–37)
Bluenose	Northland and Hauraki	282	0	0		13	(3–28)
Ling	Chatham Rise	687	0	0		12	(3–26)
Bluenose	Bay of Plenty	213	0	0		11	(2–24)
Bluenose	West Coast North Island	107	0	0		6	(0–15)

Table C-167: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			198.8
Half year to September	1	43.3	155.5
Half year to June	1	39.0	116.5

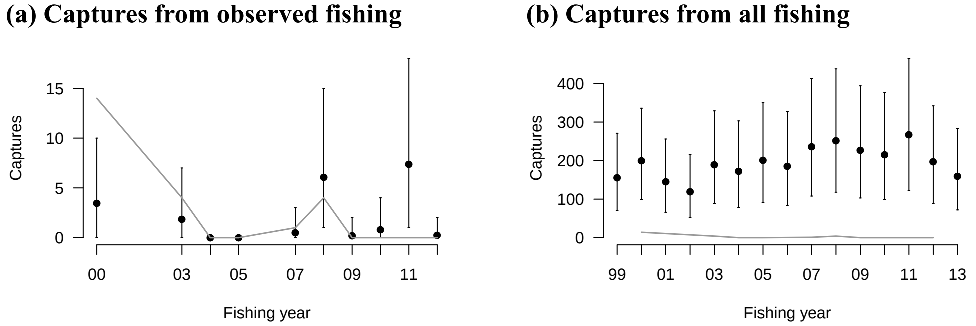


Figure C-145: Estimated captures of white-chinned petrel in all small-vessel bottom longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-168: Summary of the posterior distributions of the model parameters. The base level of "Half year to September" is "Second half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.001	0.060	0.000	0.545
Half year to September, First half	0.000	0.002	0.000	0.017
Overdispersion, θ	0.082	0.094	0.027	0.254

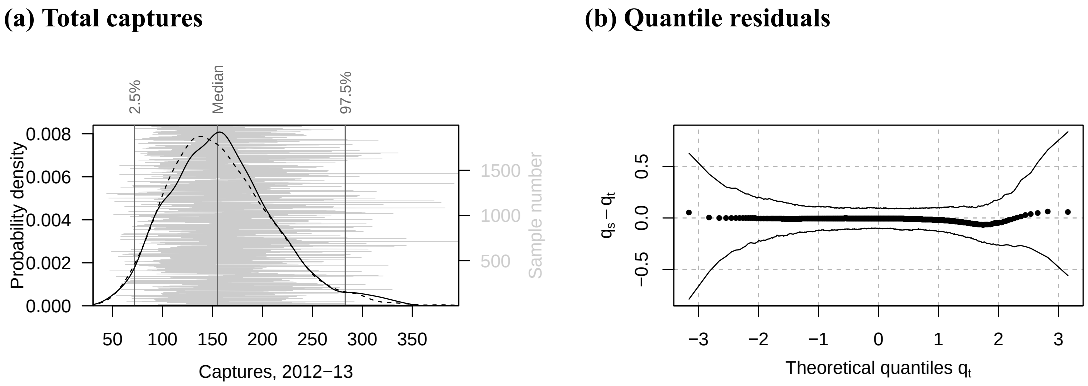


Figure C-146: Diagnostic plots for captures of white-chinned petrel in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.29 White-chinned petrel, large-vessel surface-longline fisheries

Table C-169: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-chinned petrel captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	1	0.7	1	(1–1)
Southern bluefin	Fiordland	137	100	1	0.7	1	(1–1)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)

Table C-170: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			220.6
Half year to April	1	48.5	172.1
Half year to May	1	6.2	166.0
Fishing year	1	2.3	163.7

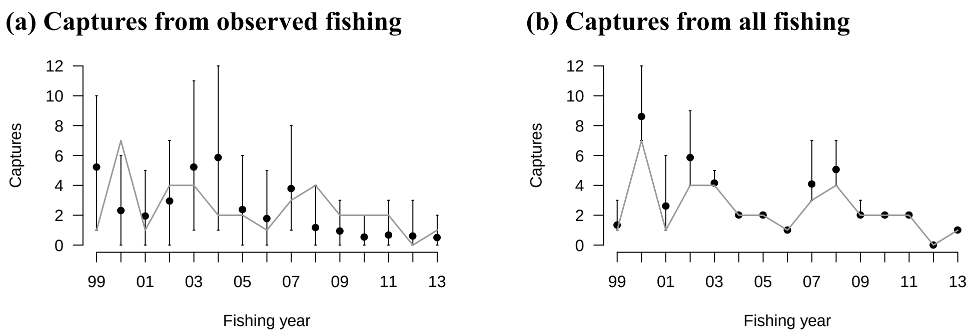


Figure C-147: Estimated captures of white-chinned petrel in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-171: Summary of the posterior distributions of the model parameters. The base level of "Half year to April" is "First half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	0.481	0.492	0.270	0.781
Half year to April, Second half	0.073	0.078	0.034	0.148

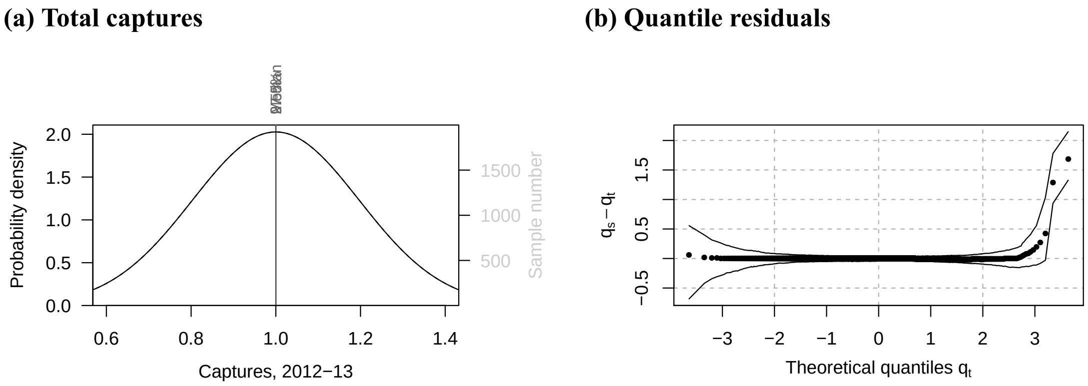


Figure C-148: Diagnostic plots for captures of white-chinned petrel in all large-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.30 White-chinned petrel, small-vessel surface-longline fisheries

Table C-172: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated white-chinned petrel captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area		Observed			Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	0	0	23	(11–39)
Bigeye	Northland and Hauraki	499	2.8	0	0	7	(2–14)
Bigeye	Bay of Plenty	193	0	0		3	(0–7)
Bigeye	East Coast North Island	209	0	0		3	(0–8)
Bigeye	West Coast North Island	119	8.4	0	0	2	(0–5)
Southern bluefin	East Coast North Island	381	2.4	0	0	1	(0–4)
Southern bluefin	West Coast South Island	393	1	0	0	1	(0–4)
Swordfish	West Coast North Island	85	2.4	0	0	1	(0–4)
Swordfish	West Coast South Island	93	0	0		1	(0–4)

Table C-173: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			78.9
Fishery	1	6.1	72.8

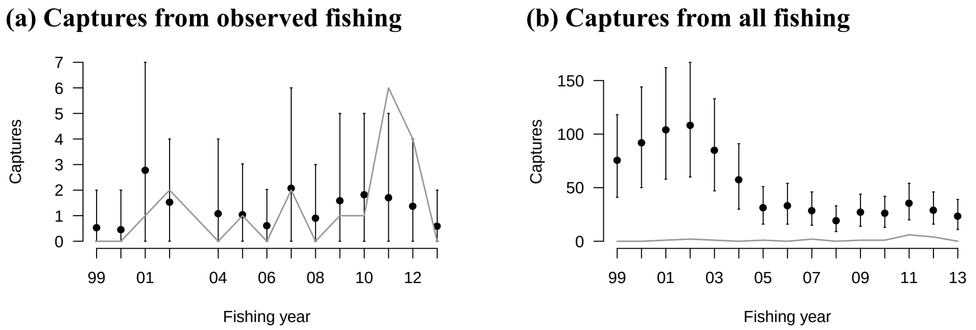


Figure C-149: Estimated captures of white-chinned petrel in all small-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-174: Summary of the posterior distributions of the model parameters. The base level of "Fishery" is "Bigeye" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, 100 × λ	0.697	0.716	0.306	1.229
Fishery, Bluefin	0.160	0.195	0.022	0.579

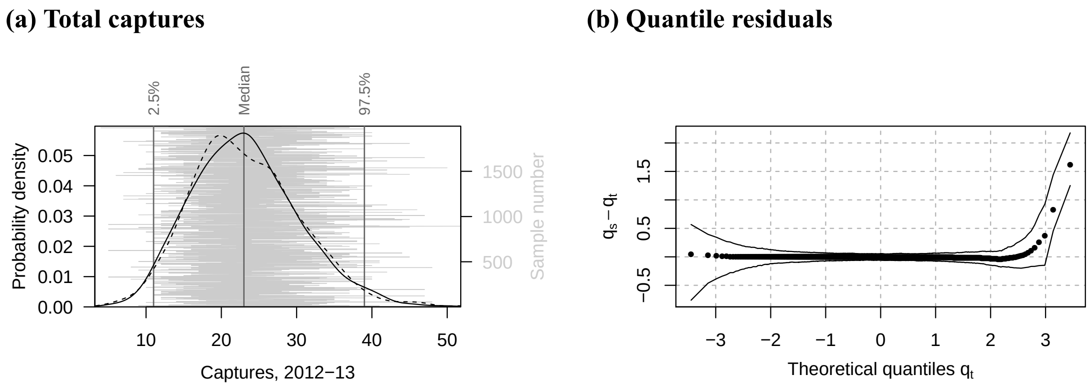


Figure C-150: Diagnostic plots for captures of white-chinned petrel in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.31 Other birds, trawl fisheries

Table C-175: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other birds captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of tows, and the observed capture rate is birds per 100 tows.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	83 723	14.8	82	0.7	863	(429–1 706)
Flatfish	East Coast South Island	5 191	0.6	0	0	179	(53–454)
Flatfish	Stewart Snares Shelf	5 420	0	0		158	(44–400)
Flatfish	Taranaki	2 892	0	0		101	(23–285)
Scampi	Bay of Plenty	870	0	0		68	(18–175)
Flatfish	West Coast South Island	1 876	1.2	0	0	55	(12–156)
Inshore	Northland and Hauraki	4 140	0.4	0	0	47	(8–148)
Squid	Stewart Snares Shelf	1 532	87.9	31	2.3	32	(31–35)
Flatfish	East Coast North Island	1 129	0	0		28	(3–94)

Table C-176: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			847.7
Fishery	7	96.9	750.7
Processing type	3	20.0	730.7
Area	1	19.9	710.8

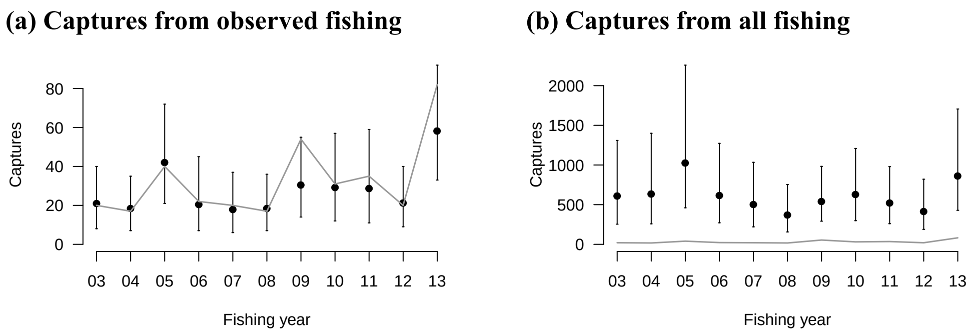


Figure C-151: Estimated captures of other birds in all trawl fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-177: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Meal plant" (Processing type), "Hoki-Hake-Ling" (Fishery), "True" (Inshore), "True" (Mandatory mitigation), and "Other" (Area).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 2003	0.146	0.151	0.072	0.260
Fishing year, 2004	0.156	0.161	0.076	0.281
Fishing year, 2005	0.248	0.259	0.138	0.449
Fishing year, 2006	0.187	0.195	0.107	0.320
Fishing year, 2007	0.166	0.171	0.094	0.275
Fishing year, 2008	0.148	0.154	0.082	0.247
Fishing year, 2009	0.204	0.210	0.125	0.336
Fishing year, 2010	0.222	0.229	0.135	0.362
Fishing year, 2011	0.219	0.228	0.133	0.368
Fishing year, 2012	0.171	0.176	0.100	0.282
Fishing year, 2013	0.353	0.363	0.227	0.559
Processing type, No meal plant	1.094	1.169	0.539	2.209
Processing type, Small vessel	0.292	0.364	0.063	1.101
Processing type, Fresher	0.045	0.061	0.007	0.206
Fishery, Squid	1.850	1.911	1.085	3.057
Fishery, Deepwater-SBW	2.356	2.484	1.271	4.389
Fishery, Scampi	2.610	3.435	0.684	10.923
Fishery, Flatfish	15.798	22.815	3.352	83.257
Fishery, Mackerel	0.621	0.657	0.300	1.208
Fishery, Mid-depths	0.716	0.759	0.346	1.428
Fishery, Inshore	0.404	0.585	0.063	2.262
Inshore, False	0.851	0.872	0.546	1.323
Mandatory mitigation, False	1.573	1.664	0.902	2.997
Annual cosine exponent	0.700	0.704	0.544	0.888
Area, Northeast	11.549	14.929	3.030	46.375
Vessel effect s.d., $\exp(\sigma_\eta)$	2.710	2.839	1.991	4.373
Overdispersion, θ	0.010	0.011	0.010	0.012

(a) Total captures **(b) Quantile residuals**

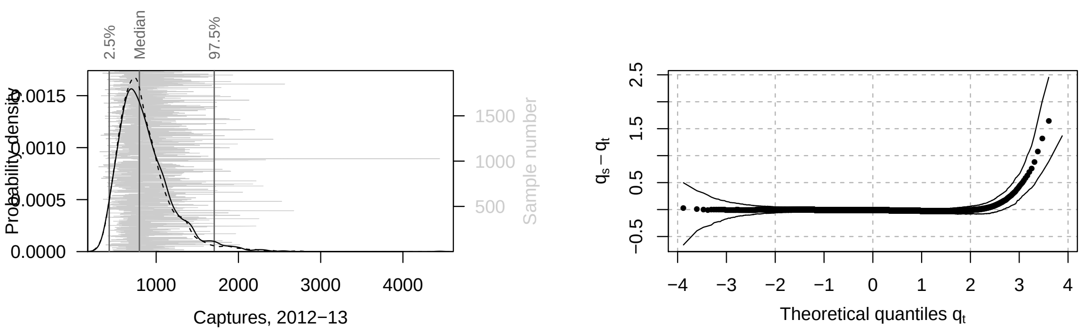


Figure C-152: Diagnostic plots for captures of other birds in all trawl fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.32 Other birds, large-vessel bottom-longline fisheries

Table C-178: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other birds captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	973	6.5	0	0	4	(0–23)
Ling	Chatham Rise	625	8.3	0	0	3	(0–16)
Ling	East Coast South Island	145	0	0		0	(0–3)
Ling	Stewart Snares Shelf	138	0	0		0	(0–3)
Minor targets	Fiordland	52	0	0		0	(0–2)
Minor targets	Stewart Snares Shelf	2	0	0		0	(0–0)
Minor targets	Subantarctic	11	100	0	0	0	(0–0)

Table C-179: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			1669.3
Area	2	458.1	1211.2
Log(hooks)	1	221.8	989.4
Half year to May	1	80.1	909.4
Half year to August	1	27.6	881.8
Integrated weight line	1	31.4	850.3
Half year to June	1	17.8	832.5
Half year to April	1	11.9	820.6

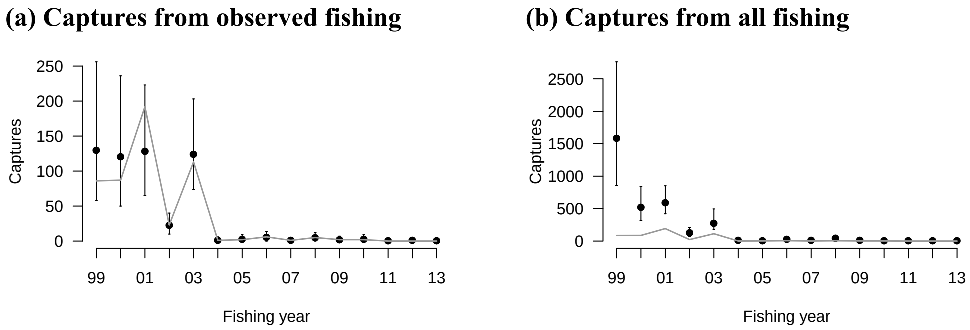
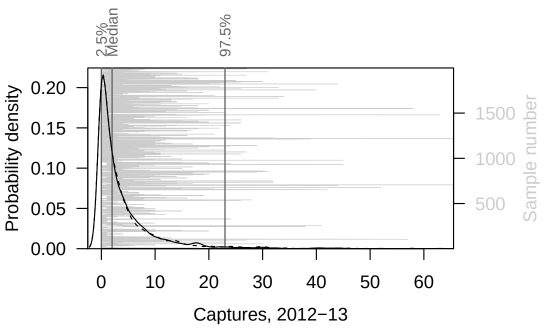


Figure C-153: Estimated captures of other birds in all large-vessel bottom-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-180: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Auckland-Campbell" (Area), "Second half" (Half year to May), and "False" (Integrated weight line).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	8.792	9.469	3.981	19.216
Fishing year, 2000	3.327	3.528	1.578	6.854
Fishing year, 2001	4.304	4.487	2.298	7.756
Fishing year, 2002	2.007	2.129	1.062	3.731
Fishing year, 2003	6.937	7.144	4.636	10.978
Fishing year, 2004	0.213	0.272	0.023	0.892
Fishing year, 2005	0.235	0.293	0.042	0.872
Fishing year, 2006	1.185	1.336	0.422	3.102
Fishing year, 2007	0.429	0.585	0.036	1.939
Fishing year, 2008	1.553	1.730	0.501	3.884
Fishing year, 2009	0.469	0.579	0.087	1.685
Fishing year, 2010	0.159	0.205	0.029	0.663
Fishing year, 2011	0.096	0.168	0.002	0.731
Fishing year, 2012	0.047	0.080	0.001	0.358
Fishing year, 2013	0.181	0.393	0.003	2.154
Area, Campbell plateau	0.633	0.689	0.286	1.401
Area, Southern	0.054	0.058	0.027	0.112
Half year to May, First half	0.193	0.199	0.111	0.322
Integrated weight line, True	0.590	0.626	0.303	1.140
Log(hooks)	1.099	1.098	0.808	1.390
Vessel effect s.d., exp(σ_η)	1.245	1.290	1.031	1.840
Overdispersion, θ	0.108	0.109	0.078	0.146

(a) Total captures



(b) Quantile residuals

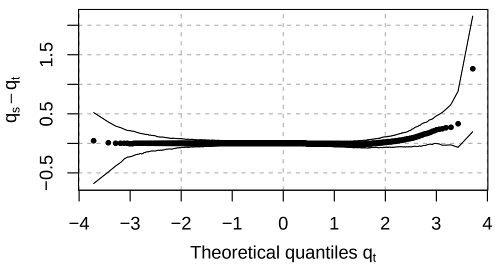


Figure C-154: Diagnostic plots for captures of other birds in all large-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.33 Other birds, small-vessel bottom-longline fisheries

Table C-181: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other birds captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	14 481	0.6	2	2.4	517	(263–815)
Snapper	Northland and Hauraki	4 537	0	0		176	(82–289)
Snapper	Bay of Plenty	1 080	1.5	0	0	41	(14–78)
Hāpuku	Chatham Rise	737	0	0		32	(9–63)
Ling	East Coast North Island	868	0	0		23	(6–46)
Minor targets	Taranaki	555	11.7	2	3.1	23	(7–46)
Bluenose	East Coast North Island	564	0	0		22	(6–46)
Ling	West Coast South Island	446	0	0		17	(3–37)
Ling	Chatham Rise	687	0	0		13	(2–29)

Table C-182: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			340.5
Half year to May	1	39.2	301.3
Half year to September	1	5.0	296.4
Half year to August	1	3.9	292.5
Area	1	2.9	289.5

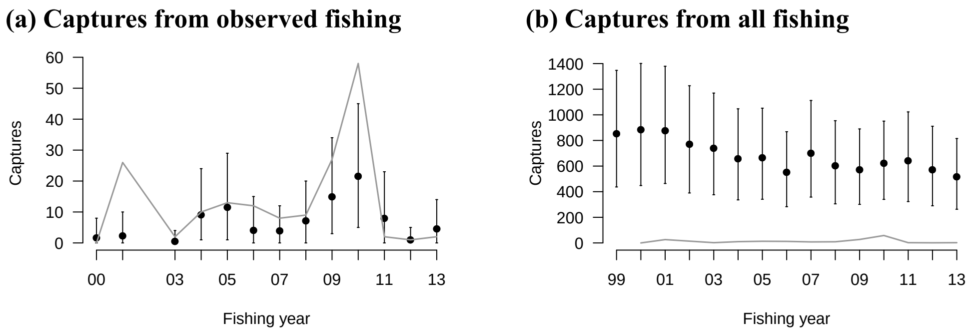


Figure C-155: Estimated captures of other birds in all small-vessel bottom longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-183: Summary of the posterior distributions of the model parameters. The base level of "Half year to May" is "First half" .

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	3.058	3.118	1.601	5.018
Half year to May, Second half	0.105	0.112	0.044	0.224
Overdispersion, θ	0.025	0.027	0.011	0.052

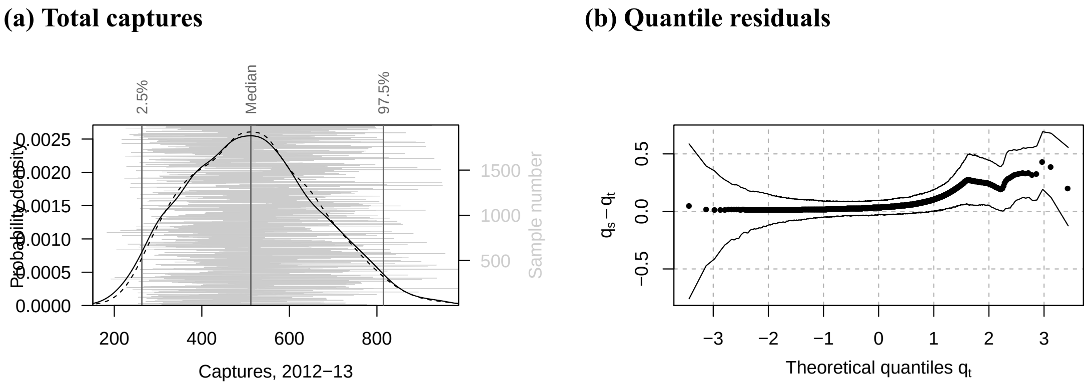


Figure C-156: Diagnostic plots for captures of other birds in all small-vessel bottom-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.34 Other birds, large-vessel surface-longline fisheries

Table C-184: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other birds captures. Fishery-areas are listed in decreasing order of estimated captures, with up to eight fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area		Observed			Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	148	100	0	0	0	(0–0)
Bigeye	Northland and Hauraki	4	100	0	0	0	(0–0)
Bigeye	West Coast North Island	7	100	0	0	0	(0–0)
Southern bluefin	Fiordland	137	100	0	0	0	(0–0)

Table C-185: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			411.1
Area	2	164.0	247.2
Set time (day, night, full moon)	2	15.4	231.7
Half year to June	1	2.7	229.0

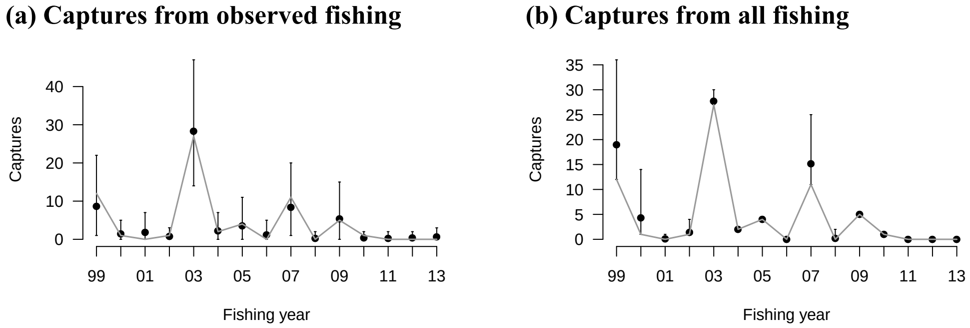


Figure C-157: Estimated captures of other birds in all large-vessel surface-longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-186: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "Daylight" (Set time), "Second half" (Half year to June), and "Northern" (Area).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Fishing year, 1999	0.493	0.569	0.186	1.404
Fishing year, 2000	0.298	0.336	0.062	0.831
Fishing year, 2001	0.237	0.265	0.030	0.695
Fishing year, 2002	0.345	0.403	0.087	1.101
Fishing year, 2003	0.280	0.311	0.070	0.713
Fishing year, 2004	0.335	0.382	0.103	0.941
Fishing year, 2005	0.379	0.466	0.124	1.360
Fishing year, 2006	0.265	0.302	0.036	0.772
Fishing year, 2007	0.415	0.484	0.160	1.211
Fishing year, 2008	0.312	0.367	0.052	1.030
Fishing year, 2009	0.311	0.350	0.099	0.825
Fishing year, 2010	0.375	0.467	0.110	1.396
Fishing year, 2011	0.304	0.348	0.052	0.922
Fishing year, 2012	0.297	0.336	0.047	0.886
Fishing year, 2013	0.292	0.330	0.046	0.871
Set time, Full moon	0.931	1.307	0.160	4.637
Set time, Night	0.231	0.323	0.043	1.114
Half year to June, First half	0.452	0.552	0.131	1.530
Area, Kermadec	0.438	0.538	0.113	1.569
Area, Southern	0.050	0.062	0.012	0.179
Vessel effect s.d., $\exp(\sigma_\eta)$	1.630	1.775	1.151	2.980
Overdispersion, θ	0.471	1.347	0.146	11.595

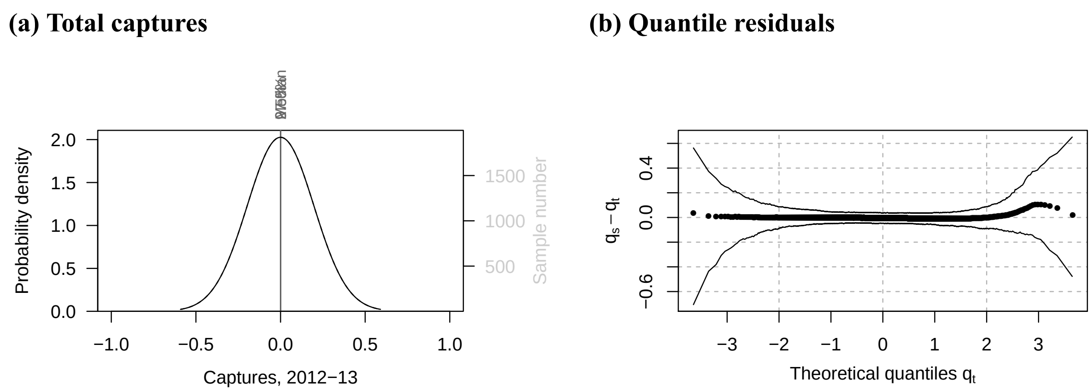


Figure C-158: Diagnostic plots for captures of other birds in all large-vessel surface-longline fisheries (a) Posterior distribution of total captures during the 2012–13 fishing year. (b) Randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.35 Other birds, small-vessel surface-longline fisheries

Table C-187: Captures by fishery and area, for the 2012–13 fishing year, giving the mean and 95% credible interval (c.i.) of estimated other birds captures. Fishery-areas are listed in decreasing order of estimated captures, with up to 8 fishery-areas being shown. Effort is the number of sets, and the observed capture rate is birds per 100 sets.

Fishery	Area	Observed				Estimated	
		Effort	Obs.(%)	Cap.	Rate	Cap.	95% c.i.
All fisheries	All areas	2 497	3.2	0	0	382	(218–676)
Bigeye	Northland and Hauraki	499	2.8	0	0	102	(55–181)
Southern bluefin	West Coast South Island	393	1	0	0	67	(9–225)
Bigeye	East Coast North Island	209	0	0		52	(22–101)
Bigeye	Bay of Plenty	193	0	0		43	(16–91)
Bigeye	West Coast North Island	119	8.4	0	0	24	(5–62)
Swordfish	West Coast South Island	93	0	0		20	(1–76)
Southern bluefin	East Coast North Island	381	2.4	0	0	17	(5–42)
Swordfish	West Coast North Island	85	2.4	0	0	14	(1–50)

Table C-188: ANOVA table summarising the maximum-likelihood model selection, giving the deviance explained by the sequential addition of covariates to the model. Only covariates whose addition led to a decrease of over 1% of the residual deviance were included in the table.

	Deg. of freedom	Resid. dev.	Dev. expl.
			614.0
Fishing year	1	136.5	477.6
Half year to April	1	32.9	444.7
Set time (day, night, full moon)	2	9.2	435.5
Area	2	6.6	428.8

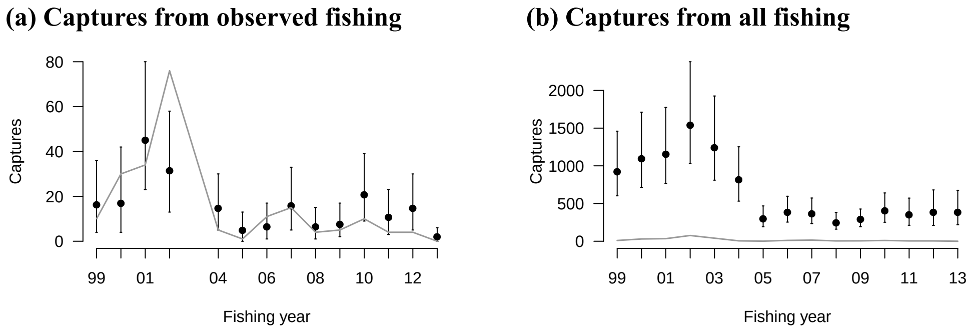


Figure C-159: Estimated captures of other birds in all small-vessel surface- longline fisheries, showing the mean and 95% credible interval (c.i.) of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

Table C-189: Summary of the posterior distributions of the model parameters. Base levels of the factor covariates are "First half" (Half year to April), "Night" (Set time), and "Northern" (Area).

Parameter	Statistic			
	Median	Mean	2.5%	97.5%
Base rate, $100 \times \lambda$	6.151	6.241	4.430	8.503
Half year to April, Second half	0.087	0.090	0.047	0.153
Set time, Full moon	2.179	2.247	1.370	3.475
Set time, Daylight	0.857	0.951	0.311	2.119
Area, Kermadec	0.424	0.565	0.092	1.899
Area, Southern	1.248	1.490	0.292	4.131
Vessel effect s.d., $\exp(\sigma_\eta)$	3.184	3.434	2.149	6.300
Overdispersion, θ	0.339	0.349	0.226	0.524

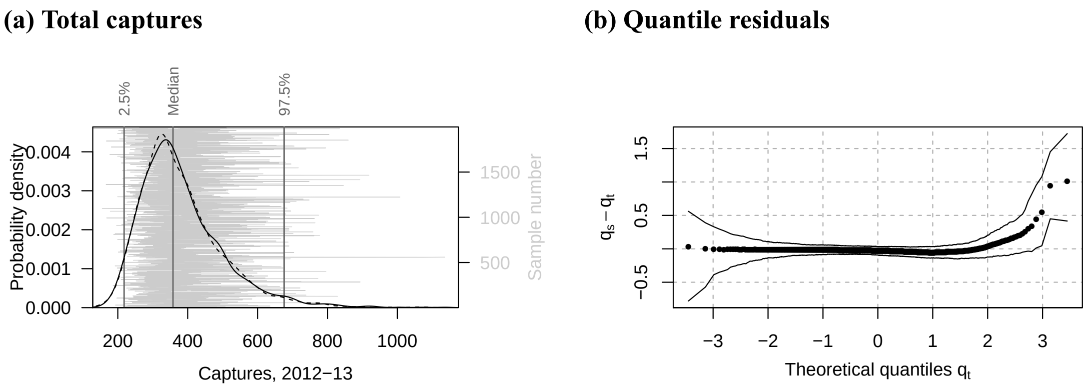


Figure C-160: Diagnostic plots for captures of other birds in all small-vessel surface-longline fisheries. (a) Posterior distribution of total captures during the 2012–13 fishing year; (b) randomised quantile residuals, showing the difference between the sample quantiles, q_s and the theoretical quantiles, q_t. The lines give the 95% credible interval (c.i.) of the difference.

C.36 Common dolphin capture model parameters

Table C-190: Mean, median, and 95% credible intervals for final model parameters. Calculated from samples of the corresponding posterior distributions.

Parameter	Mean	Median	95% c.i.	
Mean number of dolphins per capture event	1.945	1.939	1.574	2.337
Mean event rate, (events per 100 tows)	0.268	0.261	0.144	0.432
1995–96 base rate (events per 100 tows)	0.663	0.459	0.066	2.461
1996–97 base rate (events per 100 tows)	0.332	0.210	0.018	1.395
1997–98 base rate (events per 100 tows)	0.304	0.196	0.016	1.217
1998–99 base rate (events per 100 tows)	0.288	0.190	0.017	1.138
1999–00 base rate (events per 100 tows)	0.653	0.457	0.067	2.391
2000–01 base rate (events per 100 tows)	0.490	0.368	0.053	1.668
2001–02 base rate (events per 100 tows)	0.424	0.322	0.048	1.395
2002–03 base rate (events per 100 tows)	1.738	1.569	0.513	3.897
2003–04 base rate (events per 100 tows)	1.001	0.908	0.331	2.202
2004–05 base rate (events per 100 tows)	0.679	0.643	0.277	1.307
2005–06 base rate (events per 100 tows)	0.124	0.104	0.019	0.344
2006–07 base rate (events per 100 tows)	0.301	0.276	0.099	0.646
2007–08 base rate (events per 100 tows)	0.241	0.222	0.078	0.518
2008–09 base rate (events per 100 tows)	0.216	0.197	0.065	0.485
2009–10 base rate (events per 100 tows)	0.146	0.127	0.031	0.366
2010–11 base rate (events per 100 tows)	0.327	0.299	0.110	0.703
2011–12 base rate (events per 100 tows)	0.077	0.069	0.022	0.179
2012–13 base rate (events per 100 tows)	0.095	0.087	0.034	0.200
Headline depth, $\beta_{headline}$	-0.036	-0.036	-0.047	-0.025
Log trawl duration, $\beta_{duration}$	1.445	1.441	0.757	2.170
Light condition, relative to dark				
Light, exp(β_{light})	0.276	0.264	0.137	0.484
Black, exp(β_{black})	1.104	1.041	0.469	2.087
Sub-area, relative to north				
South, exp(β_{south})	0.571	0.546	0.293	0.979

(a) Captures from observed fishing **(b) Captures from all fishing**

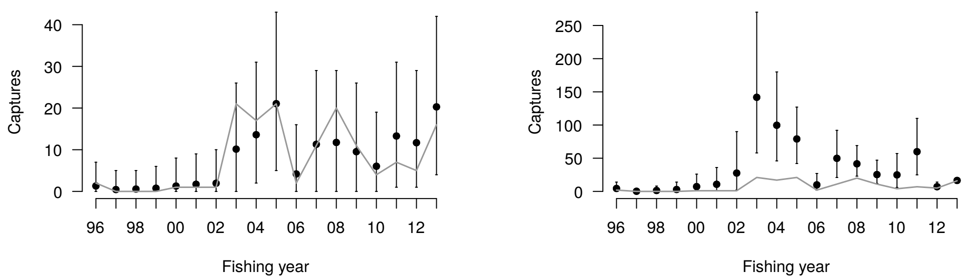


Figure C-161: Estimated captures of common dolphins off the North Island west coast in the jack mackerel trawl fishery, showing the mean and 95% credible intervals of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

C.37 Fur seal capture model parameters

Table C-191: Mean, median, and 95% credible intervals for final model parameters. Calculated from samples of the corresponding posterior distributions.

Parameter	Mean	Median	95% c.i.	
Extra dispersion, $1/\theta$	14.537	14.481	10.058	19.285
Mean rate, μ (captures per 100 tows)	0.424	0.425	0.322	0.522
Vessel/year effect standard deviation	0.723	0.722	0.586	0.876
2002–03 base rate (captures per 100 tows)	0.355	0.349	0.225	0.510
2003–04 base rate (captures per 100 tows)	0.446	0.440	0.289	0.648
2004–05 base rate (captures per 100 tows)	0.736	0.724	0.481	1.042
2005–06 base rate (captures per 100 tows)	0.532	0.522	0.347	0.763
2006–07 base rate (captures per 100 tows)	0.374	0.369	0.244	0.540
2007–08 base rate (captures per 100 tows)	0.573	0.564	0.379	0.827
2008–09 base rate (captures per 100 tows)	0.363	0.360	0.230	0.535
2009–10 base rate (captures per 100 tows)	0.327	0.322	0.211	0.493
2010–11 base rate (captures per 100 tows)	0.326	0.319	0.199	0.503
2011–12 base rate (captures per 100 tows)	0.322	0.316	0.201	0.481
2012–13 base rate (captures per 100 tows)	0.312	0.311	0.204	0.450
Sine(doy) coefficient	-1.217	-1.214	-1.431	-1.003
Cosine(doy) coefficient	-0.938	-0.931	-1.138	-0.734
Area coefficients relative to Stewart-Snares shelf				
East Coast SI	1.120	1.101	0.751	1.607
West Coast SI	0.637	0.625	0.411	0.945
Auckland Islands	0.277	0.268	0.151	0.478
West Coast NI	0.241	0.225	0.107	0.479
Subantarctic	7.102	6.074	2.106	18.197
Campbell Island	1.011	0.881	0.296	2.534
Cook Strait	2.355	2.270	1.264	3.970
Puysegur	1.086	1.023	0.553	1.951
Bounty Islands	12.913	10.625	3.776	35.286
Target coefficients relative to Hoki/Hake/Ling				
Squid	2.323	2.243	1.361	3.742
Deepwater	0.005	0.003	0.000	0.020
Middle depth	0.905	0.885	0.603	1.312
Jack mackerel	1.087	1.040	0.584	1.822
Southern blue whiting	0.728	0.643	0.222	1.700
Scampi	0.378	0.343	0.134	0.807
Inshore	0.070	0.046	0.002	0.265
Distance coefficients relative to Near (between 25 km and 90 km)				
Coastal (< 25 km)	1.518	1.506	1.008	2.151
Far (between 90 km and 180 km)	0.835	0.820	0.610	1.145
Ocean (> 180 km)	0.254	0.245	0.125	0.427
Interaction term				
Deepwater/Subantarctic	0.690	0.610	0.248	1.512

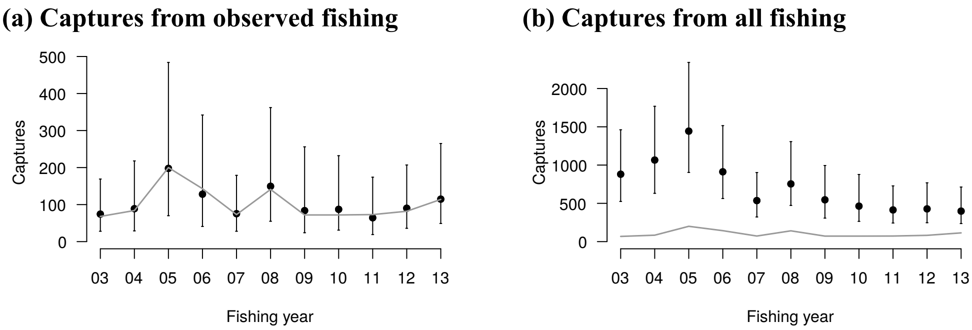


Figure C-162: Estimated captures of New Zealand fur seals in all trawl fisheries (excluding flatfish), showing the mean and 95% credible intervals of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.

C.38 Auckland Islands squid fishery sea lion capture model parameters

Table C-192: Mean, median, and 95% credible intervals for final model parameters. Calculated from samples of the corresponding posterior distributions.

Parameter	Mean	Median	95% c.i.	
Single SLED retention probability				
Extra dispersion, $1/\theta$	3.147	3.163	1.521	4.758
Vessel/year effect standard deviation	0.522	0.521	0.222	0.834
1995–96 base rate (captures per 100 tows)	0.835	0.792	0.418	1.479
1996–97 base rate (captures per 100 tows)	1.408	1.357	0.770	2.448
1997–98 base rate (captures per 100 tows)	1.193	1.130	0.577	2.173
1998–99 base rate (captures per 100 tows)	1.095	1.015	0.433	2.266
1999–00 base rate (captures per 100 tows)	2.087	1.973	1.087	3.934
2000–01 base rate (captures per 100 tows)	3.199	3.116	1.715	5.266
2001–02 base rate (captures per 100 tows)	1.313	1.259	0.661	2.286
2002–03 base rate (captures per 100 tows)	0.912	0.853	0.405	1.733
2003–04 base rate (captures per 100 tows)	2.045	1.972	1.095	3.518
2004–05 base rate (captures per 100 tows)	1.613	1.524	0.795	2.887
2005–06 base rate (captures per 100 tows)	1.251	1.199	0.600	2.165
2006–07 base rate (captures per 100 tows)	1.346	1.286	0.594	2.475
2007–08 base rate (captures per 100 tows)	1.109	1.046	0.445	2.242
2008–09 base rate (captures per 100 tows)	0.635	0.602	0.191	1.313
2009–10 base rate (captures per 100 tows)	1.246	1.157	0.440	2.522
2010–11 base rate (captures per 100 tows)	0.646	0.580	0.134	1.494
2011–12 base rate (captures per 100 tows)	0.629	0.551	0.127	1.490
2012–13 base rate (captures per 100 tows)	0.841	0.788	0.323	1.632
Tow duration	0.580	0.575	0.278	0.899
Distance to colony	-0.630	-0.633	-1.089	-0.172
Subarea, relative to north and east area	0.427	0.419	0.285	0.595
SLED retention probability	0.157	0.153	0.093	0.251
Split SLED retention probabilities				
Extra dispersion, $1/\theta$	2.859	2.752	1.357	5.253
Vessel/year effect standard deviation	0.537	0.540	0.195	0.890
1995–96 base rate (captures per 100 tows)	0.935	0.880	0.407	1.770
1996–97 base rate (captures per 100 tows)	1.540	1.483	0.829	2.591
1997–98 base rate (captures per 100 tows)	1.323	1.255	0.618	2.485
1998–99 base rate (captures per 100 tows)	1.207	1.132	0.432	2.395
1999–00 base rate (captures per 100 tows)	2.229	2.093	1.147	4.093
2000–01 base rate (captures per 100 tows)	3.280	3.159	1.718	5.562
2001–02 base rate (captures per 100 tows)	1.433	1.365	0.719	2.546
2002–03 base rate (captures per 100 tows)	1.013	0.957	0.460	1.855
2003–04 base rate (captures per 100 tows)	2.056	1.972	1.123	3.520
2004–05 base rate (captures per 100 tows)	1.623	1.534	0.773	3.008
2005–06 base rate (captures per 100 tows)	1.305	1.247	0.632	2.345
2006–07 base rate (captures per 100 tows)	1.355	1.297	0.583	2.485
2007–08 base rate (captures per 100 tows)	1.299	1.208	0.451	2.651
2008–09 base rate (captures per 100 tows)	0.779	0.715	0.206	1.738
2009–10 base rate (captures per 100 tows)	1.423	1.293	0.438	3.019
2010–11 base rate (captures per 100 tows)	0.774	0.697	0.136	1.831
2011–12 base rate (captures per 100 tows)	0.799	0.719	0.146	1.902
2012–13 base rate (captures per 100 tows)	1.041	0.958	0.310	2.263
Tow duration	0.575	0.575	0.256	0.897
Distance to colony	-0.628	-0.624	-1.096	-0.190
Subarea, relative to north and east area	0.436	0.428	0.294	0.623
Late SLED retention probability	0.134	0.084	0.012	0.598
Early SLED retention probability	0.181	0.174	0.093	0.303
SLED change, at end of this year	2006	2007	2005	2007

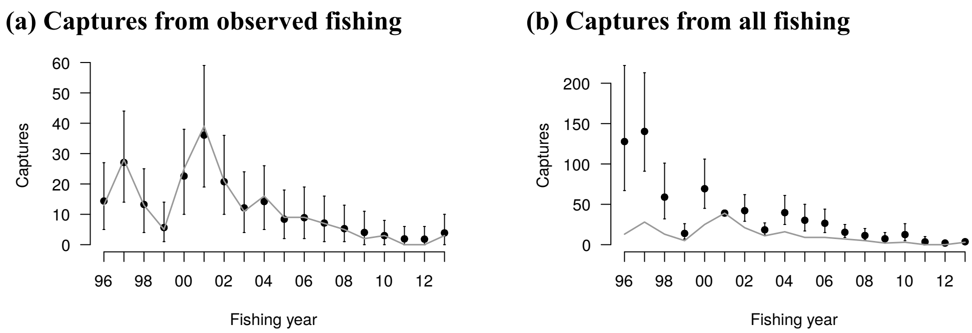


Figure C-163: Estimated captures of New Zealand sea lions in the Auckland Islands squid fishery, showing the mean and 95% credible intervals of the captures estimated on (a) observed effort, and (b) all effort. The grey line shows observed captures.