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Fishery data inputs for the New Zealand Seabird Risk Assessment

New Zealand Aquatic Environment and Biodiversity Report No. 313

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New Zealand Aquatic Environment and Biodiversity Report No. 313. **117 p.**

This report provides a comprehensive overview of fishery data inputs for assessment of the risk of New Zealand commercial fisheries to New Zealand seabird populations, and was generated as part of Fisheries New Zealand project PRO2019-10. The risk assessment uses the Spatially Explicit Fisheries Risk Assessment (SEFRA) framework, which requires spatially resolved fishing effort and capture data. Biological inputs have been detailed in an accompanying Aquatic Environment and Biodiversity report.

Fishery data inputs were extracted from the Protected Species Capture database (version 6; up to and including the 2019/20 fishing year) and prepared for analysis. Effort and captures from the bottom longline (BLL), surface longline (SLL), set net (SN) and trawl fisheries were retained, as these are responsible for almost all the bird captures (negligible captures are observed in the purse seine or potting fisheries). Recording of protected species captures has improved over time. Observer effort and recorded captures from 2006/07 were retained for the model fit, as this corresponded to the introduction of improved recording practices.

The risk assessment model used by SEFRA estimates catchability values for different segments of the fishing fleet, and therefore requires structural assumptions on how effort should be partitioned: for each method (BLL, SLL, SN or trawl), effort was partitioned into fishing groups that were considered to be consistent in their risk to birds as a result of consistent fishing practices within each group. Given these partitions, summary data on the captures are given by fishing method, fishing group and species. Finally, SEFRA requires calculation of an overlap metric which is proportional to the spatial and temporal overlap of fishing effort with the biological distribution of each bird species. Using assumed known distributions, this was calculated and plotted spatially for each species and fishing method.

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1. INTRODUCTION

This document provides a summary of fishery data inputs for the New Zealand seabird risk assessment, generated as part of Fisheries New Zealand project PRO2019-10. The scope of project PRO2019-10 covers the risk of New Zealand commercial fisheries to New Zealand seabird populations. As such, the fishery data inputs presented here reflect only those commercial vessels operating within the New Zealand Exclusive Economic Zone (EEZ), and specifically those using longline (surface and bottom), set net and trawl fishing methods. Purse seine fisheries were also considered but, given the small number of captures, were not retained in the final model input data.

The Spatially Explicit Fisheries Risk Assessment (SEFRA, Sharp 2019) considers multiple fisheries and multiple species simultaneously, and attempts to estimate not only the absolute risk per species and fishery, but also to rank them. It therefore allows future research and management efforts to be directed appropriately.

The structural assumptions by which species and fisheries are grouped are key SEFRA inputs. Species groups were reviewed by Peatman et al. (2023) and are listed in Table 2. In the current document, we review and update the fishery groups of Richard et al. (2020). Review and updates to other components of the data are also described, in particular the definition of cryptic capture multipliers, which in the final analysis are used to convert model predicted captures into total captures and death. We also prepare the catch and effort data and present summaries of the captures and effort at various disaggregations, including by fishing group and species. Where possible, all updates represented a collaborative effort with members of the Aquatic Environment Working Group (hosted by Fisheries New Zealand) and will likely be subject to further changes and refinement in the future.

2. DATA PREPARATION

2.1 Fishery groups

There are five fishing methods that result in incidental seabird bycatch in New Zealand: bottom longline (BLL), surface longline (SLL), set net (SN), trawl and purse seine (PS) fisheries. Within each fishing method, different groups represent different risk profiles. These fishing groups are a structural assumption of the SEFRA approach. As part of the current project, they have been updated from previous risk assessments (Richard et al. 2017, 2020) based on known fishing practices, and chosen to reflect perceived differences in the risk to seabirds. In our review of the fishery groups, we have concentrated on the trawl and longline fisheries as these are responsible for the majority of captures.

The following considerations were taken into account as being relevant to the risk of bird capture:

Vessel size: The size of the vessel can be indicative of fishing practices. Larger vessels are able to fish in a wider range of conditions, can stay at sea for longer periods, can hold more catch, and carry sufficient crew to fish continuously throughout the day. Bottom longline vessels larger than 34 metres, for example, typically fish offshore in the sub-Antarctic. In the trawl fisheries, vessels of greater than 28 metres are identified as a separate group according to fishing regulations (Ministry of Fisheries 2010).

Freezer boats: Freezer boats can stay at sea much longer than fresher vessels. This means that over the duration of the trip birds can aggregate at the vessel and there are likely to be more birds available for capture. Meyer & MacKenzie (2022) for example have shown that freezer vessels in the surface longline fishery have a higher bird capture rate. Fresher boats typically have shorter trips as fish stored on ice typically only last up to ten days at sea, and are more usually restricted to inshore areas.

Waste management: Waste management practices can have an important impact on bird bycatch. For example, Edwards & Dunn (2021) showed that the presence of a meal plant on vessels in the sub-Antarctic trawl fisheries was associated with a reduced bird capture rate.

Target species: The species targeted during fishing is indicative of the fishing practice being employed, including the gear, and season. Vessels targeting arrow squid (*Nototodarus sloanii*) in the sub-Antarctic for example, have higher bird capture rates than vessels targeting hoki (*Macruronus novaezelandiae*) in the same area (Edwards & Dunn 2021), due to a temporal separation of the fleets (i.e., fishing at different times of the year). However, relying solely on target species can result in vessels moving between fishery groups whilst fishing in a similar manner, particularly in the inshore fishery.

Area fished: Where fishing takes place will influence the availability of birds for capture. Within the SEFRA framework, this availability should be represented by the density overlap (with notation: $\mathbb{O}$; Sharp 2019). However, to the extent that spatial representation of the seabirds is imperfect, it can be helpful to compensate by creating artificial fishery groups that are based on the area fished, despite them having an otherwise similar risk profile.

Temporal changes: Changes in fishing regulations have occurred throughout the time series of data being considered. The 2012/13 fishing year saw the uptake of additional mitigation measures in the trawl fishery. From May 2016 joint venture vessels were required to be flagged to New Zealand, which, combined with increased coverage, resulted in a rationalisation of the large vessel fleet. Similarly, in 2016 mitigation measures requiring the use of tori line when setting longlines became more strictly enforced, resulting in wider use. Generally, fishing practices, including the use and refinement of mitigation measures, have likely changed gradually, resulting in a reduction in risk over time.

2.1.1 Trawl fisheries

A number of different fishery group partitions were considered, although not all of them were included in the final groupings. The inshore fishing fleet has the following partitions that were considered as possible fishery groups:

Inshore day boats: Identified with an approximate cut off length of 14 metres, mostly fishing one-day trips with gallows that extend trawl blocks outside the vessel. These vessels produce very little offal and can be considered very low risk.

Inshore multi day small boats: Identified by a length between 14 and 17 metres. Most cut fish occasionaly and hold offal, or batch discard over stern between warps, and have gallows that extend trawl blocks outside the vessel. Some may have a warp mitigation device if they need to discard over the side whilst towing. Can be considered medium risk.

Bigger inshore trawlers: Approximately 17 – 28 metres in length with trawl blocks mounted directly on the side of the vessel, they likely discard in front of the warps, and require a mitigation device (e.g., bird baffler) permanently deployed to deter seabirds. These vessels generally discard

in batches whilst towing, and will cut more fish and produce offal – especially those targeting ling (*Genypterus blacodes*, LIN) and school shark (*Galeorhinus galeus*, SCH). This group represents more effort and more risk than the sub-17 metre vessels.

Vessels larger than 28 metres are required by regulations to apply mitigation measures (Ministry of Fisheries 2010) and are therefore considered separate from the rest of the inshore fresher fleet. For the offshore fleet, in addition to the presence of a meal plant and freezer, the following were considered as relevant partitions based on the target species and the area fished:

Scampi: A unique fishery with unique bottom trawl gear configuration and risk profile.

Deepwater: These are vessels targeting orange roughy (*Hoplostethus atlanticus*, ORH), oreo (Oreosomatidae, OEO, BOE, SSO), black cardinalfish (*Epigonus telescopus*, CDL) and alfonsino (*Beryx decadactylus*, BYX). Generally fish short tows with bottom trawl gear, with gear shot and hauled reasonably quickly, and the warps entering the water at a steep angle, all of which reduce the risk of bird capture. A mixture of boats from 25 metre freshers to 46 – 100 metre freezer boats.

Southern Blue Whiting: A spatially contained mid-water fishery likely to have a consistent risk profile.

Jack Mackerel: Vessels targeting jack mackerel (*Trachurus* spp., JMA, JMM, JMD, JMN), predominantly using mid-water gear off the west coast of the North Island (WCNI9), tend to have lower bird capture rates. However, these capture rates are higher when fishing in other areas, particularly off the east coast of the South Island.

Squid: Squid vessels targetting arrow squid (*Nototodarus sloanii*, SQU, NOS, NOG, ASQ, SQX) operating in the sub-Antarctic (SQUAK6 and STEW5), with either mid-water or bottom trawl gear, have a particularly high risk of catching birds. In other areas there is less overlap with seabirds and less captures.

Given these partitions, trawl fishery groups were constructed based on the length, target species (combined with the area fished), and presence of a freezer. A decision tree illustrating these groupings is shown in Figure 1. The inshore fleet was grouped into less than 17 metre and 17 – 28 metre size classes, since the smallest of the inshore vessels have a low effort level and capture very few birds. There are larger fresher vessels that operate both inshore and offshore, and these are represented as their own group. The large offshore vessels, typically with a freezer, were partitioned primarily on the basis of target and area fished. Remaining freezer vessels were provided with their own group.

2.1.2 Bottom longline fisheries

For the longline fisheries, the main considerations are:

Autoliners: These vessels automatically bait the line, and typically fish with longer lines and a larger number of hooks. Autoliners with an integrated weight line (IWL) tend to have lower capture rates due to a faster and consistent sink rate. Autoliners without IWL clip weights on manually during setting resulting in variable sink rates along the line and slower sinking hooks midway between weights.

Target: The species target can give an indication of sink rate and the gear setup employed. Vessels targeting ling, and ribaldo (*Mora moro*, RIB) in particular typically use thicker lines, heavier weights and minimal floatation, resulting in faster sink rates and lower risk to birds than, for example, bluenose (*Hyperoglyphe antarctica*, BNS) target lines. The inshore or light gear

longliners target snapper (*Chrysophrys auratus*, SNA), and other shallow water species using thinner lines and a range of gear configurations.

Identification of vessels with autolines and IWL was made possible by Fisheries New Zealand, and represents an improvement on the bottom longline groupings used in previous iterations of the risk assessment.

Based on the size of the vessel (i.e., less than 34 metres or greater than 34 metres), known identification of autoline and IWL vessels, and the use of target species to infer other gear characteristics, bottom longline vessels were split according the decision tree in Figure 2.

2.1.3 Surface longline fisheries

Surface longline effort was split into the large vessel joint venture fleet and the smaller vessel domestic fleet (targeting tuna and swordfish).

2.1.4 Initial fishery group definitions

Fishing methods considered for inclusion in the model were: BLL, SLL, SN, Trawl, PS, with associated fishing groups listed in Table 1. Not all methods and groups were used in the final model runs, depending on the number of observed captures (see Section 4.1).

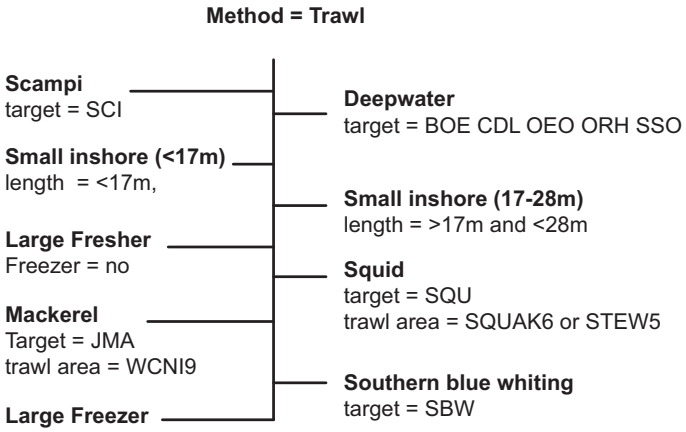

Figure 1: Decision tree for partition of trawl groups.

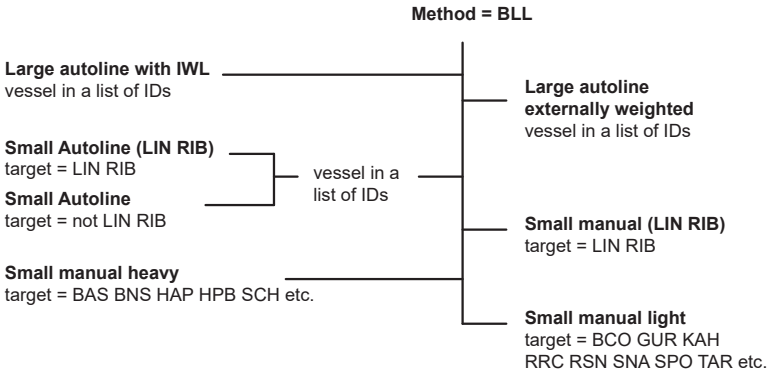

Figure 2: Decision tree for partition of BLL groups.

Table 1: Initial fishing methods (5) and fishing groups (22) for the risk assessment model, with revision following examination of the capture data (see Section 4.1).

Method	Fishing group
BLL	Large Autoline with IWL
BLL	Large Autoline
BLL	Small Autoline (LIN, RIB)
BLL	Small Autoline
BLL	Small Manual (heavy)
BLL	Small Manual (light)
BLL	Small Manual (LIN, RIB)
BLL	BLL (unclassified)
PS	PS (unclassified)
SLL	Large SLL
SLL	Small SLL (tuna and swordfish)
SN	SN (unclassified)
Trawl	Deepwater
Trawl	Large Freezer
Trawl	Large Fresher
Trawl	Mackerel
Trawl	Scampi
Trawl	Small inshore (17-28m)
Trawl	Small inshore (less than 17m)
Trawl	Southern Blue Whiting
Trawl	Squid
Trawl	Trawl (unclassified)

2.2 Review of observer briefing notes and recording practices

Observer protocols, tasking and recording practices were considered when defining temporal changes in the fishery and the potential for non-observed captures that may occur despite the observer being present (i.e., cryptic capture). For both these reasons we reviewed the observer briefing notes from Fisheries New Zealand archives, up until the present.

The various tasks undertaken by an observer when on board may influence the likelihood of a bird interaction being recorded. This is a form of cryptic capture that results from the observer being required to fulfill other obligations (e.g., catch sampling). In order to identify any changes in the likelihood of observing seabird bycatch, observer briefing notes were requested from Fisheries New Zealand for the following broad fishery definitions: deepwater trawl, squid trawl, autoline and manual BLL, SLL, inshore trawl and SN; for the period from 2000 to the present. Changes in observer tasking that may have influenced the likelihood of observers observing and recording observable captures are noted below.

2.2.1 Trawl

Briefing notes were provided for the orange roughy deepwater trawl fishery, squid trawl, and inshore trawl fishery for snapper on the west coast of the North Island and the east coast of the South Island. The priority of required observer tasks remained reasonably consistent, but differed between fisheries. In the orange roughy fishery, bird observations are the fourth priority behind independent catch assessment, biological sampling and conversion factor testing. In the squid fishery, marine mammal interactions have been the highest priority (and more recently protected species in general), which has allowed seabirds to also be recorded with high priority, and instructions include recording all birds that are caught. In the inshore trawl fishery off the east coast of the North Island, which overlaps with the Māui dolphin, observation of marine mammal and seabird interactions has been a high priority, but a lower priority off the east coast of the South Island. However, in the inshore trawl fishery, it is likely that biological sampling can be conducted at times when the vessel is either not fishing or towing.

With regards to the recording of this information, the centralised observer databased (COD) contains a table (Z_trw_2007_observer_station) that records whether non-fish bycatch has occured, but there is no record of where this observation was made from (e.g., wheelhouse, deck) and whether or not observers could fully inspect the warps, doors and net. Fish loss from nets is recorded, but there is no opportunity for the observer to record the potential loss of unobserved seabird bycatch.

2.2.2 Bottom longline

Briefing notes were provided for the auto-BLL ling fishery, which indicated that observation of seabird interactions has been consistently accorded the highest priority. Observer forms allow observers to record the number of hooks set, the number lost, and the number observed during the haul. In the manual or inshore snapper bottom longline fishery seabird and marine mammal interactions have also been accorded the highest priority since 2000. In later years observers were additionally tasked with biological sampling during the haul, which may have reduced the amount of time spent watching hooks come out of the water. Trips recorded on the same forms as the automatic longline fishery have an observed hooks field.

2.2.3 Surface longline

Priority information about the importance of surface longline observer tasking was not available for earlier years. Current instructions require observers to measure all tuna and billfish but, because the catch is processed whilst hauling, it is unlikely that observers would be able to watch all hooks coming out of the water. Effort data collected in COD (table z_sll_line_set) record a number of hooks set and a number of hooks observed.

2.2.4 Set net

Set net trips have "protected species observations" as first priority and "non-fish bycatch collection / mitigation practices" as second priority. Effort data collected in COD (table x_setnet_) record whether or not the set was observed and whether or not the haul was observed, but there is no option for recording observation of part of a haul.

2.2.5 Summary

Overall, the changes to observer briefing instructions have been minor over time with no specific wording indicating a quantifiable change in either the information being recorded or the observability of observable captures. Observer tasking beyond observing seabird captures indicates that, depending on fishing method and vessel size and layout, observers may not observe all observable captures. For example, it is unlikely that all hooks on observed sets are observed coming out of the water, and all catch dumped into a pound from a factory trawl net is followed through the sorting process. However we were not able to find information that would allow us to quantify the extent to which observable captures might not be recorded. Where this reduction of observation effort is recorded the appropriate COD tables have been noted. However, given the magnitude of changes to the assessment already being attempted in the current work, including a change in the effort units being used, we have not investigated these data further.

2.3 Legislative changes

There was no indication in our review of observer briefing practices that observer recording practices have changed or improved since 2000/01. However, legislation has changed, requiring a higher standard of bycatch mitigation over time. In particular, since 2012/13 observer coverage has increased, particularly on larger vessels, and there has been an associated improvement in mitigation practices, which may have led to a reduction in seabird bycatch. In 2016/17 joint venture vessels also began to leave the fishery. Re-flagging of vessels to New Zealand, or leaving the EEZ altogether, will have also led to an improvement in the application of mitigation measures.

2.4 Capture and effort data

Government fisheries observers on commercial fishing vessels record captures of protected species, including seabirds, which are subsequently entered into a database maintained by the National Institute of Water and Atmospheric Research (NIWA) on behalf of Fisheries New Zealand. Data are housed in the Centralised Observer Database (COD; Sanders & Fisher 2010). In addition to the protected species capture data, fishing effort data were required to allow extrapolation of the observed capture rates across unobserved components of the effort. Commercial fishing vessels complete a record of all fishing effort on each trip, and these records are stored in databases administered by Fisheries New Zealand. For the purposes of estimating the protected species

captures, and latterly performing risk analyses, the capture data, observer records and commercial effort are curated and stored in the Protected Species Capture database (PSC).

The PSC data are routinely groomed and checked for errors (a detailed summary of the preparation of observed protected species capture data is provided by Thompson et al. (2017), Abraham & Richard (2019)), with these routines recently updated under Fisheries New Zealand Project PRO2019-12. As part of this grooming, a unique event key is created that is able to link observer data and captures with the commercial effort. The linking is 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 linking of observer and commercial data greatly increases the utility. For example, although it is possible to simply fit a model to the observer capture data only, and then extrapolate across a separate representation of the commercial effort, it is preferable to only predict captures on the unobserved effort component (e.g., Thompson et al. 2013), which needs to separated. If records are linked, this separation can happen at a finer resolution. Second, the covariate data recorded in the commercial and observer data fields are complementary and only partially overlap. The observers record mitigation measures, for example, whereas other relevant vessel characteristics, such as the presence of a meal processing plant, are only recorded in the commercial data. Linking records therefore expands the range of covariates that can be considered in the modelling.

An extract from the PSC database (version 6; up to 2019/20) was provided by Fisheries New Zealand as input data for the current analysis. Additional data checks and grooming was carried out using code generated as part of the current project. Linking of the capture and effort data is more complete from around the 2001/02 fishing year onwards. Between 2006/07 and 2019/20, because the linking is incomplete, 25 bird captures and approximately 0.5% of observer records were lost.

A list of the seabird species present in the PSC database, and included in this and previous risk assessments, is given in Table 2.

Table 2: Species and species groups used in the risk assessment model (continued on next page).

Species code	Common name	Scientific name	Catchability group
XAU	Gibson's albatross	*Diomedea antipodensis gibsoni*	Great albatross
XAN	Antipodean albatross	*Diomedea antipodensis antipodensis*	Great albatross
XRA	Southern royal albatross	*Diomedea epomophora*	Great albatross
XNR	Northern royal albatross	*Diomedea sanfordi*	Great albatross
XCM	Campbell black-browed albatross	*Thalassarche impavida*	Mollymawk and Small albatross
XWM	New Zealand white-capped albatross	*Thalassarche cauta steadi*	Mollymawk and Small albatross
XSA	Salvin's albatross	*Thalassarche salvini*	Mollymawk and Small albatross
XCI	Chatham Island albatross	*Thalassarche eremita*	Mollymawk and Small albatross
XGM	Grey-headed albatross	*Thalassarche chrysostoma*	Mollymawk and Small albatross
XBM	Southern Buller's albatross	*Thalassarche bulleri bulleri*	Mollymawk and Small albatross
XNB	Northern Buller's albatross	*Thalassarche bulleri platei*	Mollymawk and Small albatross
XLM	Light-mantled sooty albatross	*Phoebetria palpebrata*	Mollymawk and Small albatross
XNP	Northern giant petrel	*Macronectes halli*	Large petrel
XGP	Grey petrel	*Procellaria cinerea*	Medium petrel
XBP	Black petrel	*Procellaria parkinsoni*	Medium petrel
XWP	Westland petrel	*Procellaria westlandica*	Medium petrel
XWC	White-chinned petrel	*Procellaria aequinoctialis*	Medium petrel
XFS	Flesh-footed shearwater	*Puffinus carneipes*	Medium shearwater
PUPA	Wedge-tailed shearwater	*Puffinus pacificus*	Small shearwater
XBS	Buller's shearwater	*Puffinus bulleri*	Small shearwater
XSH	Sooty shearwater	*Puffinus griseus*	Medium shearwater
XFL	Fluttering shearwater	*Puffinus gavia*	Small shearwater
XPH	Hutton's shearwater	*Puffinus huttoni*	Small shearwater
PUAS	Little shearwater	*Puffinus assimilis*	Small shearwater

Table 2: Continued

Species code	Common name	Scientific name	Catchability group
XCA	Snares Cape petrel	*Daption capense australe*	Small petrel
XFP	Fairy prion	*Pachyptila turtur*	Prion
XPR	Antarctic prion	*Pachyptila desolata*	Prion
XPV	Broad-billed prion	*Pachyptila vittata*	Prion
PTPY	Pycroft's petrel	*Pterodroma pycrofti*	Small petrel
PTCO	Cook's petrel	*Pterodroma cookii*	Small petrel
PTAX	Chatham petrel	*Pterodroma axillaris*	Small petrel
XMP	Mottled petrel	*Pterodroma inexpectata*	Small petrel
PTCE	White-naped petrel	*Pterodroma cervicalis*	Large petrel
PTNE	Kermadec petrel	*Pterodroma neglecta*	Large petrel
XGF	Grey-faced petrel	*Pterodroma macroptera gouldi*	Large petrel
PTMA	Chatham Island taiko	*Pterodroma magentae*	Large petrel
XWH	White-headed petrel	*Pterodroma lessonii*	Large petrel
PTMO	Soft-plumaged petrel	*Pterodroma mollis*	Small petrel
XDP	Common diving petrel	*Pelecanoides urinatrix*	Small petrel
XSD	Whenua Hou diving petrel	*Pelecanoides whenuahouensis*	Small petrel
XWF	New Zealand white-faced storm petrel	*Pelagodroma marina maoriana*	Small petrel
XWB	White-bellied storm petrel	*Fregetta grallaria grallaria*	Small petrel
XFT	Black-bellied storm petrel	*Fregetta tropica*	Small petrel
PEAL	Kermadec storm petrel	*Pelagodroma albiclunis*	Small petrel
PEMA	New Zealand storm petrel	*Pealeornis maoriana*	Small petrel
XYP	Yellow-eyed penguin	*Megadyptes antipodes*	Penguin
EUIR	Northern little penguin	*Eudyptula minor f. iredalei*	Penguin
EUAL	White-flippered little penguin	*Eudyptula minor f. albosignata*	Penguin
EUMI	Southern little penguin	*Eudyptula minor f. minor*	Penguin
EUCH	Chatham Island little penguin	*Eudyptula minor f. chathamensis*	Penguin
EUFI	Eastern rockhopper penguin	*Eudyptes chrysocome filholi*	Penguin
XFC	Fiordland crested penguin	*Eudyptes pachyrhynchus*	Penguin
EURO	Snares crested penguin	*Eudyptes robustus*	Penguin
EUSC	Erect-crested penguin	*Eudyptes sclateri*	Penguin
XGT	Australasian gannet	*Morus serrator*	Other seabirds
XMB	Masked booby	*Sula dactylatra*	Other seabirds
XPS	Pied shag	*Phalacrocorax varius varius*	Shag
XBC	Little black shag	*Phalacrocorax sulcirostris*	Shag
XKS	New Zealand king shag	*Leucocarbo carunculatus*	Shag
XSI	Otago shag	*Leucocarbo chalconotus*	Shag
XFX	Foveaux shag	*Leucocarbo stewarti*	Shag
XCS	Chatham Island shag	*Leucocarbo onslowi*	Shag
LERA	Bounty Island shag	*Leucocarbo ranfurlyi*	Shag
LECO	Auckland Island shag	*Leucocarbo colensoi*	Shag
LECA	Campbell Island shag	*Leucocarbo campbelli*	Shag
XPP	Spotted shag	*Stictocarbo punctatus*	Shag
XPF	Pitt Island shag	*Stictocarbo featherstoni*	Shag
CALO	Subantarctic skua	*Catharacta antarctica lonnbergi*	Other seabirds
XBG	Southern black-backed gull	*Larus dominicanus dominicanus*	Other seabirds
HYCA	Caspian tern	*Hydroprogne caspia*	Other seabirds
GYCA	White tern	*Gygis alba candida*	Other seabirds

2.4.1 Captures of Buller's albatross

The risk to Buller's albatrosses is assessed separately for the northern and southern Buller's albatross sub-species. It is challenging to identify Buller's albatrosses to a sub-species level based on morphological characteristics, which has raised concerns that observed captures may not have been correctly identified to a sub-species level in all cases (Richard & Abraham 2015). In total, 97 Buller's albatrosses captured in New Zealand fisheries have been identified to a sub-species level based on genetic analysis (Wold 2017). This spatially explicit dataset has been used to generate a spatial surface giving the probability that a Buller's albatross is the northern Buller's

albatross sub-species (developed through project PRO2019-09). This spatial surface was applied to species-level distribution maps of Buller's albatross, to generate distribution maps specific to the two sub-species.

A cross-check with the genetic identifications from Wold (2017) confirmed that there were errors in identifications of observed Buller's albatross captures in the PSC dataset. We used the probability surfaces developed through project PRO2019-09 to split captures of Buller's albatross to a sub-species level. Captures were assumed to be northern Buller's albatross in regions where the probability of being a northern Buller's albatross was greater than or equal to 50%, and otherwise assumed to be southern Buller's albatross. This approach ensures that the observed captures of Buller's albatrosses are not inconsistent with the assumed spatial distribution of the sub-species, and should mitigate against bias in estimated captures of, and risk to, the Buller's albatross sub-species due to errors in identifications of observed captures.

2.4.2 Capture methods in trawl fisheries

The PSC database provides the "capture method" for each observed seabird capture event, which describes the process leading to the capture of the bird. For trawl fisheries, the recorded capture methods are used to estimate the probability of an observable capture being caught in the net, which is then used to apportion observable captures into net captures and warp strike related captures (Edwards et al. 2023). Warp strike related captures were considered to include those caught on the warp, trawl door or paravane. Observers recorded four individuals caught by trawl fisheries with capture methods indicating that the seabird was tangled in the gear. Detailed comments provided by the observers, where available, indicated that these capture events included both net and warp strike related captures. As such, when estimating the probability of a net capture in trawl fisheries, we excluded these four observed captures of seabirds tangled in the gear.

2.5 Overlap calculation

The density overlap provides a measure of the opportunity for interaction between birds and fishing vessels. It is used by the SEFRA framework as an input covariate to the model. The model is not itself spatial, rather it represents the spatial features of the system using the density overlap term as a predictor of captures. For the current project, biological distributions of bird abundance were updated using new information where available, and at a monthly resolution (see Peatman et al. 2023). Calculation of the density overlap per species, per fishery group and per month, requires multiplication of the biological spatial layer with the fishing effort spatial layer, and then summation of this product across spatial and temporal dimensions.

In previous iterations of the seabird risk assessment (Richard et al. 2017, 2020), fishing effort was measured as the number of fishing events. This was updated in the current project to effort units of a thousand hooks for bottom longline (BLL) and surface longline (SLL), kilometres of net for set net (SN), and number of tows for trawl. Although this will better quantify the exposure of birds, it means that density overlap between fishing methods cannot be compared. This approach further assumes that all hooks on an observed longline set, and all contents of a trawl tow, were observed. This is consistent with previous iterations of the risk assessment but is nevertheless incorrect (see Section 2.2).

3. CRYPTIC CAPTURES AND MORTALITIES

In describing the number of interactions, captures and deaths, we require the following notation. Let C and U refer to observable captures, and unobservable (i.e., cryptic) captures respectively, such that interactions, T are:

$$T = C + U$$

Observable captures are those that would have been observed if an observer was onboard the vessel and on duty. Unobservable captures are captures which could not have been observed, even if an observer was onboard and on duty.

As set out by Edwards et al. (2023), the total observable captures for a given species, s, and fishery group, f, is modelled as a function of catchability, $q_{f,s}$, and density overlap, $\mathbb{O}_{f,s}$:

$$C_{f,s} = q_{f,s} \cdot \mathbb{O}_{f,s}$$

We use $K_{f,s}$ to refer to the cryptic capture multiplier, which relates observable captures to total interactions:

$$\begin{aligned} T_{f,s} &= C_{f,s} \cdot K_{f,s} \\ &= q_{f,s} \cdot \mathbb{O}_{f,s} \cdot K_{f,s} \end{aligned}$$

Additionally, we use $\kappa_{f,s}$ to refer to the cryptic mortality multiplier, which relates total deaths, D, to observable captures:

$$\begin{aligned} D_{f,s} &= C_{f,s} \cdot \kappa_{f,s} \\ &= q_{f,s} \cdot \mathbb{O}_{f,s} \cdot \kappa_{f,s} \end{aligned}$$

In describing how interactions T are estimated, it is convenient to make use of the notation $M = U/C$ where M is the cryptic captures per observable capture. Dropping the subscripts, interactions can then be defined as:

$$\begin{aligned} T = C + U &= C + U \cdot \frac{C}{C} \\ &= C \cdot (1 + M) \\ &= q \cdot \mathbb{O} \cdot (1 + M) \end{aligned}$$

and the cryptic capture multiplier K is equal to $1 + M$.

If all mortalities result from captures, then it can also be convenient to express the total number of deaths as a function of observable captures C, unobservable captures U, and the probability of death $p(D)$:

$$D = C \cdot p(D|C) + U \cdot p(D|U)$$

The probability of death given observable capture $p(D|C)$ is typically estimable from observer capture data (with the exception of post-release death of live captures). If total observable captures are $C = C^{\text{DEAD}} + C^{\text{ALIVE}}$, then $p(D|C) = (C^{\text{DEAD}} + C^{\text{ALIVE}} \cdot (1 - \omega))/C$, where ω is the post-release survivorship. Given ω we can estimate the product $C \cdot p(D|C)$ from the observer capture data. However when describing cryptic capture (U) and subsequent mortalities $U \cdot p(D|U)$ we require auxilliary data from experimental studies. Primary sources of information included: Brothers et al. (2010) and Zhou et al. (2019, 2020) for the longline fisheries, and Watkins et al. (2008) and Abraham (2010) for the trawl fisheries. There are no available data available for estimation of

cryptic capture rates in set net fisheries, and so these were assumed to be zero (following Richard et al. 2020).

It is important to note that cryptic mortalities can result from observable captures, e.g., post-release mortalities, as well as unobservable captures. The calculation of cryptic mortalities, and total mortalities, depends on the fishery method, and is described in the fishery method specific sub-sections below.

Contrary to previous iterations of the seabird risk assessment, cryptic multipliers are not part of the regression used to estimate the vulnerability. Rather cryptic multipliers, referred to as k, are applied following the model fit to predict the total number of deaths resulting from interactions. The specific definitions of k are determined by the data that have been collected to estimate them, which we describe below. In each case we present a distribution for k that we can use to ultimately estimate the number of deaths as a function of predicted observable captures C.

3.1 Longline fisheries

Data are available in the literature that inform the proportion of seabirds caught during setting of longlines that are still attached to the gear at haul-back, i.e., the proportions of seabirds captured at setting that are observable at haul-back. We are not aware of any information in the literature to inform the proportion of seabirds caught during haul-back that are observable, and so assume that all seabirds caught during haul-back are observable. As such, we have constructed a cryptic multiplier that accounts for captures at setting that are not observable at haul-back. No other sources of cryptic captures are considered. However, observers record seabird captures whilst monitoring the gear at haul-back, and as such do not directly observe the timing of a seabird capture within a fishing event. Following Zhou et al. (2019), we used the condition of seabird captures at-vessel to infer whether a seabird was caught during setting or during haulback. Seabirds that were alive at-vessel were assumed to have been caught during haul-back, with seabirds dead at-vessel assumed to have been caught during setting. This then allowed cryptic multipliers to be specific to whether seabirds were caught at setting or at haul-back. This approach ignores the possibility of captures during the soak.

Let cryptic captures (U) refer to captures that occurred during setting of the line that are then lost and not observable when the line is hauled. As described above, these cryptic captures are all dead ($U = U^{\text{DEAD}}$), and it is assumed that there are no cryptic captures of alive seabirds. The cryptic capture is then a multiple of the observable dead captures, and total interactions is given by:

$$\begin{aligned} T &= C^{\text{ALIVE}} + C^{\text{DEAD}} + U^{\text{DEAD}} \\ &= C^{\text{ALIVE}} + C^{\text{DEAD}} + U^{\text{DEAD}} \cdot \frac{C^{\text{DEAD}}}{C^{\text{DEAD}}} \\ &= C^{\text{ALIVE}} + (1+M) \cdot C^{\text{DEAD}} \end{aligned}$$

with $M = U^{\text{DEAD}}/C^{\text{DEAD}}$. Given $p(D|U) = 1$, we can similarly write:

$$\begin{aligned} D &= C \cdot p(D|C) + U \cdot p(D|U) \\ &= C^{\text{ALIVE}} \cdot (1-\omega) + (1+M) \cdot C^{\text{DEAD}} \end{aligned}$$

As such, cryptic mortalities arise from post-release mortalities of live captures, and seabirds that are caught at setting and drowned, but not retained on the fishing gear. The proportions of observable catches that are alive (Ψ), and dead ($1-\Psi$), are estimated from the data. Substituting in

$C^{\text{ALIVE}} = \Psi \cdot C$ and $C^{\text{DEAD}} = (1-\Psi) \cdot C$, we can then express total deaths resulting from longline captures as a function of observable captures:

$$\begin{aligned} D &= C \cdot \big(\Psi \cdot (1-\omega) + (1-\Psi) \cdot (1+M)\big) \\ &= C \cdot \big(\Psi \cdot (1-\omega) + (1-\Psi) \cdot k_{longline}\big) \end{aligned}$$

where $k_{longline} = 1+M$ is the cryptic multiplier.

Brothers et al. (2010) estimated cryptic capture rates for surface longline fisheries, based on comparisons of observed captures at setting with carcasses recovered at haul-back. Data were collected over 15 years on longline vessels operating in the Indian Ocean, Southern Ocean and Pacific Ocean. The majority of sets were made in the daytime, targeting tuna, and the remainder were shallow sets targeting swordfish in the night-time. Brothers et al. (2010) used bait-taking interactions classified as "observed caught" to estimate a loss rate of 51.7%, i.e., the proportion of seabirds caught at setting that were lost and so not recovered dead at haulback, based on 176 interactions at setting and 85 recovered carcasses at haul-back. Richard et al. (2020) used this information to generate a distribution for $k_{longline}$, with a mean of 2.08 and a 95% credible interval of 1.8 to 2.44. This cryptic multiplier is specific to captures during setting, i.e., captures that are dead at haul-back. Richard et al. (2020) applied $k_{longline}$ to all estimated observable captures, in the absence of information as to whether seabirds were caught during setting or haul-back.

Zhou et al. (2019) re-analysed the full dataset reported by Brothers et al. (2010), i.e., including bait-taking interactions at setting classified as "possibly caught" (553 interactions, and 42 recovered carcasses) and "observed not caught" (5 367 interactions, 5 recovered carcasses). The loss rate was estimated using Bayesian methods, accounting for misclassification of the bait-taking interactions. The estimated loss rate was 29.8% (95% credible interval of $0.24-51.88\%$).

We used the reported loss rate from Zhou et al. (2019) to generate a log-normal distribution for the cryptic multiplier, $k_{longline}$, for surface longliners. The reported loss rate, p_{loss}, is given by $p_{loss} = U^{\text{DEAD}}/T^{\text{DEAD}}$ and $1-p_{loss} = C^{\text{DEAD}}/T^{\text{DEAD}}$. It follows that:

$$\begin{aligned} \frac{1}{1-p_{loss}} &= \frac{T^{\text{DEAD}}}{C^{\text{DEAD}}} = \frac{C^{\text{DEAD}} + U^{\text{DEAD}}}{C^{\text{DEAD}}} \\ &= 1+M = k_{longline} \end{aligned}$$

The log-normal distribution for $k_{longline}$ had a mean of 1.42, i.e., $(1-p_{loss})^{-1}$, with a CV of 0.186 to approximate the reported 95% credible interval. The proposed cryptic multiplier distribution is provided in Figure 3, along with the previous distribution used by Richard et al. (2020).

The data used to inform this distribution were from surface longline fisheries only. Following the approach of previous risk assessments (e.g., Richard et al. 2020), we also apply this distribution to bottom longliners, given the lack of relevant information for this fishery. The distribution of $k_{longline}$ applies to all species. We note that there is evidence of between-species variability in loss-rates of seabirds caught at setting (Zhou et al. 2020), though there is currently insufficient information to incorporate species-specific, or species group-specific, distributions in the risk assessment. We also reiterate that estimation of mortalities only considers two sources of cryptic mortality: seabirds caught at setting and subsequently drowned, but lost from the gear before haul-back; and post-release mortality of seabirds released alive. Other potential sources of cryptic mortalities are not included, e.g., incomplete detection of captures whilst observers are undertaking biological sampling and other duties.

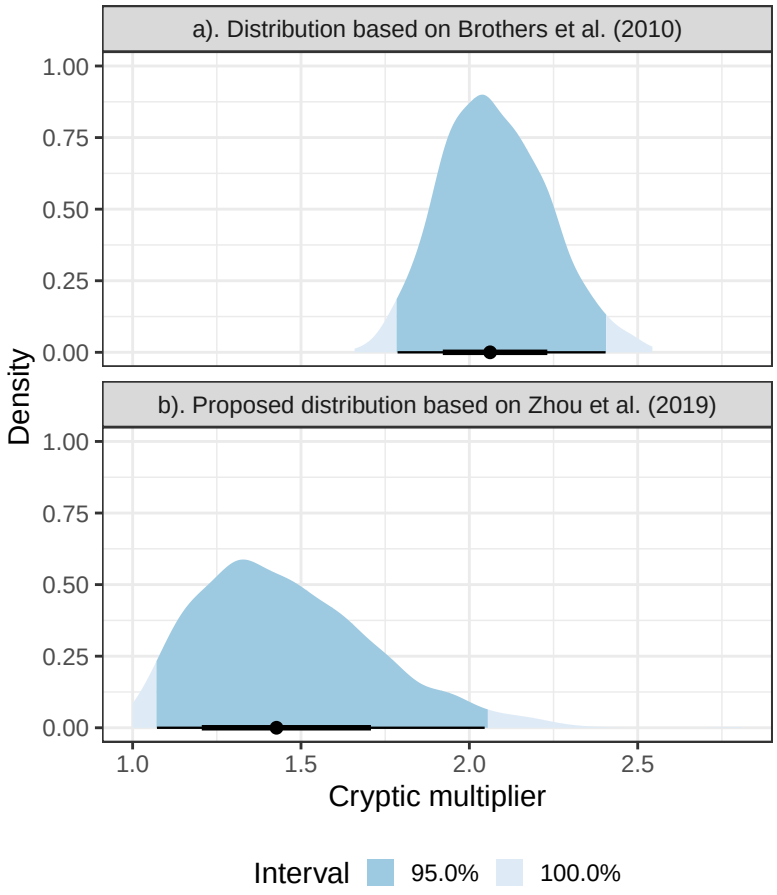

Figure 3: a) Previous and b) proposed distributions for the cryptic multiplier k for longline fisheries.

Baker et al. (2021) estimated loss-rates of birds from New Zealand surface longliners, by placing duck carcasses on longline gear before setting and calculating loss-rates of carcasses at haul-back. Three treatments were applied, with ducks either hooked through the bill, internally hooked in the throat or by entangling the line and hook around the wing. The remaining hooks on the longline were not baited. In total, 193 carcasses were attached to the gear, of which 8 were missing at haul-back, i.e., a loss rate of approximately 4%. There were no significant differences in loss-rates between treatments. It is not clear to what extent the experiment reflects loss rates of seabirds during commercial fishing, given the use of dead ducks as a surrogate for seabirds that are alive when hooked, along with differences in the set-up of the fishing gear during the experiments compared with that used during commercial fishing. However, we note that the 95% credible interval of the proposed distribution covers the estimated loss-rate from Baker et al. (2021). We also note that the proposed distribution covers estimates for surface longline fisheries from other sources, i.e., a loss rate of 26% in the Uruguayan surface longline fishery (Jiménez et al. 2012).

3.2 Trawl fisheries

Mitigation measures have substantially reduced the number of warp captures in New Zealand trawl fisheries, and the distribution of captures between the net and the warp has therefore changed. To reflect this, warp and net captures in trawl fisheries are now treated separately (Edwards et al. 2023). As such, it is necessary to provide cryptic multipliers specific to trawl capture type. These have been obtained using the methodology and data sources from Richard et al. (2020), which we report here in full.

3.2.1 Net captures

As described by Richard et al. (2020), seabirds can become entangled in trawl nets during the shooting and hauling of nets. Cryptic captures occur when seabirds are entangled in the trawl gear, but subsequently fall off or are lost through the mesh and so are not "observable" when the observers monitor the net during hauling. Richard et al. (2020) assumed that the ratio of unobservable net captures to observable net captures ($M = U/C$) was log-normally distributed with a mean of 0.3 and a 95% credible interval of 0.1 to 0.7. The distribution for M reflects the assumption that unobservable net captures are likely to be less than observable net captures, but was not empirically derived. We note that all cryptic net captures were previously considered to result in fatalities. However, in the current risk assessment, the cryptic multiplier is applied to both alive and dead observable captures, and post-release mortalities are included in the estimation of total deaths.

As detailed above, total interactions T can be estimated from M and C:

$$T = C \cdot (1 + M) = C \cdot k_{net}$$

where $k_{net} = 1 + M$.

For net captures, the probability of a seabird capture being killed is assumed to be equal for observable and cryptic captures, and set equal to that estimated for the observable component, i.e., $p(D) = p(D|C)$. The total number of deaths is then:

$$\begin{aligned} D &= C \cdot p(D|C) + U \cdot p(D|U) \\ &= C \cdot p(D) + U \cdot p(D) = C \cdot (1 + M) \cdot p(D) \end{aligned}$$

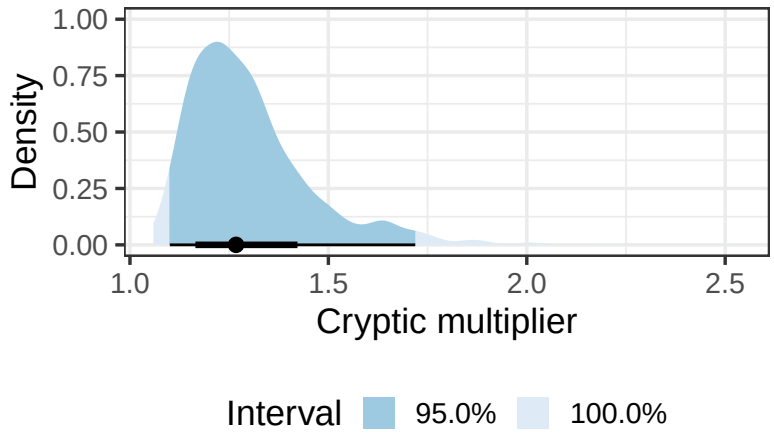

Figure 4: The cryptic multiplier distribution for net captures in trawl fisheries.

The probability of death, $p(D)$, can be separated into immediate mortality and post-release mortality:

$$p(D) = 1 - \Psi * \omega$$

where Ψ is the probability of a seabird surviving the interaction and ω is the post-release survival rate. Ψ is estimable using the numbers of observed captures that were alive and dead at-vessel. Then total mortalities from net captures are estimated as:

$$D = C \cdot k_{net} \cdot (1 - \Psi \cdot \omega)$$

As such, cryptic mortalities arise from unobservable captures that are killed during the capture process, as well as post-release mortalities of both observable and unobservable captures. Ψ is estimated from the data, and a separate distribution for ω defined, and so we provide the distribution of the cryptic multiplier k_{net} (see Figure 4).

3.2.2 Warp strikes

Two types of warp strike (S_{warp}) are included in the model: "surface" warp strikes (S_{surf}) - when a bird that is on the surface of the water is struck, or entangled, by the warp; and, "aerial" warp strikes (S_{air}) - when a bird flies into the warp. Surface warp strikes may result in an observable capture (C_{warp}) when a bird is dragged underwater by the warp and is either impaled on a warp sprag or becomes lodged against the trawl door. Cryptic mortalities from surface strikes occur when seabirds are dragged under the surface by the warp and drown, but the carcasses do not remain on the gear and so are not "observable" when the gear is hauled. Observable surface warp strike captures are treated as always fatal by definition, since the capture is only observable if the bird is dead. Aerial warp strikes do not result in observable captures, but can result in mortalities if the strike results in a broken, or damaged, wing. As such all aerial warp strike related mortalities are cryptic, and all observable captures from warp strikes result from surface strikes.

Cryptic multipliers for warp captures were constructed using dedicated monitoring of warps in New Zealand trawl fisheries (Abraham 2010) and the South African deepwater hake fishery (Watkins et al. 2008). Abraham (2010) report estimates of the total number of warp strikes per observable capture, i.e., S_{warp}/C_{warp}. Watkins et al. (2008) report information that was used to calculate the probability of a strike being a surface warp strike, $p(S_{surf}|S_{warp})$, and an aerial warp strike,

$p(S_{air}|S_{warp})$. In combination, the observations of Watkins et al. (2008) and Abraham (2010) allow estimation of the number of surface warp strikes per observable capture, S_{surf}/C_{warp}, and the number of aerial warp strikes per observable capture S_{air}/C_{warp}:

$$\begin{aligned} S_{surf}/C_{warp} &= p(S_{surf}|S_{warp}) \cdot (S_{warp}/C_{warp}) \\ S_{air}/C_{warp} &= p(S_{air}|S_{warp}) \cdot (S_{warp}/C_{warp}) \\ &= \big(1 - p(S_{surf}|S_{warp})\big) \cdot (S_{warp}/C_{warp}) \end{aligned}$$

Watkins et al. (2008) also report the total number of mortalities resulting from the observed surface warp strikes, with seabirds considered as drowned if they did not resurface within *ca.* 30 seconds of a surface strike. As such, the mortalities include both "observable" mortalities, i.e., seabird carcasses that remain on the gear, as well as "unobservable" mortalities. This allows estimation of the probability that a surface strike results in a mortality, $p(D_{surf}|S_{surf})$. The total deaths resulting from surface warp strikes per observable capture, k_{surf}, is then:

$$\begin{aligned} k_{surf} = D_{surf}/C_{warp} &= p(D_{surf}|S_{surf}) \cdot (S_{surf}/C_{warp}) \\ &= p(D_{surf}|S_{surf}) \cdot p(S_{surf}|S_{warp}) \cdot (S_{warp}/C_{warp}) \end{aligned}$$

Similarly, the total deaths from aerial warp strikes per observable capture, k_{air}, is:

$$\begin{aligned} k_{air} = D_{air}/C_{warp} &= p(D_{air}|S_{air}) \cdot (S_{air}/C_{warp}) \\ &= p(D_{air}|S_{air}) \cdot \big(1 - p(S_{surf}|S_{warp})\big) \cdot (S_{warp}/C_{warp}) \end{aligned}$$

The probability of an aerial strike resulting in a mortality, $p(D_{air}|S_{air})$, was not derived empirically and was based on best estimates.

The total deaths from warp strikes can then be estimated directly from observable catches:

$$D = (k_{surf} + k_{air}) \cdot C_{warp} = k_{warp} \cdot C_{warp}$$

where $k_{warp} = k_{surf} + k_{air}$. Warp-related cryptic mortalities are therefore not exclusively a result of captures, but also include fatalities resulting from aerial warp strikes.

For warp strikes we partition birds into cryptic multiplier groups based on their size and behaviour around fishing vessels, to account for differing rates of surface and aerial warp strikes and so cryptic mortalities (see cryptic multiplier groups in Table 3). There are four cryptic multiplier groups: "large" seabirds, i.e., great albatrosses (*Diomedea* spp.), mollymawks and giant petrel; "diving" seabirds, i.e., penguins, shags, boobies and gannets; "medium" seabirds, i.e., remaining species at least as large as white-naped petrel; and, "small" seabirds, i.e., remaining species smaller than white-naped petrel. It was assumed that there are no warp strike-related cryptic mortalities of diving seabirds, with all mortalities in trawl fisheries resulting from net entanglements.

For the "large" seabirds, Abraham (2010) reported 244 (95% CI 190 – 330) warp strikes per observable capture, i.e., S_{warp}/C_{warp}. For "small" and "medium" seabirds, Abraham (2010) reported 6,440 (95% CI 3 400 – 20 000) warp strikes per observable capture. For these data, reported as a mean and 95% confidence interval, log-normal distributions were assumed and defined to match the reported summary statistics.

Watkins et al. (2008) reported 139 surface warp strikes from 376 total warp strikes of "large" seabirds, where "large" seabirds included albatrosses, giant petrels, sub-Antarctic skuas and great

shearwater. This gives a probability distribution for $p(S_{surf}|S_{warp})$ with a mean of 0.37 and 95% CI of 0.32 – 0.42. They also reported 24 observed mortalities from 139 observed surface strikes of "large" seabirds, with an unknown fate for 16 individuals. Discounting individuals with unknown fates, there were 24 fatalities from 123 observed surface strikes, giving a probability distribution for $p(D_{surf}|S_{surf})$ with mean 0.20 and 95% CI of 0.13 – 0.27. In each case a simple binomial observation model was used to estimate posterior probability distributions from these data. We drew 1,000 samples from the distributions of $p(D_{surf}|S_{surf})$, $p(S_{surf}|S_{warp})$ and S_{warp}/C_{warp}. Taking the product of these terms results in a distribution for k_{surf} for "large" birds with mean 17.9 and 95% CI of 10.8 – 27.7.

For "small" and "medium" seabirds, Watkins et al. (2008) reported 124 surface warp strikes from 615 total warp strikes, giving a probability distribution for $p(S_{surf}|S_{warp})$ with a mean of 0.20 and 95% CI of 0.17 – 0.24. They reported 6 observed mortalities from 124 observed surface strikes, with an unknown fate for 10 individuals. Discounting individuals with unknown fates, the probability distribution for $p(D_{surf}|S_{surf})$ had mean 0.061 and 95% CI of 0.024 – 0.11. Sampling from, and taking the product of $p(D_{surf}|S_{surf})$, $p(S_{surf}|S_{warp})$ and S_{warp}/C_{warp} results in a distribution for k_{surf} for "small" and "medium" birds with mean 112 and 95% CI of 28.2 – 296.

Beta distributions were defined for $p(D_{air}|S_{air})$ with a coefficient of variation of 0.2, and species group-specific means. A mean of 2% was assumed for the "large" seabird group, with means of 1% and 0.5% assumed for species in the "medium" and "small" groups, respectively. Sampling from, and taking the product of, $p(D_{air}|S_{air})$, $1 - p(S_{surf}|S_{warp})$ and S_{warp}/C_{warp} results in a distribution of k_{air} for the "large" seabird group with a mean of 3.1 and 95% CI of 1.8 – 4.8. The resulting distribution of k_{air} for species in the "medium" seabird group had a mean of 73 and 95% CI of 24 – 170, and the distribution of k_{air} for species in the "small" group had a mean of 36 and a 95% CI of 12 – 85.

Species-specific distributions of k_{warp} were then obtained by taking the sum of the samples from distributions for k_{surf} and k_{air}. Fitting a log-normal distribution, the corresponding cryptic multiplier group-specific parameters for the distribution of k_{warp} are provided in Table 3, with the distributions provided in Figure 5.

Table 3: Trawl cryptic mortality groups, and warp-related crpytic multiplier distributions.

Cryptic mortality group	Surface warp group	Aerial warp group	Distribution	a	b
Large seabirds	Large	Large	log-normal	21.1	0.217
Medium seabirds	Medium/Small	Medium	log-normal	184.5	0.511
Small seabirds	Medium/Small	Small	log-normal	148.1	0.536
Diving seabirds	Diving	Diving	log-normal	0.0	0.000

We note that these estimates of cryptic mortality are substantially higher than preliminary estimates reported for demersal trawl fisheries in the Falkland Islands (Parker et al. 2013). However, "corpse-catchers" were deployed on the trawl warps on approximately half of the sets, which appears to increase the chances of carcass retention and so the "observability" of surface-warp strike related captures. As such, it is reasonable to expect cryptic mortality rates from the study to be relatively low.

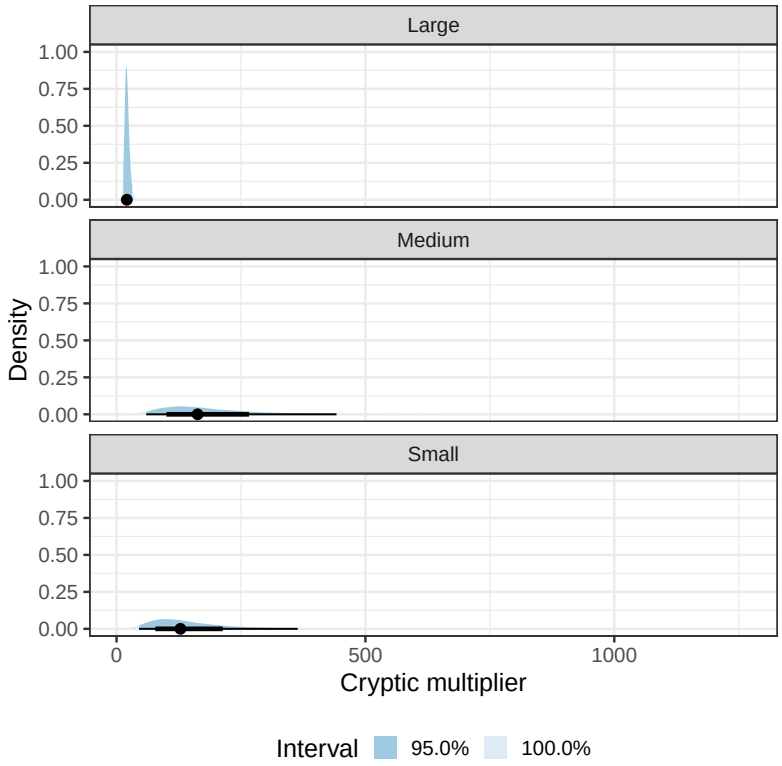

Figure 5: Cryptic multiplier distributions for warp captures in trawl fisheries, by cryptic mortality group

3.3 Post-release survival rates

Post-release survival rates (ω) are used to estimate unobserved mortalities of live captures following release. Post-release mortalities are not included directly in the cryptic multipliers, k, and are accounted for separately in the estimation of total deaths. Richard et al. (2020) assumed a uniform beta prior for post-release survival rates. Phillips & Wood (2020) estimated that post-release survival rates of wandering albatrosses following capture at hauling by longline fisheries were 40% of those for the wider population, based on resighting records of 19 banded individuals after capture and release. We have applied this to longline live captures from the "large" seabird cryptic multiplier group.

4. DATA SUMMARIES

4.1 Fishing groups

Methods and groups with few captures were dropped giving the final list of fishing groups in Table 4. During model development, attempts were made to partition some of the fishery groups temporally, in accordance with legislative changes that have occurred since 2006/07 (see Section 2.3). In particular, a change in mitigation changes since 2012/2013 and rationalisation of the fleet after departure of the joint venture vessels. However, our review of the data did not indicate any noticeable change in the captures per unit overlap at this time in any of the fishery groups, although there have been changes in the number of captures. Accordingly, structuring the fishery groups into early and recent partitions caused problems with model convergence (as would be expected if it is not supported by the data). We therefore assummed that fishery groups have been reasonably consistent in their risk to birds since 2006/07. We note that risk is only estimated using captures from the last three years of commercial effort data (Edwards et al. 2023) and therefore changes in the fleet composition (i.e., departure of joint venture vessels) is accounted for.

4.2 Captures and effort

Consistent with previous iterations (Richard et al. 2017, 2020), only capture data from 2006/07 onwards were initially retained for analysis. Considering changes to observer coverage and reporting, with an increase in both the quality and quantity of observer data increasing from 2006/07, the analysis was revised to start from this year under the assumption that data collection practices have been consistent since then. For estimation of the risk, we retained commercial effort data from 2017/18 to 2017/18, which is also consistent with previous iterations of the assessment.

Observed captures by species, species group, fishing group and method are shown in Table 5, Table 6, and Figures 6, 7 and 8. Of the total captures, 97% of those with an age recorded were recorded as adults.

A total of 7716 captures across species are present in the data for the current risk assessment (approximately 551 captures per year for 14 years). The top species, which make up 88% of all captures, are: White-chinned petrel, New Zealand white-capped albatross, Sooty shearwater, Southern Buller's albatross, Salvin's albatross, Flesh-footed shearwater (Table 2). These are mainly mollymawks, medium petrels and medium shearwaters (Figure 7). The majority of captures are observed in: Squid, Large Freezer, Small SLL (tuna and swordfish) fishing groups (see Table 4), which make up 76% of capture observations (Figure 8).

The number of captures disaggregated according to whether they were observed caught alive or dead are listed in Table 7 by fishing method. Net captures are listed in Tables 8 and 9. Effort data are listed in Tables 10 and 11. Because effort is measured in different units per fishing method, they cannot be compared between methods. They are therefore only provided for purposes of validating the data compilation in future work.

4.3 Density overlap

The model assumes that captures are proportional to the density overlap. The overlap provides a model input for fitting and prediction of captures. Figures 9 to 23 show the overlap, captures and captures per unit overlap for each fishing year and each method. Values per fishery group are also shown. These help us to understand whether data from 2006/07 onwards can be used to estimate and predict the captures up until 2019/20.

The model does not have any temporal dimension. Rather, it fits to the sum of the captures using the sum over the overlap. Ideally, for the model estimate of catchability to be valid across the time series, the overlap should not show any noticeable trends over the time series. If there has been a trend in the overlap over time, then the catchability may be biased if applied to estimate captures for the most recent period only. Specifically, if effort (overlap) has been increasing since 2006/07, then the catchability will be an overestimate if used to estimate annual captures with only the most recent data. Conversely, if effort has been decreasing, then the catchability will be an underestimate.

Including a longer time series of observer data, whilst increasing the empirical information available to fit the model, therefore represents a trade-off against relevance of the catchability estimate for the most recent time period. This could be accommodated by temporal partition of the fishery groups.

In Tables 12 and 13, exact overlap calculations are listed. As a more intuitive validation of the relationship between density overlap and captures, species-specific maps of the summed density overlap and captures are plotted spatially per species in Section 5. Each species-specific summary illustrates the overlap per fishing method and the associated captures per fishery group, with the captures also provided in tabular form.

Table 4: Fishing methods (4) and fishing groups (19). Observed and total effort, and percentage coverage, are reported using the number of fishing events. Fishing groups BLL (unclassified) and PS (unclassified) and Trawl (unclassified) were removed due to the negligible captures in these groups.

Method	Fishing group	ID	Observed effort	Total effort	Coverage (%)	Captures
BLL	Large Autoline with IWL	1	2 493	10 876	22.9	71
BLL	Large Autoline	2	1 149	13 640	8.4	199
BLL	Small Autoline (LIN, RIB)	3	496	9 991	5	89
BLL	Small Autoline	4	332	16 843	2	19
BLL	Small Manual (heavy)	5	811	57 582	1.4	62
BLL	Small Manual (light)	6	2 899	82 486	3.5	178
BLL	Small Manual (LIN, RIB)	7	1 266	42 709	3	68
SLL	Large SLL	8	1 533	1 782	86	323
SLL	Small SLL (tuna and swordfish)	9	2 821	33 564	8.4	604
SN	SN (unclassified)	10	16 339	1 010 015	1.6	64
Trawl	Deepwater	11	19 300	64 099	30.1	57
Trawl	Large Freezer	12	60 646	175 541	34.5	1 812
Trawl	Large Fresher	13	5 268	51 998	10.1	21
Trawl	Mackerel	14	17 178	27 797	61.8	84
Trawl	Scampi	15	5 833	63 716	9.2	249
Trawl	Small inshore (17-28m)	16	11 857	332 565	3.6	160
Trawl	Small inshore (less than 17m)	17	7 060	385 301	1.8	76
Trawl	Southern Blue Whiting	18	7 101	10 629	66.8	119
Trawl	Squid	19	28 063	46 505	60.3	3 461
Total	-	-	192 445	2 437 639	420.4	–

Table 5: Number of observed seabird captures by species and method (continued on next page).

Code	Common name	BLL	SLL	SN	Trawl	Total
XAU	Gibson's albatross	–	34	–	1	35
XAN	Antipodean albatross	–	42	–	–	42
XRA	Southern royal albatross	6	12	–	25	43
XNR	Northern royal albatross	–	4	–	1	5
XCM	Campbell black-browed albatross	4	23	–	17	44
XWM	New Zealand white-capped albatross	12	230	1	1 187	1 430
XSA	Salvin's albatross	43	8	–	462	513
XCI	Chatham Island albatross	15	–	–	18	33
XGM	Grey-headed albatross	–	1	–	–	1
XBM	Southern Buller's albatross	6	363	–	416	785
XNB	Northern Buller's albatross	6	22	–	31	59
XLM	Light-mantled sooty albatross	–	–	–	1	1
XNP	Northern giant petrel	4	–	–	11	15
XGP	Grey petrel	17	31	–	91	139
XBP	Black petrel	92	47	–	32	171
XWP	Westland petrel	17	45	3	38	103
XWC	White-chinned petrel	291	36	9	2 172	2 508
XFS	Flesh-footed shearwater	109	18	2	57	186
PUPA	Wedge-tailed shearwater	–	–	–	–	–
XBS	Buller's shearwater	13	–	–	3	16
XSH	Sooty shearwater	28	2	13	1 330	1 373
XFL	Fluttering shearwater	5	–	2	–	7
XPH	Hutton's shearwater	–	–	–	–	–
PUAS	Little shearwater	–	–	–	–	–
XCA	Snares Cape petrel	–	–	–	12	12
XFP	Fairy prion	–	–	–	20	20
XPR	Antarctic prion	–	–	–	10	10
XPV	Broad-billed prion	–	–	–	7	7
PTPY	Pycroft's petrel	–	–	–	–	–
PTCO	Cook's petrel	–	–	–	–	–
PTAX	Chatham petrel	–	–	–	–	–
XMP	Mottled petrel	–	–	–	4	4
PTCE	White-naped petrel	–	–	–	–	–
PTNE	Kermadec petrel	–	–	–	–	–
XGF	Grey-faced petrel	6	9	–	6	21
PTMA	Chatham Island taiko	–	–	–	–	–
XWH	White-headed petrel	–	–	–	1	1
PTMO	Soft-plumaged petrel	–	–	–	–	–
XDP	Common diving petrel	–	–	3	35	38
XSD	Whenua Hou diving petrel	–	–	–	–	–
XWF	New Zealand white-faced storm petrel	4	–	–	10	14
XWB	White-bellied storm petrel	–	–	–	–	–
XFT	Black-bellied storm petrel	–	–	–	4	4
PEAL	Kermadec storm petrel	–	–	–	–	–
PEMA	New Zealand storm petrel	–	–	–	–	–
XYP	Yellow-eyed penguin	–	–	17	–	17
EUIR	Northern little penguin	–	–	–	–	–
EUAL	White-flippered little penguin	–	–	–	–	–
EUMI	Southern little penguin	–	–	–	–	–
EUCH	Chatham Island little penguin	–	–	–	–	–
EUFI	Eastern rockhopper penguin	–	–	–	–	–

Table 5: Continued

Code	Common name	BLL	SLL	SN	Trawl	Total
XFC	Fiordland crested penguin	–	–	5	–	5
EURO	Snares crested penguin	–	–	–	–	–
EUSC	Erect-crested penguin	–	–	–	–	–
XGT	Australasian gannet	–	–	–	1	1
XMB	Masked booby	–	–	–	–	–
XPS	Pied shag	–	–	1	–	1
XBC	Little black shag	–	–	–	–	–
XKS	New Zealand king shag	–	–	–	–	–
XSI	Otago shag	–	–	2	–	2
XFX	Foveaux shag	–	–	–	–	–
XCS	Chatham Island shag	–	–	–	–	–
LERA	Bounty Island shag	–	–	–	–	–
LECO	Auckland Island shag	–	–	–	–	–
LECA	Campbell Island shag	–	–	–	–	–
XPP	Spotted shag	–	–	6	34	40
XPF	Pitt Island shag	–	–	–	–	–
CALO	Subantarctic skua	–	–	–	–	–
XBG	Southern black-backed gull	8	–	–	2	10
HYCA	Caspian tern	–	–	–	–	–
GYCA	White tern	–	–	–	–	–
Total	**-**	**686**	**927**	**64**	**6 039**	**7 716**
Total per year	**-**	**49**	**66**	**5**	**431**	**551**

Table 6: Number of observed seabird captures by species group and method.

Group name	BLL	SLL	SN	Trawl	Total	Total per year
Great albatross	6	92	–	27	125	9
Mollymawk and Small albatross	86	647	1	2 132	2 866	205
Large petrel	10	9	–	18	37	3
Medium petrel	417	159	12	2 333	2 921	209
Small petrel	4	–	3	65	72	5
Medium shearwater	137	20	15	1 387	1 559	111
Small shearwater	18	–	2	3	23	2
Prion	–	–	–	37	37	3
Shag	–	–	9	34	43	3
Penguin	–	–	22	–	22	2
Other seabirds	8	–	–	3	11	1
Total	**686**	**927**	**64**	**6 039**	**7 716**	**–**
Total per year	**49**	**66**	**5**	**431**	**551**	**–**

Table 7: Number of alive and dead captures per species group and fishing method.

	BLL			SLL			SN			Trawl		
Species group	Alive	Dead	Total	Alive	Dead	Total	Alive	Dead	Total	Alive	Dead	Total
Great albatross	5	1	6	26	66	92	0	0	0	15	12	27
Mollymawk and Small albatross	19	67	86	160	487	647	1	0	1	657	1 475	2 132
Large petrel	3	7	10	3	6	9	0	0	0	11	7	18
Medium petrel	69	348	417	9	150	159	4	8	12	858	1 475	2 333
Small petrel	4	0	4	0	0	0	3	0	3	41	24	65
Medium shearwater	34	103	137	15	5	20	9	6	15	406	981	1 387
Small shearwater	6	12	18	0	0	0	1	1	2	3	0	3
Prion	0	0	0	0	0	0	0	0	0	27	10	37
Shag	0	0	0	0	0	0	0	9	9	2	32	34
Penguin	0	0	0	0	0	0	0	22	22	0	0	0
Other seabirds	4	4	8	0	0	0	0	0	0	1	2	3

Table 8: Sum of net captures per species group

Species group	Net	Warp	Other	Unknown	Total
Great albatross	20	10	4	5	39
Mollymawk and Small albatross	1 631	1 061	120	403	3 215
Large petrel	8	4	9	1	22
Medium petrel	2 360	29	35	182	2 606
Small petrel	30	5	17	32	84
Medium shearwater	1 709	16	19	467	2 211
Small shearwater	0	0	2	1	3
Prion	24	0	10	20	54
Shag	34	0	0	0	34
Penguin	0	0	0	0	0
Other seabirds	1	1	0	2	4

Table 9: Sum of net captures per species group per year, with total captures in parentheses.

Fishing year	Great albatross	Mollymawk and Small albatross	Large petrel	Medium petrel	Small petrel	Medium shearwater	Small shearwater	Prion	Shag	Penguin	Other seabirds
2000/01	0.00 (2)	0.05 (140)	0.00 (2)	0.57 (7)	0.00 (1)	0.93 (30)	– (0)	– (0)	– (0)	– (0)	– (0)
2001/02	0.00 (3)	0.03 (92)	– (0)	0.33 (3)	– (0)	1.00 (10)	– (0)	1.00 (1)	– (0)	– (0)	– (0)
2002/03	– (0)	0.33 (83)	0.00 (1)	0.92 (12)	1.00 (1)	1.00 (87)	– (0)	1.00 (2)	– (0)	– (0)	– (0)
2003/04	0.50 (2)	0.48 (131)	– (0)	0.87 (15)	1.00 (2)	1.00 (47)	– (0)	– (0)	– (0)	– (0)	– (0)
2004/05	1.00 (1)	0.45 (218)	– (0)	0.90 (50)	0.50 (2)	1.00 (69)	– (0)	1.00 (3)	– (0)	– (0)	– (0)
2005/06	1.00 (1)	0.41 (71)	– (0)	0.96 (69)	0.33 (3)	0.99 (153)	– (0)	– (0)	– (0)	– (0)	– (0)
2006/07	– (0)	0.78 (63)	0.33 (3)	1.00 (33)	– (0)	1.00 (74)	– (0)	1.00 (1)	– (0)	– (0)	– (0)
2007/08	1.00 (2)	0.59 (71)	0.00 (1)	0.98 (62)	– (0)	0.93 (85)	– (0)	– (0)	– (0)	– (0)	– (0)
2008/09	1.00 (1)	0.55 (146)	– (0)	1.00 (108)	0.67 (3)	0.98 (156)	– (0)	1.00 (2)	1.00 (32)	– (0)	– (0)
2009/10	1.00 (1)	0.49 (101)	– (0)	0.99 (83)	– (0)	0.98 (50)	– (0)	0.17 (6)	– (0)	– (0)	– (0)
2010/11	1.00 (1)	0.78 (86)	– (0)	1.00 (128)	1.00 (2)	0.99 (125)	– (0)	1.00 (1)	– (0)	– (0)	0.00 (1)
2011/12	0.50 (2)	0.52 (132)	– (0)	0.97 (68)	0.00 (2)	1.00 (29)	– (0)	1.00 (1)	– (0)	– (0)	– (0)
2012/13	0.67 (3)	0.71 (240)	1.00 (1)	0.99 (298)	1.00 (3)	0.99 (134)	– (0)	0.75 (4)	– (0)	– (0)	– (0)
2013/14	– (0)	0.58 (161)	1.00 (2)	0.98 (167)	1.00 (1)	0.97 (133)	– (0)	1.00 (4)	– (0)	– (0)	– (0)
2014/15	– (0)	0.81 (152)	0.20 (5)	1.00 (301)	0.67 (6)	0.99 (140)	– (0)	0.33 (3)	– (0)	– (0)	– (0)
2015/16	1.00 (1)	0.71 (196)	0.00 (1)	0.95 (176)	0.57 (7)	0.98 (64)	0.00 (2)	0.50 (2)	– (0)	– (0)	1.00 (1)
2016/17	0.00 (2)	0.76 (131)	1.00 (1)	0.99 (153)	0.00 (2)	0.99 (136)	– (0)	– (0)	– (0)	– (0)	– (0)
2017/18	0.50 (2)	0.76 (191)	1.00 (1)	0.97 (225)	1.00 (5)	1.00 (56)	– (0)	1.00 (1)	1.00 (2)	– (0)	– (0)
2018/19	0.25 (4)	0.60 (200)	0.33 (3)	0.94 (190)	0.38 (8)	0.91 (99)	– (0)	0.00 (1)	– (0)	– (0)	– (0)
2019/20	1.00 (6)	0.74 (207)	– (0)	0.97 (276)	0.25 (4)	0.94 (67)	– (0)	1.00 (2)	– (0)	– (0)	– (0)

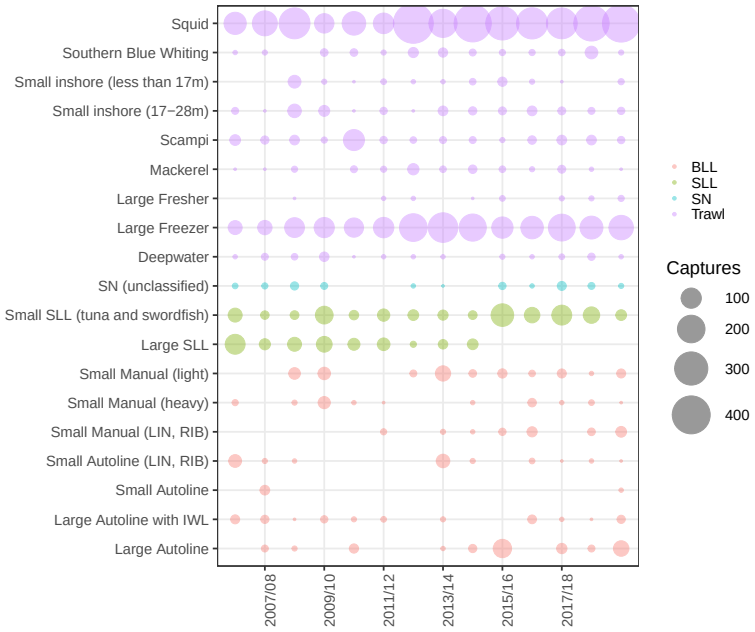

Figure 6: Observed captures per fishery group over years available in the data.

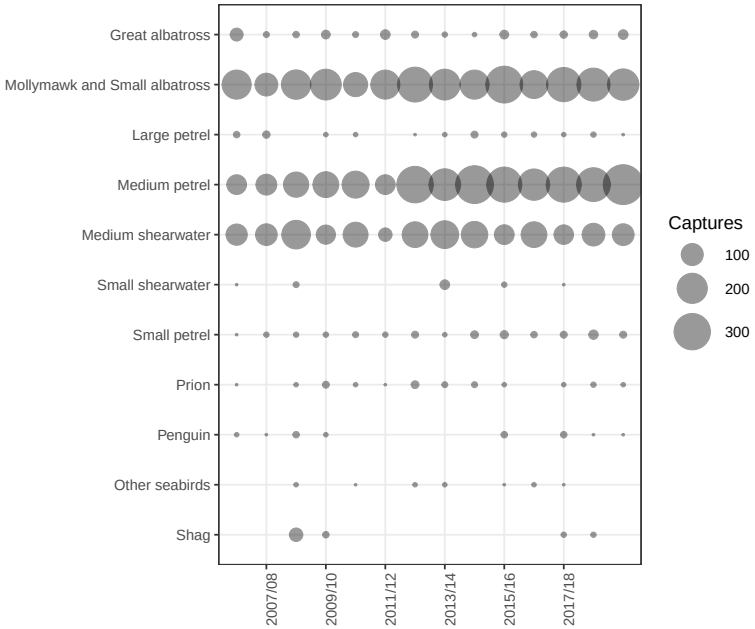

Figure 7: Observed captures per species group over years available in the data.

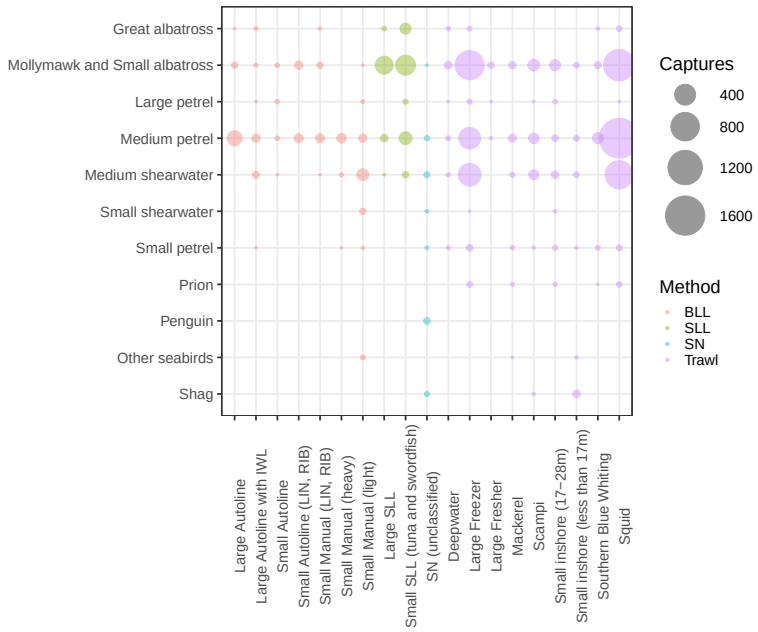

Figure 8: Observed captures per species and fishery group combination.

Table 10: Observed fishing effort by method and fishing year between 2006/07 and 2019/20. Units are of a thousand hooks for bottom longline (BLL) and surface longline (SLL), km of net for set net (SN), and number of tows for trawl.

Fishing year	BLL	SLL	SN	Trawl
2006/07	2 310	1 033	268	7 811
2007/08	3 571	419	356	9 015
2008/09	4 079	933	473	9 710
2009/10	2 439	661	476	8 965
2010/11	1 826	672	163	7 401
2011/12	2 102	723	68	9 335
2012/13	742	560	745	12 375
2013/14	2 912	781	331	13 221
2014/15	877	725	574	13 497
2015/16	2 642	318	450	12 929
2016/17	5 020	342	867	13 691
2017/18	5 862	289	850	14 905
2018/19	2 697	179	765	13 874
2019/20	4 316	191	480	15 577
-	**41 398**	**7 826**	**6 866**	**162 306**
-	**2 957**	**559**	**490**	**11 593**

Table 11: Total fishing effort by method and fishing year between 2006/07 and 2019/20. Units are of a thousand hooks for bottom longline (BLL) and surface longline (SLL), km of net for set net (SN), and number of tows for trawl.

Fishing year	BLL	SLL	SN	Trawl
2006/07	37 200	3 738	22 661	102 875
2007/08	41 445	2 244	20 395	89 498
2008/09	37 390	3 116	19 948	87 525
2009/10	40 399	2 995	20 787	92 860
2010/11	40 852	3 188	19 734	86 048
2011/12	37 808	3 100	18 531	84 395
2012/13	32 471	2 877	20 133	83 801
2013/14	40 788	2 551	19 337	85 091
2014/15	39 320	2 413	17 563	78 753
2015/16	43 433	2 358	15 600	78 020
2016/17	46 527	2 094	15 024	78 161
2017/18	40 142	2 291	14 040	74 236
2018/19	41 295	2 055	12 436	70 906
2019/20	40 405	1 998	11 049	65 982
-	**559 475**	**37 019**	**247 237**	**1 158 151**
-	**39 963**	**2 644**	**17 660**	**82 725**

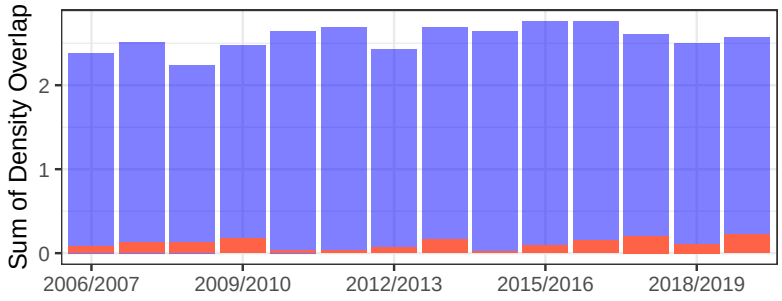

Figure 9: Sum of the density overlap for all species: BLL Observed overlap is in red.

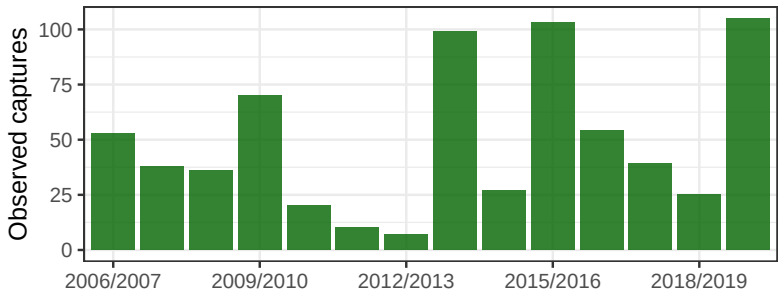

Figure 10: Sum of the observed captures for all species: BLL.

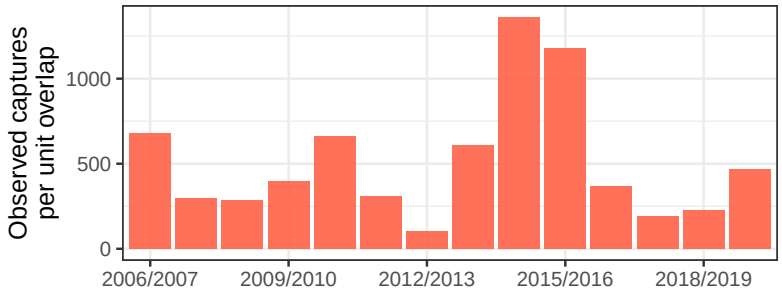

Figure 11: Average of the observed captures per unit overlap for all species: BLL

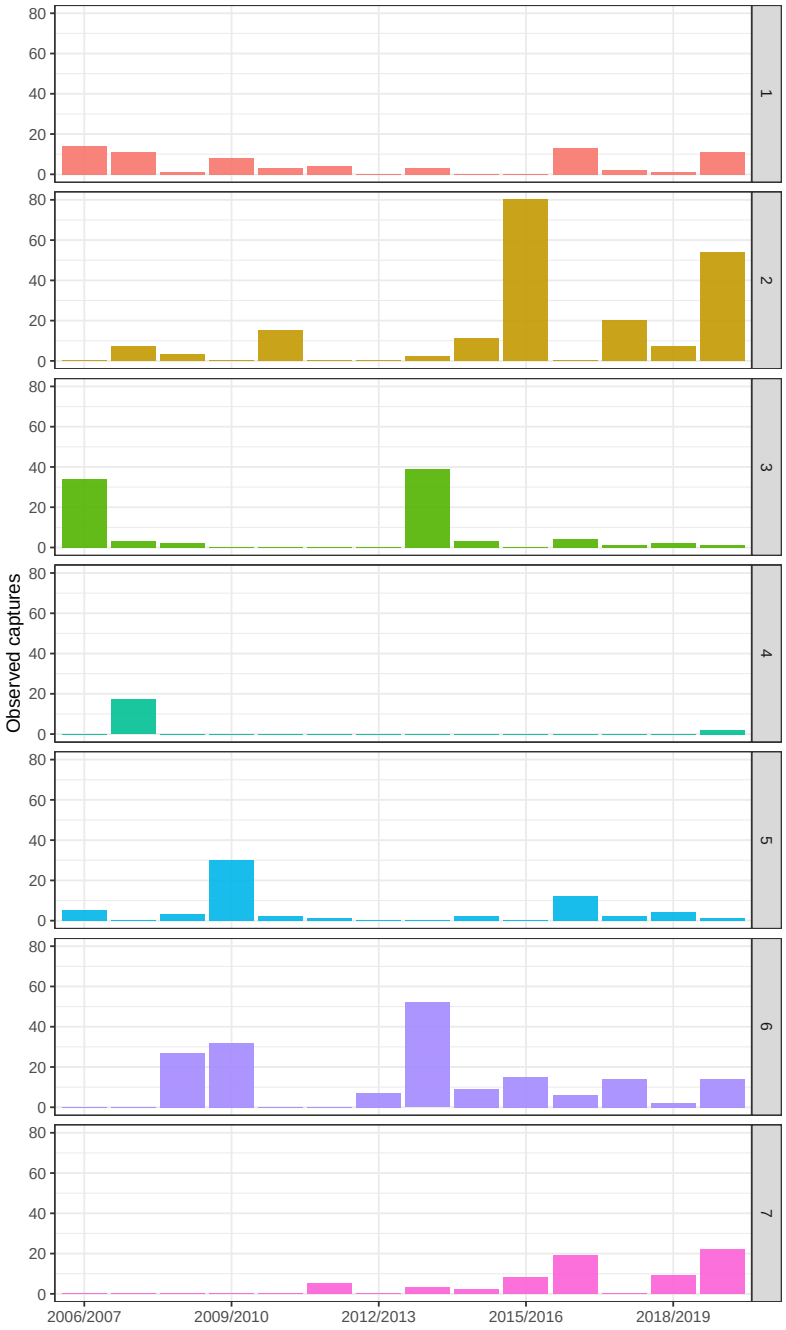

Figure 12: Sum of the observed captures for all species: BLL fishery groups.

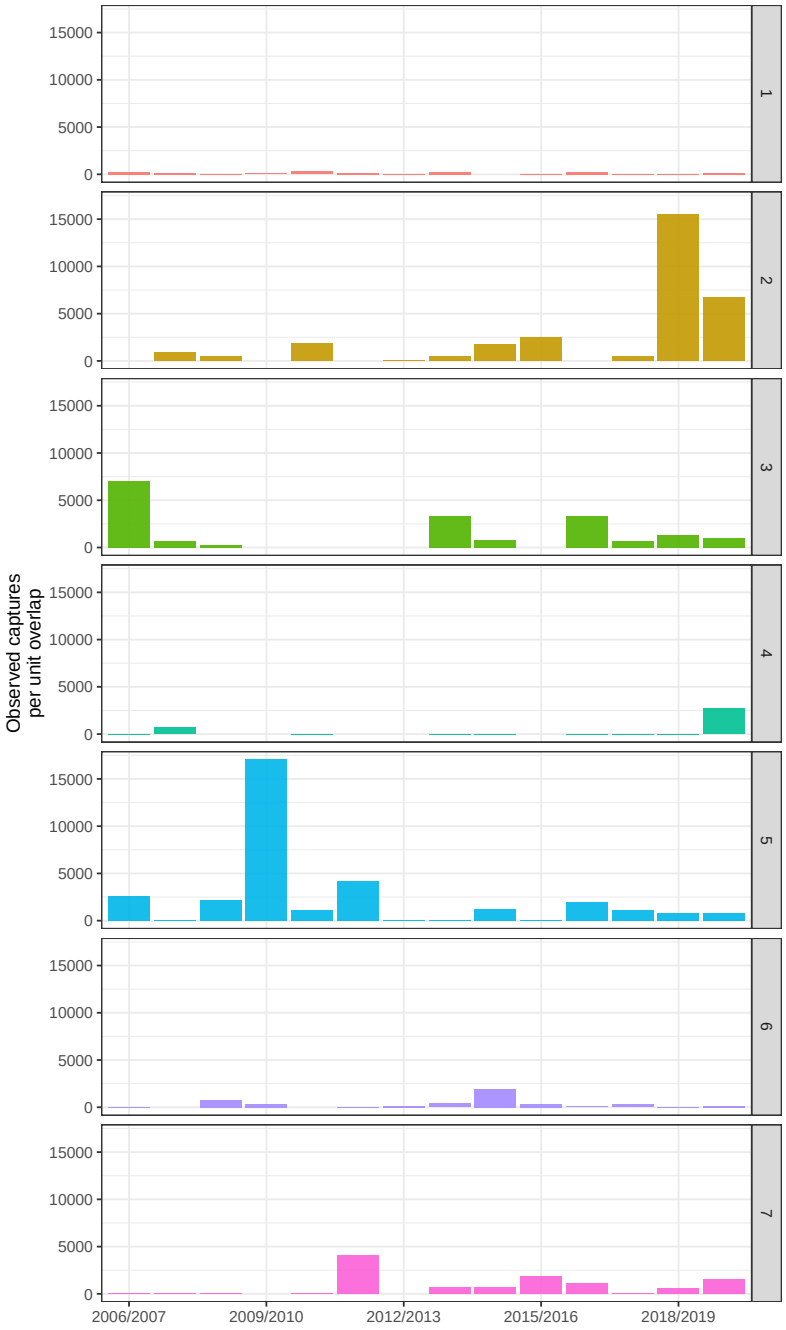

Figure 13: Average of the observed captures per unit overlap for all species: BLL fishery groups.

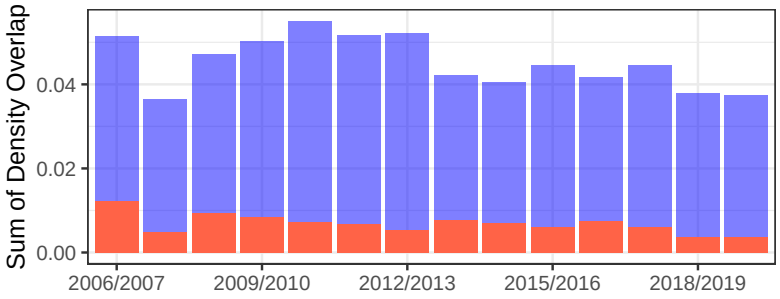

Figure 14: Sum of the density overlap for all species: SLL. Observed overlap is in red.

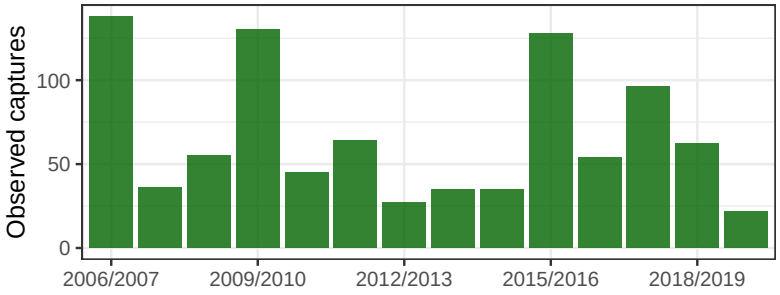

Figure 15: Sum of the observed captures for all species: SLL.

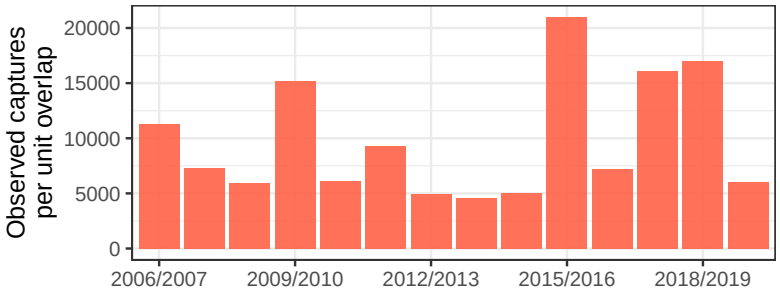

Figure 16: Average of the observed captures per unit overlap for all species: SLL.

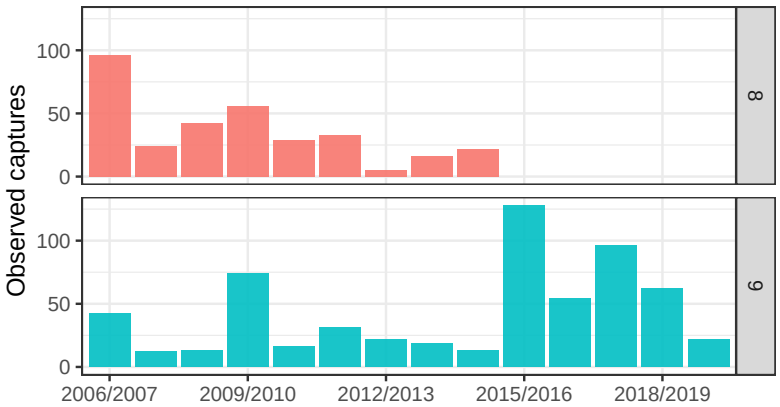

Figure 17: Sum of the observed captures for all species: SLL fishery groups.

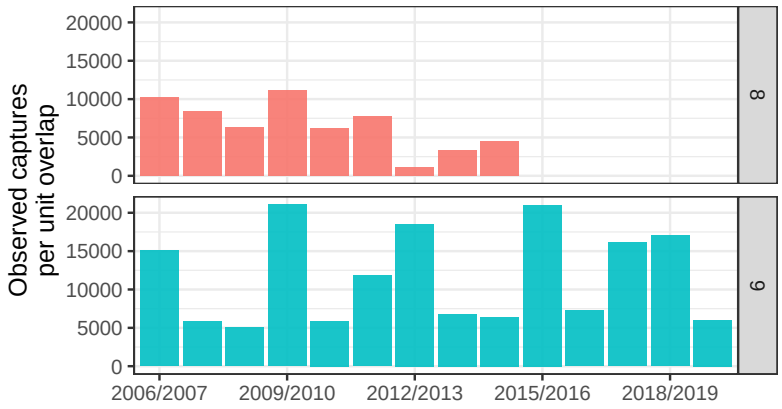

Figure 18: Average of the observed captures per unit overlap for all species: SLL fishery groups.

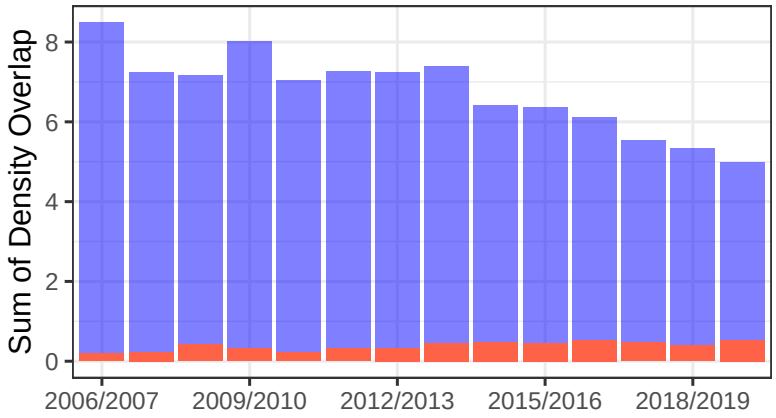

Figure 19: Sum of the density overlap for all species: Trawl. Observed overlap is in red.

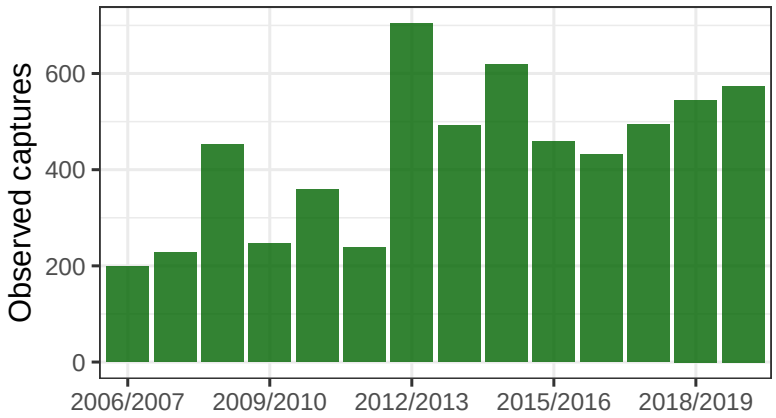

Figure 20: Sum of the observed captures for all species: Trawl.

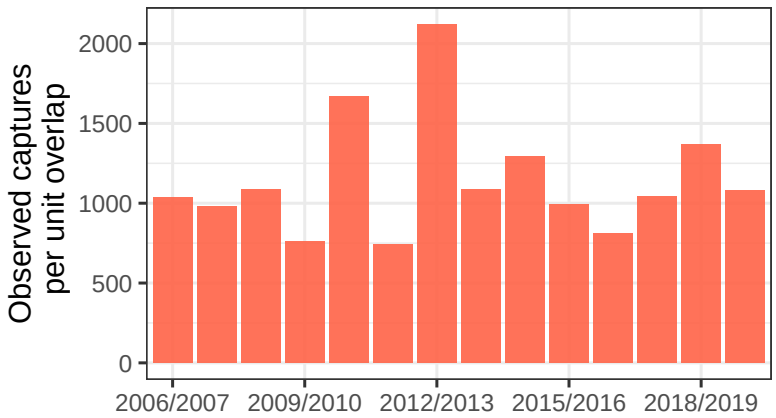

Figure 21: Average of the observed captures per unit overlap for all species: Trawl.

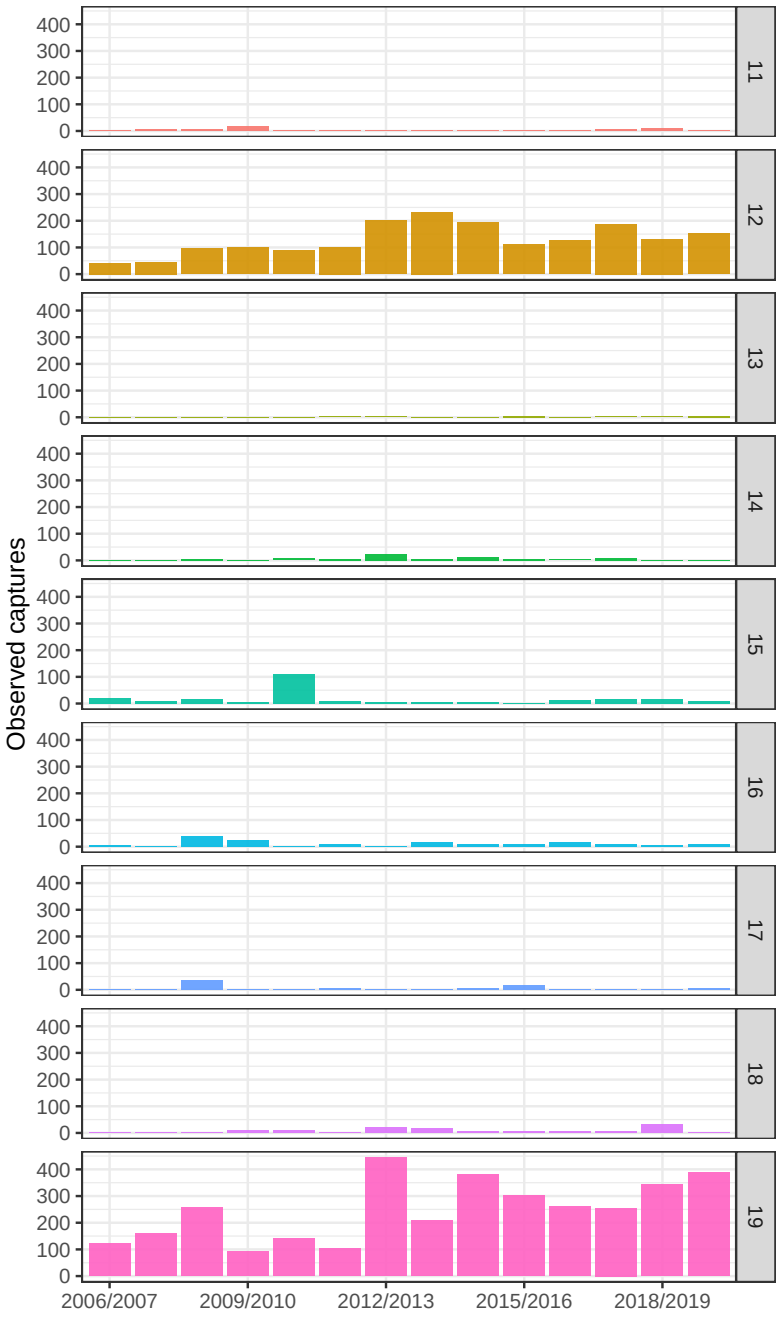

Figure 22: Sum of the observed captures for all species: Trawl fishery groups.

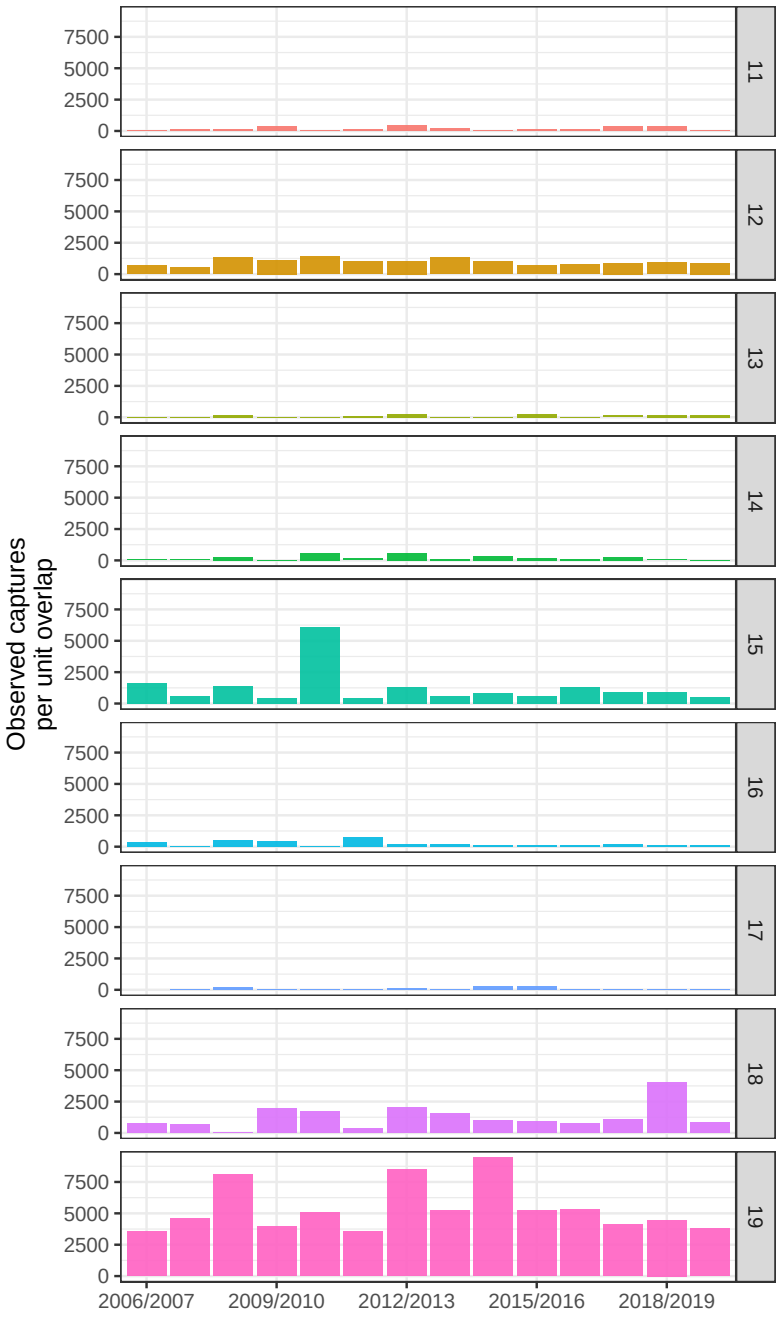

Figure 23: Average of the observed captures per unit overlap for all species: Trawl fishery groups.

Table 12: Observed overlap by species for bottom longline (BLL), surface longline (SLL), set net (SN), and trawl fishing methods between 2006/07 and 2019/20 (continued on next page). The summed overlap is only included as a diagnostic for construction of the data.

Common name	BLL	SLL	SN	Trawl	Sum
Gibson's albatross	0.007	0.003	0.002	0.085	0.096
Antipodean albatross	0.017	0.001	0.000	0.020	0.038
Southern royal albatross	0.014	0.001	0.001	0.055	0.071
Northern royal albatross	0.034	0.001	0.004	0.077	0.117
Campbell black-browed albatross	0.016	0.001	0.001	0.057	0.075
New Zealand white-capped albatross	0.012	0.003	0.008	0.138	0.160
Salvin's albatross	0.042	0.000	0.001	0.070	0.114
Chatham Island albatross	0.050	0.000	0.000	0.057	0.107
Grey-headed albatross	0.013	0.002	0.002	0.055	0.072
Southern Buller's albatross	0.021	0.004	0.010	0.115	0.149
Northern Buller's albatross	0.028	0.000	0.000	0.049	0.077
Light-mantled sooty albatross	0.013	0.002	0.002	0.060	0.078
Northern giant petrel	0.021	0.002	0.001	0.051	0.075
Grey petrel	0.011	0.001	0.001	0.030	0.044
Black petrel	0.015	0.004	0.000	0.034	0.054
Westland petrel	0.015	0.006	0.004	0.708	0.733
White-chinned petrel	0.008	0.001	0.000	0.041	0.050
Flesh-footed shearwater	0.024	0.006	0.001	0.089	0.120
Wedge-tailed shearwater	-	0.000	-	0.001	0.001
Buller's shearwater	0.015	0.004	0.003	0.058	0.079
Sooty shearwater	0.019	0.001	0.017	0.100	0.137
Fluttering shearwater	0.059	0.002	0.001	0.152	0.214
Hutton's shearwater	0.018	0.000	0.157	0.082	0.258
Little shearwater	0.005	0.001	0.001	0.025	0.032
Snares Cape petrel	0.011	0.002	0.003	0.080	0.095
Fairy prion	0.009	0.001	0.003	0.138	0.151
Antarctic prion	0.013	0.002	0.001	0.108	0.125
Broad-billed prion	0.027	0.001	0.001	0.053	0.082
Pycroft's petrel	0.066	0.002	0.000	0.069	0.136
Cook's petrel	0.063	0.003	0.002	0.099	0.167
Chatham petrel	0.008	-	-	0.033	0.041
Mottled petrel	0.033	0.001	0.034	0.085	0.153
White-naped petrel	0.000	0.000	-	-	0.000
Kermadec petrel	0.001	0.000	0.000	0.003	0.004
Grey-faced petrel	0.019	0.004	0.003	0.076	0.102
Chatham Island taiko	0.024	-	-	0.039	0.063
White-headed petrel	0.011	0.002	0.001	0.060	0.074
Soft-plumaged petrel	0.010	0.002	0.002	0.043	0.057
Common diving petrel	0.057	0.001	0.013	0.050	0.122
Whenua Hou diving petrel	0.037	-	0.023	0.042	0.102
New Zealand white-faced storm petrel	0.011	0.001	0.000	0.042	0.055
White-bellied storm petrel	0.000	0.001	-	0.000	0.001
Black-bellied storm petrel	0.010	0.002	0.002	0.038	0.052
Kermadec storm petrel	0.000	0.000	-	0.000	0.000
New Zealand storm petrel	0.019	0.004	0.001	0.043	0.066
Yellow-eyed penguin	0.000	0.000	0.019	0.022	0.041
Northern little penguin	0.038	0.003	0.020	0.150	0.211
White-flippered little penguin	0.023	-	0.012	0.232	0.268
Southern little penguin	0.025	0.002	0.043	0.171	0.242

Table 12: Continued

Common name	BLL	SLL	SN	Trawl	Sum
Chatham Island little penguin	0.042	-	-	0.055	0.097
Eastern rockhopper penguin	0.016	0.001	0.000	0.046	0.063
Fiordland crested penguin	0.021	0.003	0.032	0.105	0.161
Snares crested penguin	0.019	0.003	0.003	0.111	0.136
Erect-crested penguin	0.027	-	-	0.037	0.064
Australasian gannet	0.044	0.005	0.004	0.124	0.178
Masked booby	0.010	0.002	0.002	0.040	0.053
Pied shag	0.076	0.000	0.036	0.153	0.266
Little black shag	0.095	0.000	0.015	0.132	0.242
New Zealand king shag	0.001	-	0.007	0.033	0.041
Otago shag	0.000	-	0.077	0.192	0.270
Foveaux shag	0.000	-	0.139	0.030	0.169
Chatham Island shag	0.009	-	-	0.003	0.012
Bounty Island shag	0.051	-	-	0.000	0.051
Auckland Island shag	0.001	-	-	0.019	0.021
Campbell Island shag	-	-	-	-	-
Spotted shag	0.057	0.000	0.051	0.094	0.202
Pitt Island shag	0.006	-	-	0.001	0.007
Subantarctic skua	0.009	0.002	0.002	0.027	0.040
Southern black-backed gull	0.058	0.000	0.046	0.121	0.226
Caspian tern	0.054	0.000	0.043	0.135	0.232
White tern	0.004	0.001	0.001	0.016	0.023
Sum	**1.597**	**0.096**	**0.862**	**5.358**	**7.913**
Sum per year	**0.228**	**0.014**	**0.123**	**0.765**	**1.130**

Table 13: Total overlap by species for bottom longline (BLL), surface longline (SLL), set net (SN), and trawl fishing methods between 2017/18 and 2019/20 (continued on next page). The summed overlap is only included as a diagnostic for construction of the data.

Common name	BLL	SLL	SN	Trawl	Sum
Gibson's albatross	0.017	0.001	0.004	0.063	0.086
Antipodean albatross	0.035	0.001	0.001	0.023	0.060
Southern royal albatross	0.029	0.001	0.005	0.049	0.083
Northern royal albatross	0.080	0.001	0.013	0.118	0.212
Campbell black-browed albatross	0.030	0.000	0.004	0.047	0.082
New Zealand white-capped albatross	0.020	0.001	0.014	0.110	0.145
Salvin's albatross	0.075	0.001	0.005	0.088	0.169
Chatham Island albatross	0.115	0.000	0.000	0.048	0.163
Grey-headed albatross	0.032	0.001	0.006	0.056	0.096
Southern Buller's albatross	0.027	0.002	0.017	0.118	0.164
Northern Buller's albatross	0.083	0.001	0.000	0.050	0.134
Light-mantled sooty albatross	0.032	0.001	0.007	0.060	0.100
Northern giant petrel	0.052	0.001	0.006	0.056	0.116
Grey petrel	0.025	0.001	0.005	0.034	0.064
Black petrel	0.108	0.008	0.011	0.069	0.196
Westland petrel	0.120	0.012	0.009	0.610	0.752
White-chinned petrel	0.015	0.001	0.001	0.033	0.050
Flesh-footed shearwater	0.172	0.013	0.015	0.201	0.401
Wedge-tailed shearwater	0.000	0.000	-	0.000	0.000
Buller's shearwater	0.065	0.003	0.015	0.106	0.189
Sooty shearwater	0.057	0.001	0.045	0.130	0.232
Fluttering shearwater	0.603	0.001	0.047	0.319	0.970
Hutton's shearwater	0.121	0.002	0.575	0.549	1.246
Little shearwater	0.028	0.001	0.007	0.034	0.069
Snares Cape petrel	0.027	0.001	0.008	0.068	0.104
Fairy prion	0.052	0.001	0.036	0.326	0.415
Antarctic prion	0.032	0.002	0.006	0.078	0.118
Broad-billed prion	0.106	0.001	0.004	0.054	0.164
Pycroft's petrel	0.249	0.005	0.055	0.162	0.471
Cook's petrel	0.302	0.004	0.051	0.184	0.541
Chatham petrel	0.088	0.000	0.000	0.030	0.118
Mottled petrel	0.025	0.000	0.050	0.172	0.248
White-naped petrel	0.000	0.000	-	-	0.000
Kermadec petrel	0.003	0.000	0.001	0.004	0.008
Grey-faced petrel	0.120	0.007	0.030	0.139	0.295
Chatham Island taiko	0.076	-	-	0.032	0.108
White-headed petrel	0.025	0.001	0.005	0.051	0.081
Soft-plumaged petrel	0.025	0.002	0.007	0.056	0.089
Common diving petrel	0.105	0.001	0.027	0.131	0.264
Whenua Hou diving petrel	0.026	0.000	0.037	0.129	0.193
New Zealand white-faced storm petrel	0.123	0.001	0.003	0.041	0.168
White-bellied storm petrel	0.000	0.001	0.000	0.000	0.001
Black-bellied storm petrel	0.030	0.002	0.007	0.051	0.089
Kermadec storm petrel	0.000	0.000	0.000	-	0.000
New Zealand storm petrel	0.135	0.007	0.029	0.086	0.257
Yellow-eyed penguin	0.000	0.000	0.044	0.272	0.316
Northern little penguin	0.274	0.009	0.126	0.434	0.842
White-flippered little penguin	0.100	0.000	0.147	0.742	0.989
Southern little penguin	0.078	0.003	0.083	0.602	0.766

Table 13: Continued

Common name	BLL	SLL	SN	Trawl	Sum
Chatham Island little penguin	0.219	-	-	0.053	0.273
Eastern rockhopper penguin	0.024	0.000	0.001	0.032	0.057
Fiordland crested penguin	0.183	0.003	0.046	0.455	0.687
Snares crested penguin	0.034	0.001	0.007	0.086	0.128
Erect-crested penguin	0.036	-	-	0.021	0.057
Australasian gannet	0.206	0.005	0.082	0.336	0.628
Masked booby	0.030	0.002	0.007	0.051	0.089
Pied shag	0.545	0.000	0.329	0.752	1.626
Little black shag	0.754	0.000	0.416	0.742	1.912
New Zealand king shag	0.071	-	0.093	0.868	1.032
Otago shag	0.002	-	0.173	2.475	2.651
Foveaux shag	0.007	-	0.224	0.645	0.876
Chatham Island shag	0.254	-	-	0.028	0.282
Bounty Island shag	0.043	-	-	-	0.043
Auckland Island shag	0.001	-	0.000	0.009	0.010
Campbell Island shag	-	-	-	-	-
Spotted shag	0.294	0.000	0.377	1.002	1.673
Pitt Island shag	0.245	-	-	0.023	0.268
Subantarctic skua	0.030	0.001	0.005	0.035	0.071
Southern black-backed gull	0.390	0.000	0.230	0.701	1.321
Caspian tern	0.354	0.001	0.201	0.696	1.252
White tern	0.022	0.001	0.004	0.027	0.055
Sum	**7.681**	**0.120**	**3.763**	**15.851**	**27.415**
Sum per year	**1.097**	**0.017**	**0.538**	**2.264**	**3.916**

5. SPECIES-SPECIFIC INPUTS

5.1 Gibson's albatross (XAU)

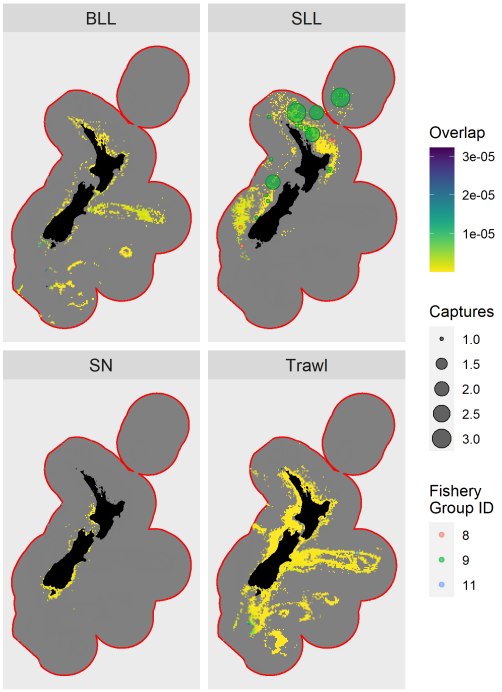

Figure 24: Sum of observed density overlap per method for Gibson's albatross (XAU) between 2006/07 and 2019/20, with captures per event.

Table 14: Density overlap and captures for Gibson's albatross (XAU). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.004	0.019	23	-
BLL	2	Large Autoline	0.002	0.018	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.009	4	-
BLL	4	Small Autoline	0.000	0.012	2	-
BLL	5	Small Manual (heavy)	0.000	0.013	1	-
BLL	6	Small Manual (light)	0.000	0.004	4	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.015	3	-
SLL	8	Large SLL	0.002	0.003	87	5
SLL	9	Small SLL (tuna and swordfish)	0.000	0.007	6	29
SN	10	SN (unclassified)	0.002	0.020	9	-
Trawl	11	Deepwater	0.009	0.030	31	1
Trawl	12	Large Freezer	0.018	0.052	35	-
Trawl	13	Large Fresher	0.001	0.010	7	-
Trawl	14	Mackerel	0.001	0.002	67	-
Trawl	15	Scampi	0.005	0.042	12	-
Trawl	16	Small inshore (17-28m)	0.001	0.043	3	-
Trawl	17	Small inshore (less than 17m)	0.001	0.045	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	94	-
Trawl	19	Squid	0.048	0.074	65	-
Total	**-**	**-**	**0.096**	**0.420**	**23**	**35**

5.2 Antipodean albatross (XAN)

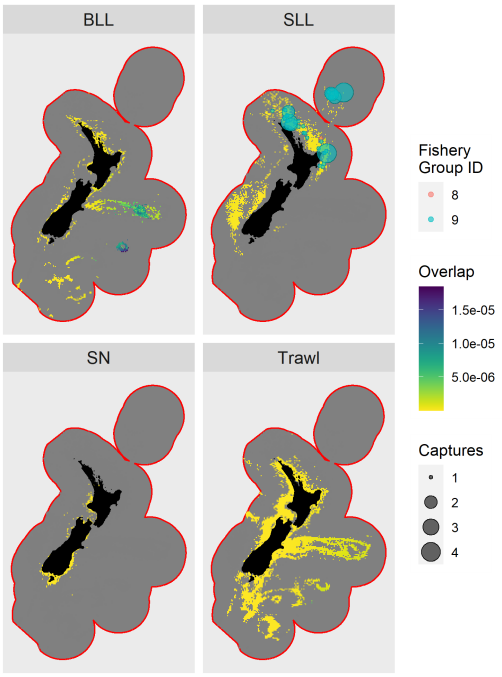

Figure 25: Sum of observed density overlap per method for Antipodean albatross (XAN) between 2006/07 and 2019/20, with captures per event.

Table 15: Density overlap and captures for Antipodean albatross (XAN). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.012	0.042	28	-
BLL	2	Large Autoline	0.004	0.033	11	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.024	4	-
BLL	4	Small Autoline	0.000	0.032	1	-
BLL	5	Small Manual (heavy)	0.000	0.011	1	-
BLL	6	Small Manual (light)	0.000	0.014	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.009	1	-
SLL	8	Large SLL	0.000	0.000	84	1
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	9	41
SN	10	SN (unclassified)	0.000	0.009	1	-
Trawl	11	Deepwater	0.009	0.029	32	-
Trawl	12	Large Freezer	0.006	0.022	25	-
Trawl	13	Large Fresher	0.001	0.011	7	-
Trawl	14	Mackerel	0.001	0.001	70	-
Trawl	15	Scampi	0.001	0.014	8	-
Trawl	16	Small inshore (17-28m)	0.001	0.026	4	-
Trawl	17	Small inshore (less than 17m)	0.000	0.021	1	-
Trawl	18	Southern Blue Whiting	0.001	0.002	50	-
Trawl	19	Squid	0.000	0.000	59	-
Total	**-**	**-**	**0.038**	**0.307**	**12**	**42**

5.3 Southern royal albatross (XRA)

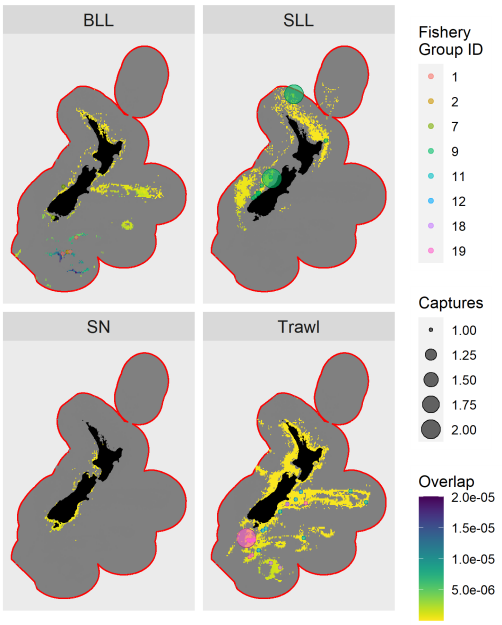

Figure 26: Sum of observed density overlap per method for Southern royal albatross (XRA) between 2006/07 and 2019/20, with captures per event.

Table 16: Density overlap and captures for Southern royal albatross (XRA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.011	0.044	25	3
BLL	2	Large Autoline	0.002	0.014	12	1
BLL	3	Small Autoline (LIN, RIB)	0.000	0.007	4	-
BLL	4	Small Autoline	0.000	0.007	2	-
BLL	5	Small Manual (heavy)	0.000	0.011	1	-
BLL	6	Small Manual (light)	0.001	0.023	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.011	3	2
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	8	12
SN	10	SN (unclassified)	0.001	0.031	4	-
Trawl	11	Deepwater	0.004	0.012	33	4
Trawl	12	Large Freezer	0.015	0.042	37	6
Trawl	13	Large Fresher	0.001	0.008	10	-
Trawl	14	Mackerel	0.003	0.004	63	-
Trawl	15	Scampi	0.003	0.025	11	-
Trawl	16	Small inshore (17-28m)	0.002	0.053	3	-
Trawl	17	Small inshore (less than 17m)	0.001	0.067	2	-
Trawl	18	Southern Blue Whiting	0.008	0.011	71	2
Trawl	19	Squid	0.018	0.029	62	13
Total	**-**	**-**	**0.071**	**0.404**	**18**	**43**

5.4 Northern royal albatross (XNR)

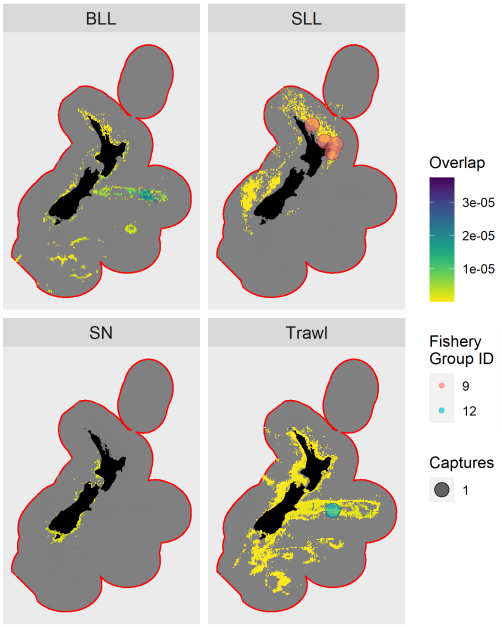

Figure 27: Sum of observed density overlap per method for Northern royal albatross (XNR) between 2006/07 and 2019/20, with captures per event.

Table 17: Density overlap and captures for Northern royal albatross (XNR). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.020	0.073	27	-
BLL	2	Large Autoline	0.009	0.082	11	-
BLL	3	Small Autoline (LIN, RIB)	0.002	0.054	5	-
BLL	4	Small Autoline	0.001	0.065	2	-
BLL	5	Small Manual (heavy)	0.000	0.030	1	-
BLL	6	Small Manual (light)	0.001	0.021	4	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.038	3	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	8	4
SN	10	SN (unclassified)	0.004	0.079	6	-
Trawl	11	Deepwater	0.008	0.028	29	-
Trawl	12	Large Freezer	0.034	0.110	30	1
Trawl	13	Large Fresher	0.002	0.030	7	-
Trawl	14	Mackerel	0.010	0.016	63	-
Trawl	15	Scampi	0.003	0.045	8	-
Trawl	16	Small inshore (17-28m)	0.004	0.159	2	-
Trawl	17	Small inshore (less than 17m)	0.004	0.227	2	-
Trawl	18	Southern Blue Whiting	0.001	0.002	63	-
Trawl	19	Squid	0.011	0.020	59	-
Total	**-**	**-**	**0.117**	**1.084**	**11**	**5**

5.5 Campbell black-browed albatross (XCM)

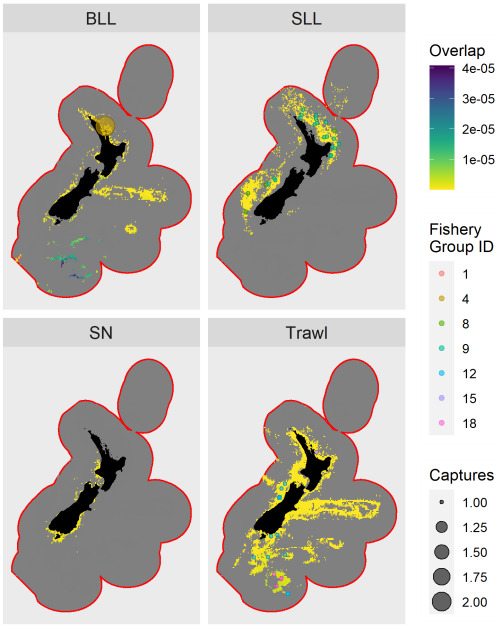

Figure 28: Sum of observed density overlap per method for Campbell black-browed albatross (XCM) between 2006/07 and 2019/20, with captures per event.

Table 18: Density overlap and captures for Campbell black-browed albatross (XCM). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.014	0.060	23	1
BLL	2	Large Autoline	0.002	0.011	17	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	3	-
BLL	4	Small Autoline	0.000	0.003	1	3
BLL	5	Small Manual (heavy)	0.000	0.005	1	-
BLL	6	Small Manual (light)	0.000	0.009	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.010	3	-
SLL	8	Large SLL	0.000	0.000	86	4
SLL	9	Small SLL (tuna and swordfish)	0.000	0.002	9	19
SN	10	SN (unclassified)	0.001	0.024	5	-
Trawl	11	Deepwater	0.003	0.009	38	-
Trawl	12	Large Freezer	0.015	0.039	39	12
Trawl	13	Large Fresher	0.000	0.005	11	-
Trawl	14	Mackerel	0.001	0.002	65	-
Trawl	15	Scampi	0.003	0.024	11	1
Trawl	16	Small inshore (17-28m)	0.001	0.047	2	-
Trawl	17	Small inshore (less than 17m)	0.001	0.064	1	-
Trawl	18	Southern Blue Whiting	0.015	0.022	72	4
Trawl	19	Squid	0.016	0.026	62	-
Total	**-**	**-**	**0.075**	**0.365**	**20**	**44**

5.6 New Zealand white-capped albatross (XWM)

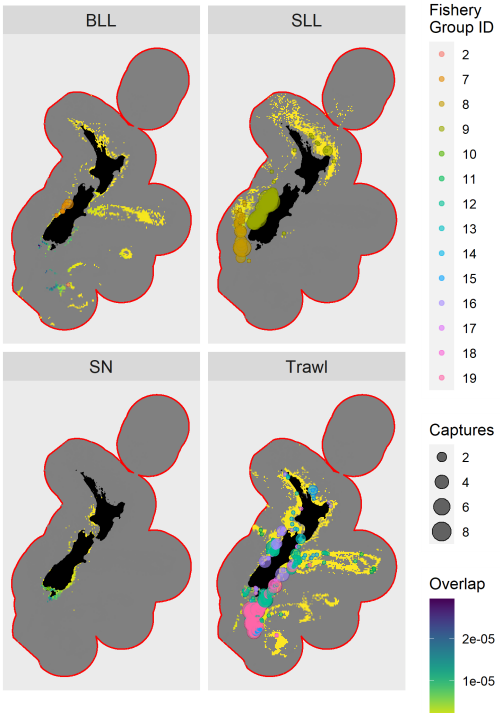

Figure 29: Sum of observed density overlap per method for New Zealand white-capped albatross (XWM) between 2006/07 and 2019/20, with captures per event.

Table 19: Density overlap and captures for New Zealand white-capped albatross (XWM). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.010	0.044	23	-
BLL	2	Large Autoline	0.001	0.012	8	1
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	6	-
BLL	4	Small Autoline	0.000	0.003	2	-
BLL	5	Small Manual (heavy)	0.000	0.014	1	-
BLL	6	Small Manual (light)	0.000	0.003	4	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.022	3	11
SLL	8	Large SLL	0.002	0.003	87	57
SLL	9	Small SLL (tuna and swordfish)	0.000	0.003	11	173
SN	10	SN (unclassified)	0.008	0.071	11	1
Trawl	11	Deepwater	0.003	0.010	32	6
Trawl	12	Large Freezer	0.049	0.115	43	283
Trawl	13	Large Fresher	0.001	0.013	9	8
Trawl	14	Mackerel	0.007	0.010	68	19
Trawl	15	Scampi	0.006	0.047	12	35
Trawl	16	Small inshore (17-28m)	0.002	0.116	2	44
Trawl	17	Small inshore (less than 17m)	0.002	0.125	1	10
Trawl	18	Southern Blue Whiting	0.000	0.000	60	2
Trawl	19	Squid	0.068	0.111	61	780
Total	**-**	**-**	**0.160**	**0.727**	**22**	**1430**

5.7 Salvin's albatross (XSA)

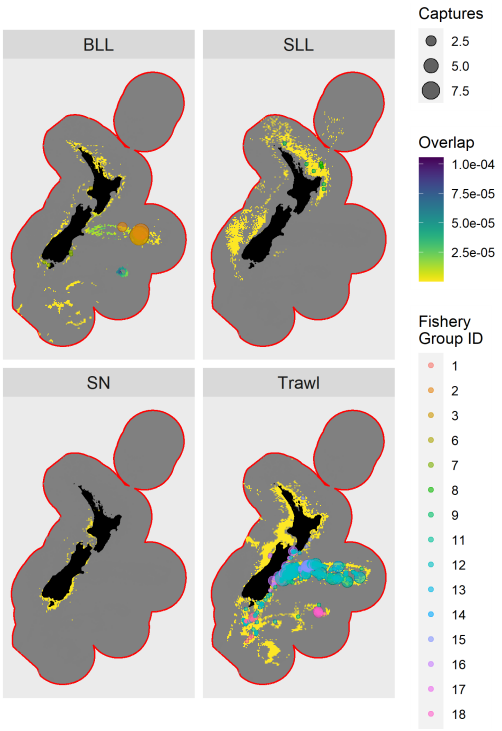

Figure 30: Sum of observed density overlap per method for Salvin's albatross (XSA) between 2006/07 and 2019/20, with captures per event.

Table 20: Density overlap and captures for Salvin's albatross (XSA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.026	0.106	25	1
BLL	2	Large Autoline	0.011	0.145	8	10
BLL	3	Small Autoline (LIN, RIB)	0.002	0.048	5	27
BLL	4	Small Autoline	0.001	0.024	2	-
BLL	5	Small Manual (heavy)	0.000	0.015	2	-
BLL	6	Small Manual (light)	0.000	0.000	3	1
BLL	7	Small Manual (LIN, RIB)	0.001	0.032	4	4
SLL	8	Large SLL	0.000	0.000	83	3
SLL	9	Small SLL (tuna and swordfish)	0.000	0.002	6	5
SN	10	SN (unclassified)	0.001	0.031	4	-
Trawl	11	Deepwater	0.008	0.032	26	17
Trawl	12	Large Freezer	0.039	0.167	24	313
Trawl	13	Large Fresher	0.001	0.014	9	7
Trawl	14	Mackerel	0.003	0.005	68	3
Trawl	15	Scampi	0.006	0.078	7	40
Trawl	16	Small inshore (17-28m)	0.002	0.070	2	42
Trawl	17	Small inshore (less than 17m)	0.001	0.057	2	2
Trawl	18	Southern Blue Whiting	0.004	0.006	55	17
Trawl	19	Squid	0.006	0.010	61	21
Total	**-**	**-**	**0.114**	**0.843**	**14**	**513**

5.8 Chatham Island albatross (XCI)

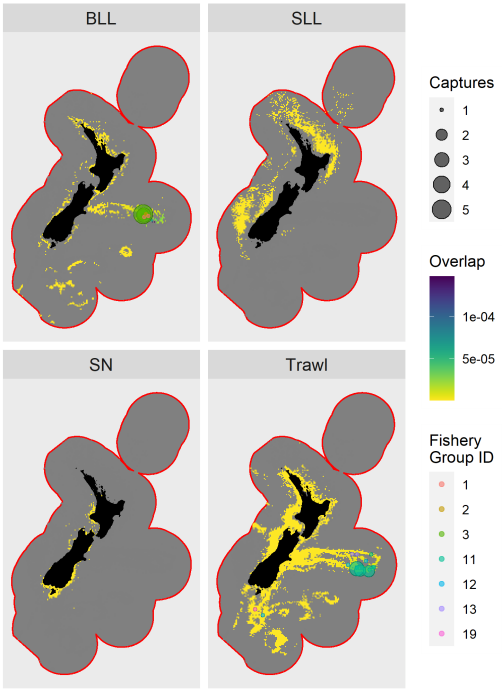

Figure 31: Sum of observed density overlap per method for Chatham Island albatross (XCI) between 2006/07 and 2019/20, with captures per event.

Table 21: Density overlap and captures for Chatham Island albatross (XCI). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.031	0.096	32	2
BLL	2	Large Autoline	0.013	0.097	13	1
BLL	3	Small Autoline (LIN, RIB)	0.003	0.101	3	12
BLL	4	Small Autoline	0.003	0.190	2	-
BLL	5	Small Manual (heavy)	0.000	0.018	-	-
BLL	6	Small Manual (light)	0.000	0.001	1	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.006	-	-
SLL	8	Large SLL	0.000	0.000	82	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	6	-
SN	10	SN (unclassified)	0.000	0.000	2	-
Trawl	11	Deepwater	0.038	0.134	28	11
Trawl	12	Large Freezer	0.014	0.052	27	4
Trawl	13	Large Fresher	0.002	0.041	6	2
Trawl	14	Mackerel	0.002	0.002	82	-
Trawl	15	Scampi	0.002	0.020	8	-
Trawl	16	Small inshore (17-28m)	0.000	0.005	1	-
Trawl	17	Small inshore (less than 17m)	0.000	0.002	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	54	-
Trawl	19	Squid	0.000	0.000	60	1
Total	**-**	**-**	**0.107**	**0.764**	**14**	**33**

5.9 Grey-headed albatross (XGM)

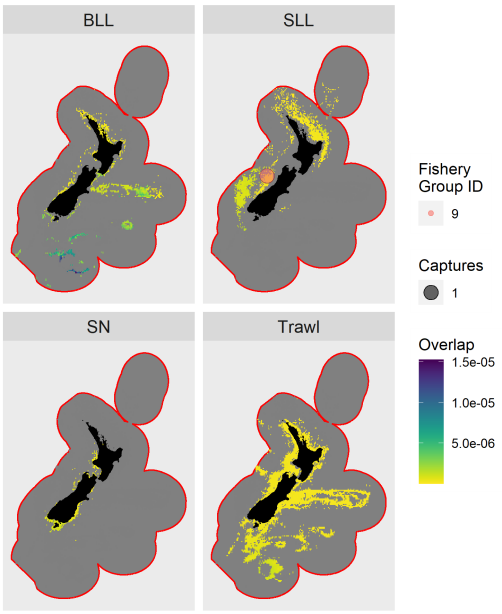

Figure 32: Sum of observed density overlap per method for Grey-headed albatross (XGM) between 2006/07 and 2019/20, with captures per event.

Table 22: Density overlap and captures for Grey-headed albatross (XGM). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.009	0.040	23	-
BLL	2	Large Autoline	0.002	0.019	10	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.009	5	-
BLL	4	Small Autoline	0.000	0.009	2	-
BLL	5	Small Manual (heavy)	0.000	0.014	1	-
BLL	6	Small Manual (light)	0.001	0.029	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.015	3	-
SLL	8	Large SLL	0.001	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.006	9	1
SN	10	SN (unclassified)	0.002	0.041	4	-
Trawl	11	Deepwater	0.005	0.015	33	-
Trawl	12	Large Freezer	0.019	0.051	37	-
Trawl	13	Large Fresher	0.001	0.011	10	-
Trawl	14	Mackerel	0.004	0.006	62	-
Trawl	15	Scampi	0.002	0.019	10	-
Trawl	16	Small inshore (17-28m)	0.002	0.073	3	-
Trawl	17	Small inshore (less than 17m)	0.001	0.092	2	-
Trawl	18	Southern Blue Whiting	0.006	0.008	70	-
Trawl	19	Squid	0.015	0.024	61	-
Total	**-**	**-**	**0.072**	**0.483**	**15**	**1**

5.10 Southern Buller's albatross (XBM)

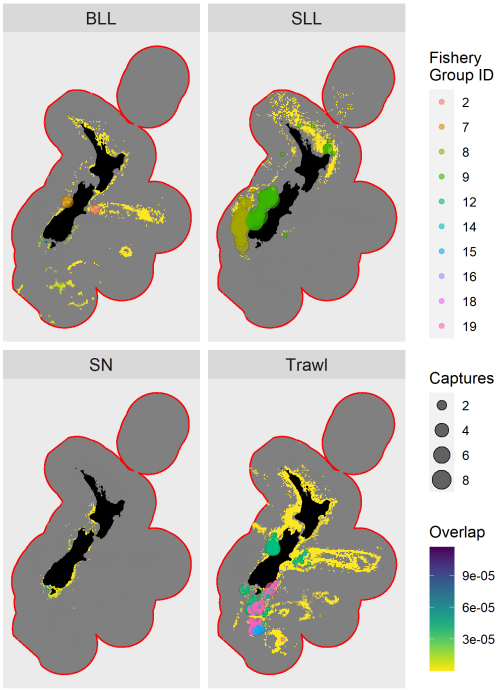

Figure 33: Sum of observed density overlap per method for Southern Buller's albatross (XBM) between 2006/07 and 2019/20, with captures per event.

Table 23: Density overlap and captures for Southern Buller's albatross (XBM). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.018	0.109	17	-
BLL	2	Large Autoline	0.001	0.015	8	3
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	5	-
BLL	4	Small Autoline	0.000	0.002	3	-
BLL	5	Small Manual (heavy)	0.000	0.012	2	-
BLL	6	Small Manual (light)	0.000	0.001	4	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.031	4	3
SLL	8	Large SLL	0.003	0.004	85	221
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	10	142
SN	10	SN (unclassified)	0.010	0.083	12	-
Trawl	11	Deepwater	0.004	0.014	28	-
Trawl	12	Large Freezer	0.056	0.137	41	210
Trawl	13	Large Fresher	0.001	0.012	6	-
Trawl	14	Mackerel	0.005	0.007	73	5
Trawl	15	Scampi	0.002	0.014	11	16
Trawl	16	Small inshore (17-28m)	0.002	0.154	1	2
Trawl	17	Small inshore (less than 17m)	0.002	0.180	1	-
Trawl	18	Southern Blue Whiting	0.001	0.001	71	1
Trawl	19	Squid	0.043	0.072	59	182
Total	**-**	**-**	**0.149**	**0.858**	**17**	**785**

5.11 Northern Buller's albatross (XNB)

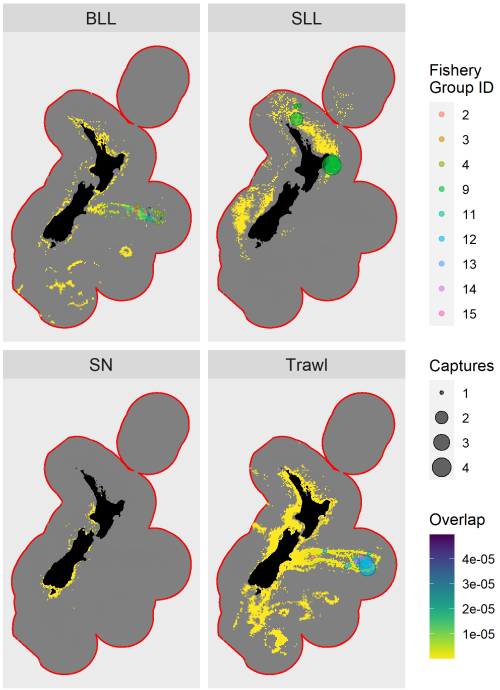

Figure 34: Sum of observed density overlap per method for Northern Buller's albatross (XNB) between 2006/07 and 2019/20, with captures per event.

Table 24: Density overlap and captures for Northern Buller's albatross (XNB). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.014	0.048	30	-
BLL	2	Large Autoline	0.009	0.105	8	2
BLL	3	Small Autoline (LIN, RIB)	0.002	0.063	3	1
BLL	4	Small Autoline	0.003	0.155	2	3
BLL	5	Small Manual (heavy)	0.000	0.021	-	-
BLL	6	Small Manual (light)	0.000	0.001	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.006	2	-
SLL	8	Large SLL	0.000	0.000	82	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.003	5	22
SN	10	SN (unclassified)	0.000	0.002	1	-
Trawl	11	Deepwater	0.021	0.072	30	1
Trawl	12	Large Freezer	0.017	0.074	23	19
Trawl	13	Large Fresher	0.002	0.030	6	1
Trawl	14	Mackerel	0.002	0.002	79	1
Trawl	15	Scampi	0.004	0.053	7	9
Trawl	16	Small inshore (17-28m)	0.000	0.011	2	-
Trawl	17	Small inshore (less than 17m)	0.000	0.005	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	52	-
Trawl	19	Squid	0.003	0.004	69	-
Total	**-**	**-**	**0.077**	**0.655**	**12**	**59**

5.12 Light-mantled sooty albatross (XLM)

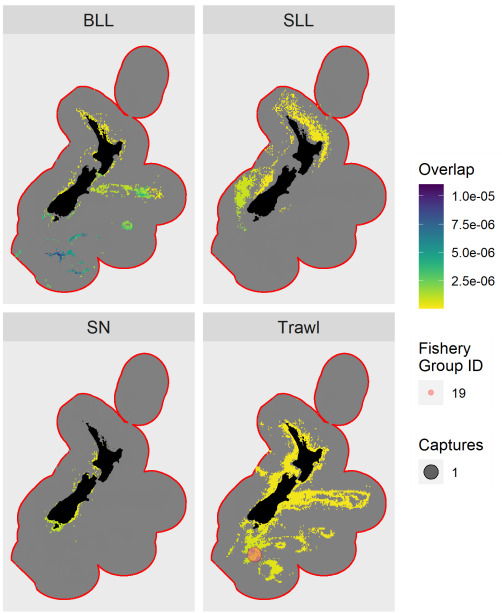

Figure 35: Sum of observed density overlap per method for Light-mantled sooty albatross (XLM) between 2006/07 and 2019/20, with captures per event.

Table 25: Density overlap and captures for Light-mantled sooty albatross (XLM). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.009	0.039	24	-
BLL	2	Large Autoline	0.002	0.019	10	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.009	5	-
BLL	4	Small Autoline	0.000	0.009	2	-
BLL	5	Small Manual (heavy)	0.000	0.014	1	-
BLL	6	Small Manual (light)	0.001	0.030	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.016	3	-
SLL	8	Large SLL	0.001	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.006	9	-
SN	10	SN (unclassified)	0.002	0.043	5	-
Trawl	11	Deepwater	0.005	0.015	32	-
Trawl	12	Large Freezer	0.020	0.054	37	-
Trawl	13	Large Fresher	0.001	0.011	10	-
Trawl	14	Mackerel	0.004	0.006	63	-
Trawl	15	Scampi	0.003	0.024	11	-
Trawl	16	Small inshore (17-28m)	0.002	0.076	3	-
Trawl	17	Small inshore (less than 17m)	0.002	0.097	2	-
Trawl	18	Southern Blue Whiting	0.004	0.005	69	-
Trawl	19	Squid	0.020	0.033	61	1
Total	**-**	**-**	**0.078**	**0.508**	**15**	**1**

5.13 Northern giant petrel (XNP)

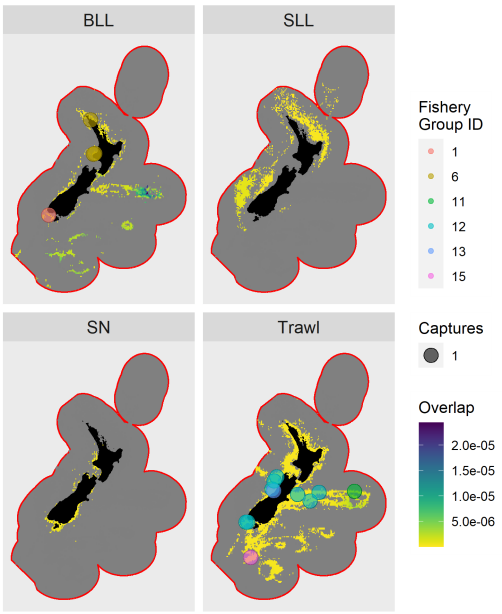

Figure 36: Sum of observed density overlap per method for Northern giant petrel (XNP) between 2006/07 and 2019/20, with captures per event.

Table 26: Density overlap and captures for Northern giant petrel (XNP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.013	0.051	26	1
BLL	2	Large Autoline	0.004	0.039	10	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.035	3	-
BLL	4	Small Autoline	0.001	0.045	2	-
BLL	5	Small Manual (heavy)	0.000	0.018	1	-
BLL	6	Small Manual (light)	0.001	0.032	3	3
BLL	7	Small Manual (LIN, RIB)	0.000	0.015	2	-
SLL	8	Large SLL	0.001	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.007	8	-
SN	10	SN (unclassified)	0.001	0.038	3	-
Trawl	11	Deepwater	0.011	0.036	30	1
Trawl	12	Large Freezer	0.017	0.048	34	8
Trawl	13	Large Fresher	0.002	0.018	8	1
Trawl	14	Mackerel	0.004	0.006	64	-
Trawl	15	Scampi	0.002	0.024	10	1
Trawl	16	Small inshore (17-28m)	0.002	0.070	3	-
Trawl	17	Small inshore (less than 17m)	0.001	0.079	2	-
Trawl	18	Southern Blue Whiting	0.002	0.003	67	-
Trawl	19	Squid	0.009	0.015	61	-
Total	**-**	**-**	**0.075**	**0.582**	**13**	**15**

5.14 Grey petrel (XGP)

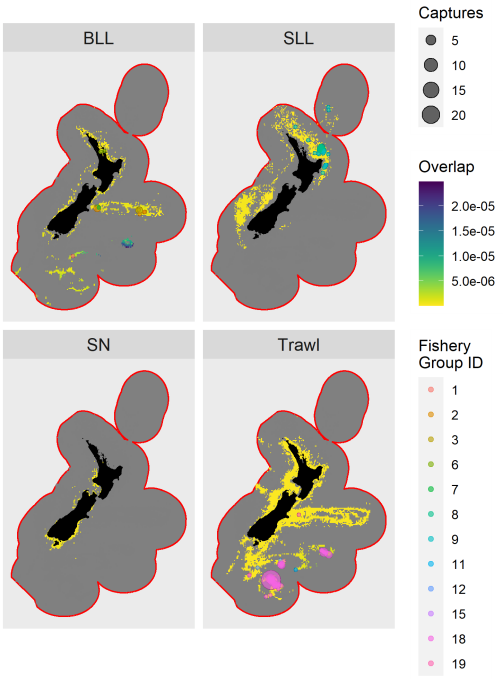

Figure 37: Sum of observed density overlap per method for Grey petrel (XGP) between 2006/07 and 2019/20, with captures per event.

Table 27: Density overlap and captures for Grey petrel (XGP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.009	0.038	23	1
BLL	2	Large Autoline	0.001	0.013	7	7
BLL	3	Small Autoline (LIN, RIB)	0.000	0.006	4	5
BLL	4	Small Autoline	0.000	0.007	2	-
BLL	5	Small Manual (heavy)	0.000	0.011	1	-
BLL	6	Small Manual (light)	0.001	0.024	3	2
BLL	7	Small Manual (LIN, RIB)	0.000	0.010	2	2
SLL	8	Large SLL	0.001	0.001	85	15
SLL	9	Small SLL (tuna and swordfish)	0.000	0.004	8	16
SN	10	SN (unclassified)	0.001	0.030	4	-
Trawl	11	Deepwater	0.006	0.016	36	1
Trawl	12	Large Freezer	0.009	0.027	33	2
Trawl	13	Large Fresher	0.001	0.008	10	-
Trawl	14	Mackerel	0.003	0.005	61	-
Trawl	15	Scampi	0.001	0.010	8	1
Trawl	16	Small inshore (17-28m)	0.002	0.052	4	-
Trawl	17	Small inshore (less than 17m)	0.001	0.058	2	-
Trawl	18	Southern Blue Whiting	0.003	0.005	55	85
Trawl	19	Squid	0.005	0.008	61	2
Total	**-**	**-**	**0.044**	**0.334**	**13**	**139**

5.15 Black petrel (XBP)

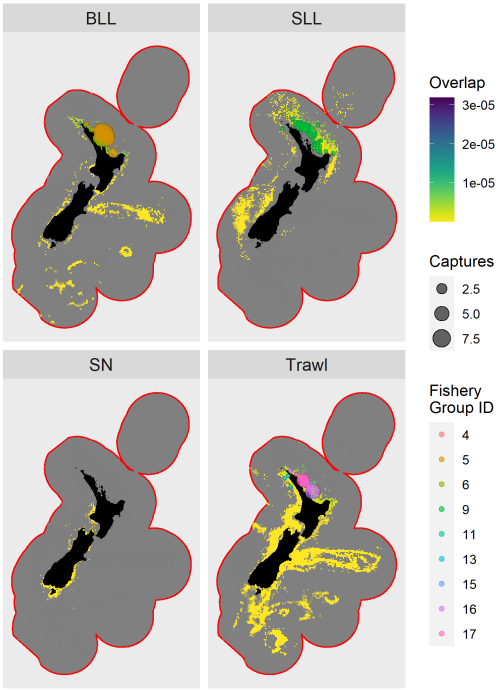

Figure 38: Sum of observed density overlap per method for Black petrel (XBP) between 2006/07 and 2019/20, with captures per event.

Table 28: Density overlap and captures for Black petrel (XBP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.001	1	-
BLL	2	Large Autoline	0.000	0.000	5	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.002	3	-
BLL	4	Small Autoline	0.001	0.010	5	3
BLL	5	Small Manual (heavy)	0.002	0.114	2	53
BLL	6	Small Manual (light)	0.011	0.373	3	36
BLL	7	Small Manual (LIN, RIB)	0.001	0.031	2	-
SLL	8	Large SLL	0.000	0.001	78	-
SLL	9	Small SLL (tuna and swordfish)	0.004	0.050	8	47
SN	10	SN (unclassified)	0.000	0.087	-	-
Trawl	11	Deepwater	0.006	0.021	27	1
Trawl	12	Large Freezer	0.001	0.004	33	-
Trawl	13	Large Fresher	0.004	0.026	15	2
Trawl	14	Mackerel	0.000	0.000	59	-
Trawl	15	Scampi	0.003	0.032	9	1
Trawl	16	Small inshore (17-28m)	0.017	0.264	6	14
Trawl	17	Small inshore (less than 17m)	0.003	0.112	3	14
Trawl	18	Southern Blue Whiting	0.000	0.000	71	-
Trawl	19	Squid	0.000	0.000	63	-
Total	**-**	**-**	**0.054**	**1.129**	**5**	**171**

5.16 Westland petrel (XWP)

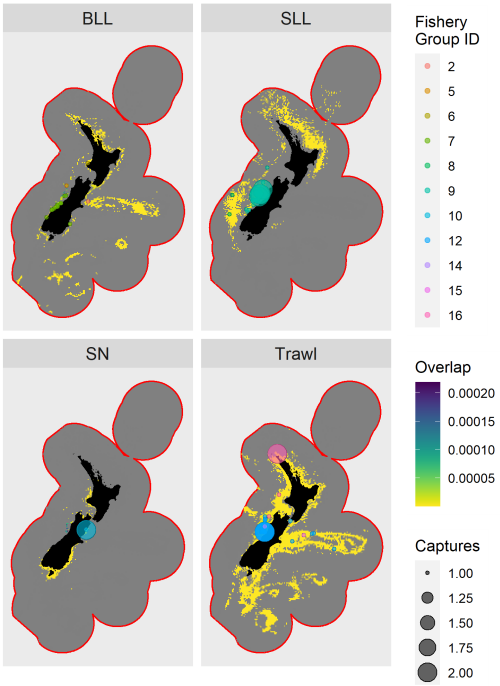

Figure 39: Sum of observed density overlap per method for Westland petrel (XWP) between 2006/07 and 2019/20, with captures per event.

Table 29: Density overlap and captures for Westland petrel (XWP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.008	21	-
BLL	2	Large Autoline	0.001	0.013	9	1
BLL	3	Small Autoline (LIN, RIB)	0.000	0.006	8	-
BLL	4	Small Autoline	0.000	0.003	3	-
BLL	5	Small Manual (heavy)	0.001	0.108	1	1
BLL	6	Small Manual (light)	0.000	0.003	4	1
BLL	7	Small Manual (LIN, RIB)	0.010	0.298	3	14
SLL	8	Large SLL	0.000	0.001	82	2
SLL	9	Small SLL (tuna and swordfish)	0.006	0.049	11	43
SN	10	SN (unclassified)	0.004	0.079	5	3
Trawl	11	Deepwater	0.001	0.009	14	-
Trawl	12	Large Freezer	0.628	1.330	47	31
Trawl	13	Large Fresher	0.009	0.058	16	-
Trawl	14	Mackerel	0.039	0.062	63	1
Trawl	15	Scampi	0.000	0.005	6	1
Trawl	16	Small inshore (17-28m)	0.028	0.965	3	5
Trawl	17	Small inshore (less than 17m)	0.001	0.201	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	66	-
Trawl	19	Squid	0.001	0.002	53	-
Total	**-**	**-**	**0.733**	**3.201**	**23**	**103**

5.17 White-chinned petrel (XWC)

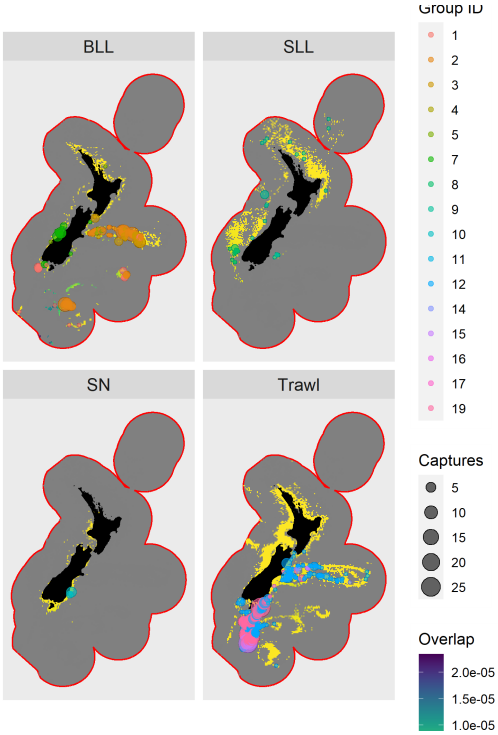

Figure 40: Sum of observed density overlap per method for White-chinned petrel (XWC) between 2006/07 and 2019/20, with captures per event.

Table 30: Density overlap and captures for White-chinned petrel (XWC). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.006	0.025	25	37
BLL	2	Large Autoline	0.001	0.019	7	173
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	5	44
BLL	4	Small Autoline	0.000	0.004	3	3
BLL	5	Small Manual (heavy)	0.000	0.004	1	3
BLL	6	Small Manual (light)	0.000	0.000	4	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.007	4	31
SLL	8	Large SLL	0.001	0.001	88	14
SLL	9	Small SLL (tuna and swordfish)	0.000	0.002	5	22
SN	10	SN (unclassified)	0.000	0.006	7	9
Trawl	11	Deepwater	0.004	0.014	31	5
Trawl	12	Large Freezer	0.015	0.046	33	404
Trawl	13	Large Fresher	0.000	0.003	8	-
Trawl	14	Mackerel	0.001	0.001	71	36
Trawl	15	Scampi	0.004	0.032	11	74
Trawl	16	Small inshore (17-28m)	0.000	0.018	2	1
Trawl	17	Small inshore (less than 17m)	0.000	0.015	1	1
Trawl	18	Southern Blue Whiting	0.001	0.002	68	-
Trawl	19	Squid	0.015	0.024	61	1651
Total	**-**	**-**	**0.050**	**0.227**	**22**	**2508**

5.18 Flesh-footed shearwater (XFS)

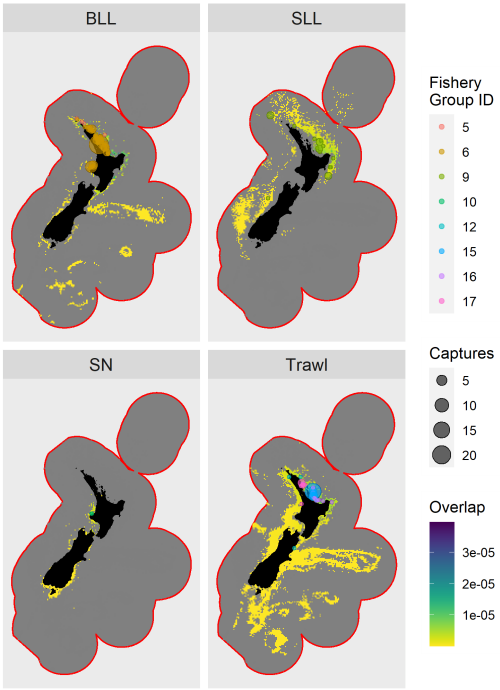

Figure 41: Sum of observed density overlap per method for Flesh-footed shearwater (XFS) between 2006/07 and 2019/20, with captures per event.

Table 31: Density overlap and captures for Flesh-footed shearwater (XFS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.006	8	-
BLL	2	Large Autoline	0.000	0.003	7	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.006	5	-
BLL	4	Small Autoline	0.001	0.026	3	-
BLL	5	Small Manual (heavy)	0.002	0.147	1	4
BLL	6	Small Manual (light)	0.019	0.582	3	105
BLL	7	Small Manual (LIN, RIB)	0.001	0.106	1	-
SLL	8	Large SLL	0.001	0.001	76	-
SLL	9	Small SLL (tuna and swordfish)	0.005	0.064	8	18
SN	10	SN (unclassified)	0.001	0.124	1	2
Trawl	11	Deepwater	0.007	0.039	19	-
Trawl	12	Large Freezer	0.009	0.028	31	3
Trawl	13	Large Fresher	0.007	0.070	10	-
Trawl	14	Mackerel	0.009	0.015	60	-
Trawl	15	Scampi	0.008	0.090	9	29
Trawl	16	Small inshore (17-28m)	0.039	0.667	6	15
Trawl	17	Small inshore (less than 17m)	0.010	0.359	3	10
Trawl	18	Southern Blue Whiting	0.000	0.000	65	-
Trawl	19	Squid	0.000	0.000	60	-
Total	**-**	**-**	**0.120**	**2.331**	**5**	**186**

5.19 Wedge-tailed shearwater (PUPA)

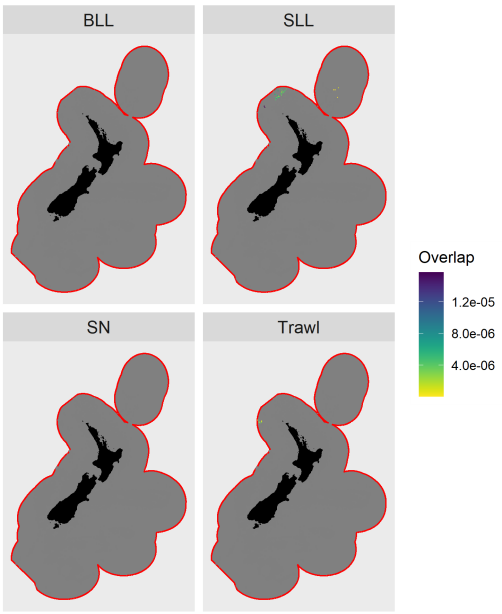

Figure 42: Sum of observed density overlap per method for Wedge-tailed shearwater (PUPA) between 2006/07 and 2019/20, with captures per event.

Table 32: Density overlap and captures for Wedge-tailed shearwater (PUPA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	100	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	30	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.001	0.001	92	-
Trawl	12	Large Freezer	0.000	0.000	-	-
Trawl	13	Large Fresher	0.000	0.000	98	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.001**	**0.002**	**50**	**-**

5.20 Buller's shearwater (XBS)

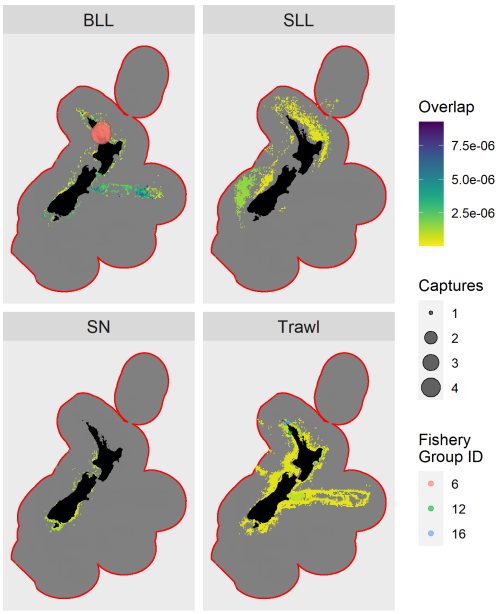

Figure 43: Sum of observed density overlap per method for Buller's shearwater (XBS) between 2006/07 and 2019/20, with captures per event.

Table 33: Density overlap and captures for Buller's shearwater (XBS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.006	0.023	24	-
BLL	2	Large Autoline	0.003	0.037	9	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.020	5	-
BLL	4	Small Autoline	0.000	0.023	2	-
BLL	5	Small Manual (heavy)	0.000	0.044	1	-
BLL	6	Small Manual (light)	0.003	0.112	3	13
BLL	7	Small Manual (LIN, RIB)	0.001	0.044	2	-
SLL	8	Large SLL	0.002	0.003	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.015	8	-
SN	10	SN (unclassified)	0.003	0.102	3	-
Trawl	11	Deepwater	0.006	0.022	27	-
Trawl	12	Large Freezer	0.025	0.079	32	1
Trawl	13	Large Fresher	0.003	0.031	9	-
Trawl	14	Mackerel	0.008	0.013	61	-
Trawl	15	Scampi	0.002	0.025	8	-
Trawl	16	Small inshore (17-28m)	0.007	0.199	4	2
Trawl	17	Small inshore (less than 17m)	0.004	0.220	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.002	0.004	57	-
Total	**-**	**-**	**0.079**	**1.017**	**8**	**16**

5.21 Sooty shearwater (XSH)

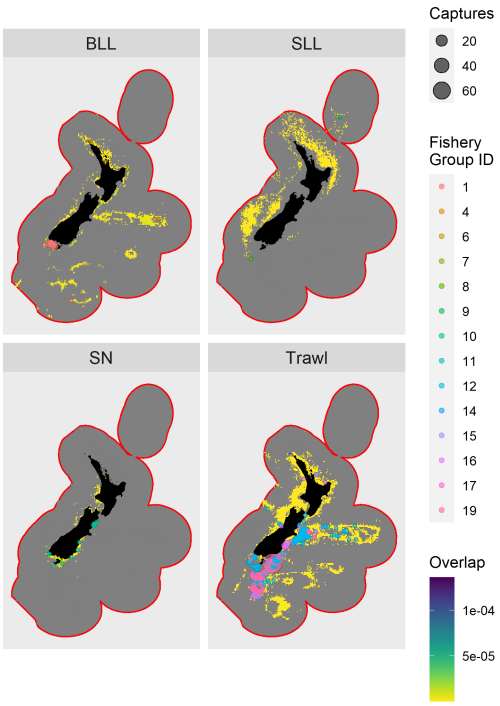

Figure 44: Sum of observed density overlap per method for Sooty shearwater (XSH) between 2006/07 and 2019/20, with captures per event.

Table 34: Density overlap and captures for Sooty shearwater (XSH). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.012	0.064	19	24
BLL	2	Large Autoline	0.002	0.025	10	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.017	5	-
BLL	4	Small Autoline	0.000	0.016	1	1
BLL	5	Small Manual (heavy)	0.000	0.030	1	-
BLL	6	Small Manual (light)	0.002	0.094	2	2
BLL	7	Small Manual (LIN, RIB)	0.001	0.038	3	1
SLL	8	Large SLL	0.001	0.001	93	1
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	10	1
SN	10	SN (unclassified)	0.017	0.253	7	13
Trawl	11	Deepwater	0.004	0.016	26	5
Trawl	12	Large Freezer	0.043	0.107	41	480
Trawl	13	Large Fresher	0.002	0.025	10	-
Trawl	14	Mackerel	0.010	0.015	68	9
Trawl	15	Scampi	0.002	0.023	10	37
Trawl	16	Small inshore (17-28m)	0.006	0.200	3	15
Trawl	17	Small inshore (less than 17m)	0.003	0.252	1	3
Trawl	18	Southern Blue Whiting	0.003	0.005	70	-
Trawl	19	Squid	0.025	0.045	56	781
Total	**-**	**-**	**0.137**	**1.228**	**11**	**1373**

5.22 Fluttering shearwater (XFL)

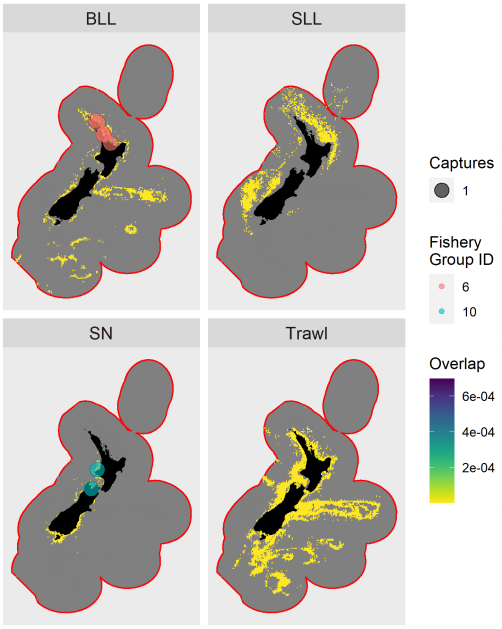

Figure 45: Sum of observed density overlap per method for Fluttering shearwater (XFL) between 2006/07 and 2019/20, with captures per event.

Table 35: Density overlap and captures for Fluttering shearwater (XFL). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.003	0.015	23	-
BLL	2	Large Autoline	0.001	0.009	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	5	-
BLL	4	Small Autoline	0.000	0.006	2	-
BLL	5	Small Manual (heavy)	0.001	0.064	1	-
BLL	6	Small Manual (light)	0.054	1.437	4	5
BLL	7	Small Manual (LIN, RIB)	0.000	0.067	1	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.006	8	-
SN	10	SN (unclassified)	0.001	1.014	-	2
Trawl	11	Deepwater	0.003	0.009	30	-
Trawl	12	Large Freezer	0.008	0.030	25	-
Trawl	13	Large Fresher	0.001	0.015	5	-
Trawl	14	Mackerel	0.002	0.004	63	-
Trawl	15	Scampi	0.015	0.189	8	-
Trawl	16	Small inshore (17-28m)	0.106	0.899	12	-
Trawl	17	Small inshore (less than 17m)	0.012	0.632	2	-
Trawl	18	Southern Blue Whiting	0.001	0.001	67	-
Trawl	19	Squid	0.005	0.008	60	-
Total	**-**	**-**	**0.214**	**4.410**	**5**	**7**

5.23 Hutton's shearwater (XPH)

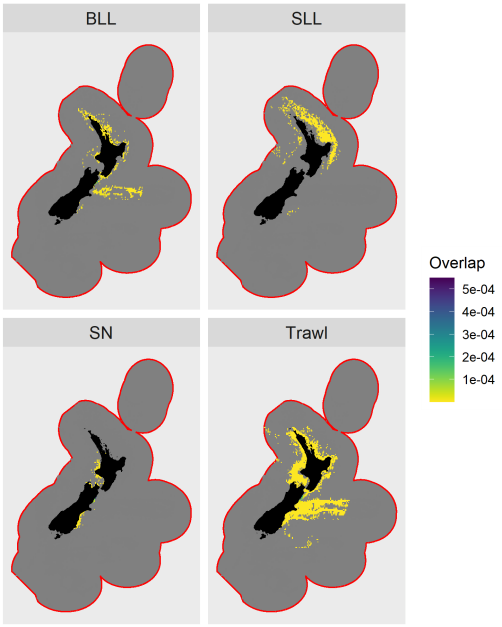

Figure 46: Sum of observed density overlap per method for Hutton's shearwater (XPH) between 2006/07 and 2019/20, with captures per event.

Table 36: Density overlap and captures for Hutton's shearwater (XPH). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.006	24	-
BLL	2	Large Autoline	0.002	0.031	7	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.021	5	-
BLL	4	Small Autoline	0.000	0.011	2	-
BLL	5	Small Manual (heavy)	0.000	0.073	1	-
BLL	6	Small Manual (light)	0.002	0.106	2	-
BLL	7	Small Manual (LIN, RIB)	0.011	0.223	5	-
SLL	8	Large SLL	0.000	0.000	75	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	7	-
SN	10	SN (unclassified)	0.157	4.199	4	-
Trawl	11	Deepwater	0.011	0.135	8	-
Trawl	12	Large Freezer	0.029	0.233	13	-
Trawl	13	Large Fresher	0.006	0.090	6	-
Trawl	14	Mackerel	0.008	0.015	58	-
Trawl	15	Scampi	0.002	0.017	9	-
Trawl	16	Small inshore (17-28m)	0.009	0.522	2	-
Trawl	17	Small inshore (less than 17m)	0.015	0.902	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.002	0.004	50	-
Total	**-**	**-**	**0.258**	**6.594**	**4**	**-**

5.24 Little shearwater (PUAS)

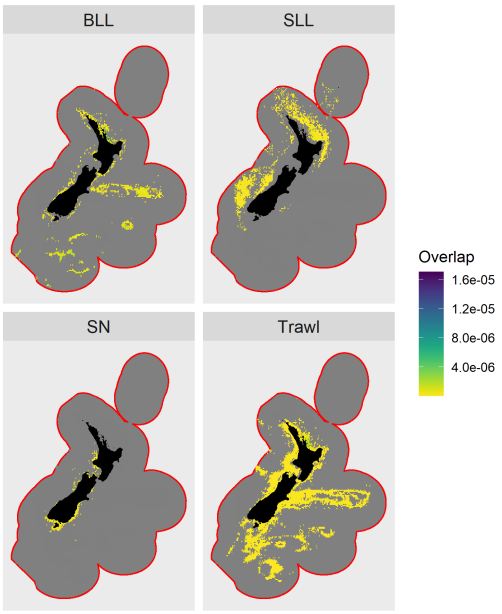

Figure 47: Sum of observed density overlap per method for Little shearwater (PUAS) between 2006/07 and 2019/20, with captures per event.

Table 37: Density overlap and captures for Little shearwater (PUAS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.008	21	-
BLL	2	Large Autoline	0.001	0.008	7	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	3	-
BLL	4	Small Autoline	0.000	0.006	2	-
BLL	5	Small Manual (heavy)	0.000	0.013	1	-
BLL	6	Small Manual (light)	0.003	0.082	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.011	2	-
SLL	8	Large SLL	0.000	0.000	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	8	-
SN	10	SN (unclassified)	0.001	0.047	2	-
Trawl	11	Deepwater	0.002	0.009	26	-
Trawl	12	Large Freezer	0.006	0.020	32	-
Trawl	13	Large Fresher	0.001	0.008	9	-
Trawl	14	Mackerel	0.002	0.004	62	-
Trawl	15	Scampi	0.002	0.017	11	-
Trawl	16	Small inshore (17-28m)	0.004	0.070	6	-
Trawl	17	Small inshore (less than 17m)	0.001	0.054	3	-
Trawl	18	Southern Blue Whiting	0.000	0.001	67	-
Trawl	19	Squid	0.005	0.008	63	-
Total	**-**	**-**	**0.032**	**0.374**	**9**	**-**

5.25 Snares Cape petrel (XCA)

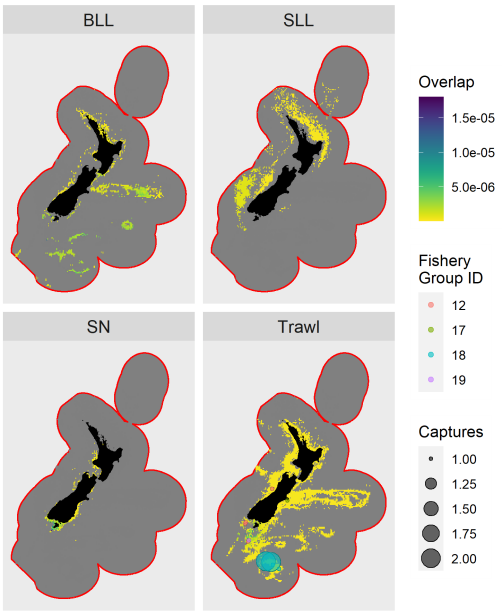

Figure 48: Sum of observed density overlap per method for Snares Cape petrel (XCA) between 2006/07 and 2019/20, with captures per event.

Table 38: Density overlap and captures for Snares Cape petrel (XCA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.007	0.035	20	-
BLL	2	Large Autoline	0.001	0.016	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.009	5	-
BLL	4	Small Autoline	0.000	0.009	2	-
BLL	5	Small Manual (heavy)	0.000	0.014	1	-
BLL	6	Small Manual (light)	0.001	0.033	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.015	3	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.007	9	-
SN	10	SN (unclassified)	0.003	0.046	7	-
Trawl	11	Deepwater	0.004	0.014	31	-
Trawl	12	Large Freezer	0.028	0.067	41	4
Trawl	13	Large Fresher	0.001	0.013	9	-
Trawl	14	Mackerel	0.004	0.007	64	-
Trawl	15	Scampi	0.001	0.013	10	-
Trawl	16	Small inshore (17-28m)	0.003	0.077	3	-
Trawl	17	Small inshore (less than 17m)	0.002	0.095	2	1
Trawl	18	Southern Blue Whiting	0.002	0.003	67	6
Trawl	19	Squid	0.035	0.059	59	1
Total	**-**	**-**	**0.095**	**0.533**	**18**	**12**

5.26 Fairy prion (XFP)

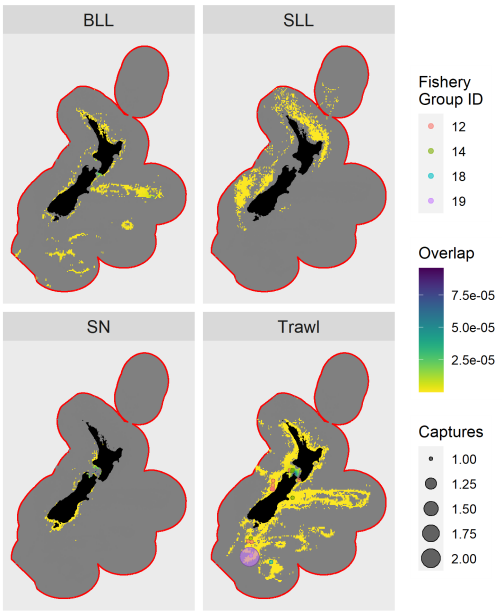

Figure 49: Sum of observed density overlap per method for Fairy prion (XFP) between 2006/07 and 2019/20, with captures per event.

Table 39: Density overlap and captures for Fairy prion (XFP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.005	0.019	28	-
BLL	2	Large Autoline	0.001	0.014	10	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.014	3	-
BLL	4	Small Autoline	0.001	0.039	1	-
BLL	5	Small Manual (heavy)	0.000	0.112	-	-
BLL	6	Small Manual (light)	0.001	0.021	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.018	3	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.004	8	-
SN	10	SN (unclassified)	0.003	0.281	1	-
Trawl	11	Deepwater	0.003	0.013	27	-
Trawl	12	Large Freezer	0.020	0.068	30	12
Trawl	13	Large Fresher	0.008	0.064	13	-
Trawl	14	Mackerel	0.089	0.138	64	4
Trawl	15	Scampi	0.001	0.009	9	-
Trawl	16	Small inshore (17-28m)	0.007	0.547	1	-
Trawl	17	Small inshore (less than 17m)	0.004	0.988	-	-
Trawl	18	Southern Blue Whiting	0.001	0.001	67	1
Trawl	19	Squid	0.004	0.007	62	3
Total	**-**	**-**	**0.151**	**2.358**	**6**	**20**

5.27 Antarctic prion (XPR)

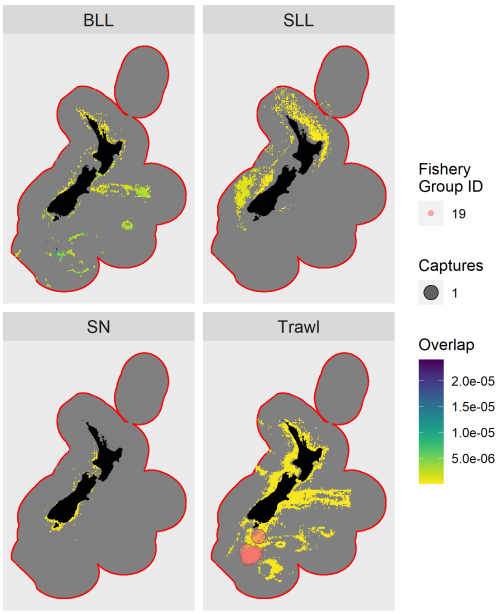

Figure 50: Sum of observed density overlap per method for Antarctic prion (XPR) between 2006/07 and 2019/20, with captures per event.

Table 40: Density overlap and captures for Antarctic prion (XPR). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.009	0.033	27	-
BLL	2	Large Autoline	0.002	0.019	10	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.010	6	-
BLL	4	Small Autoline	0.000	0.006	2	-
BLL	5	Small Manual (heavy)	0.000	0.016	1	-
BLL	6	Small Manual (light)	0.001	0.039	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.018	3	-
SLL	8	Large SLL	0.002	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.008	9	-
SN	10	SN (unclassified)	0.001	0.043	3	-
Trawl	11	Deepwater	0.005	0.015	34	-
Trawl	12	Large Freezer	0.020	0.054	38	-
Trawl	13	Large Fresher	0.001	0.012	11	-
Trawl	14	Mackerel	0.004	0.007	62	-
Trawl	15	Scampi	0.004	0.032	11	-
Trawl	16	Small inshore (17-28m)	0.003	0.082	4	-
Trawl	17	Small inshore (less than 17m)	0.002	0.095	2	-
Trawl	18	Southern Blue Whiting	0.002	0.003	67	-
Trawl	19	Squid	0.066	0.096	68	10
Total	**-**	**-**	**0.125**	**0.591**	**21**	**10**

5.28 Broad-billed prion (XPV)

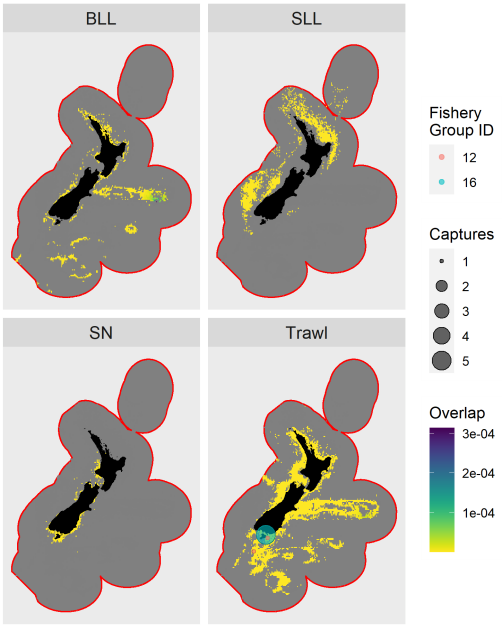

Figure 51: Sum of observed density overlap per method for Broad-billed prion (XPV) between 2006/07 and 2019/20, with captures per event.

Table 41: Density overlap and captures for Broad-billed prion (XPV). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.015	0.041	35	-
BLL	2	Large Autoline	0.006	0.048	13	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.084	1	-
BLL	4	Small Autoline	0.004	0.341	1	-
BLL	5	Small Manual (heavy)	0.000	0.034	-	-
BLL	6	Small Manual (light)	0.001	0.022	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.013	2	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.004	8	-
SN	10	SN (unclassified)	0.001	0.024	4	-
Trawl	11	Deepwater	0.020	0.076	27	-
Trawl	12	Large Freezer	0.016	0.048	33	2
Trawl	13	Large Fresher	0.003	0.052	6	-
Trawl	14	Mackerel	0.004	0.006	69	-
Trawl	15	Scampi	0.002	0.022	9	-
Trawl	16	Small inshore (17-28m)	0.002	0.049	3	5
Trawl	17	Small inshore (less than 17m)	0.001	0.051	2	-
Trawl	18	Southern Blue Whiting	0.001	0.001	67	-
Trawl	19	Squid	0.004	0.006	60	-
Total	**-**	**-**	**0.082**	**0.924**	**9**	**7**

5.29 Pycroft's petrel (PTPY)

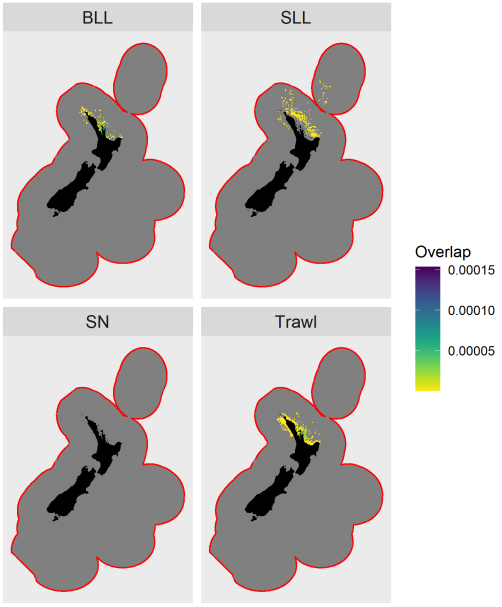

Figure 52: Sum of observed density overlap per method for Pycroft's petrel (PTPY) between 2006/07 and 2019/20, with captures per event.

Table 42: Density overlap and captures for Pycroft's petrel (PTPY). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.001	-	-
BLL	4	Small Autoline	0.000	0.005	-	-
BLL	5	Small Manual (heavy)	0.002	0.080	2	-
BLL	6	Small Manual (light)	0.064	1.316	5	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.018	1	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.002	0.029	6	-
SN	10	SN (unclassified)	0.000	0.385	-	-
Trawl	11	Deepwater	0.002	0.010	16	-
Trawl	12	Large Freezer	0.003	0.008	34	-
Trawl	13	Large Fresher	0.001	0.017	7	-
Trawl	14	Mackerel	0.000	0.000	57	-
Trawl	15	Scampi	0.022	0.179	12	-
Trawl	16	Small inshore (17-28m)	0.035	0.474	7	-
Trawl	17	Small inshore (less than 17m)	0.007	0.220	3	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.136**	**2.741**	**5**	**-**

5.30 Cook's petrel (PTCO)

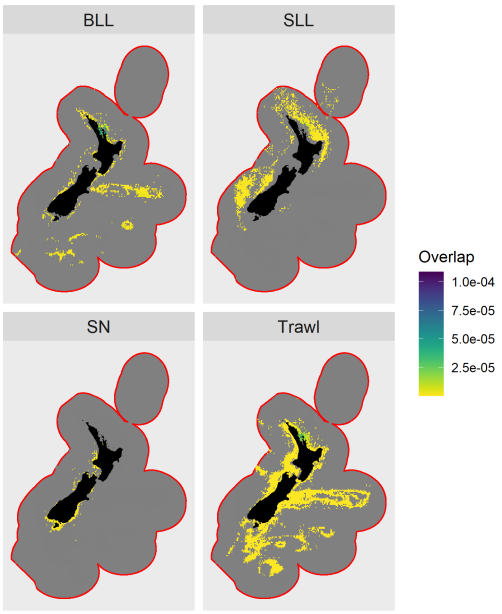

Figure 53: Sum of observed density overlap per method for Cook's petrel (PTCO) between 2006/07 and 2019/20, with captures per event.

Table 43: Density overlap and captures for Cook's petrel (PTCO). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.005	0.025	21	-
BLL	2	Large Autoline	0.001	0.011	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.008	4	-
BLL	4	Small Autoline	0.000	0.013	1	-
BLL	5	Small Manual (heavy)	0.002	0.088	2	-
BLL	6	Small Manual (light)	0.053	1.629	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.018	2	-
SLL	8	Large SLL	0.001	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.002	0.025	8	-
SN	10	SN (unclassified)	0.002	0.347	1	-
Trawl	11	Deepwater	0.004	0.014	28	-
Trawl	12	Large Freezer	0.013	0.038	35	-
Trawl	13	Large Fresher	0.002	0.026	9	-
Trawl	14	Mackerel	0.002	0.004	61	-
Trawl	15	Scampi	0.007	0.065	11	-
Trawl	16	Small inshore (17-28m)	0.054	0.744	7	-
Trawl	17	Small inshore (less than 17m)	0.012	0.521	2	-
Trawl	18	Southern Blue Whiting	0.001	0.001	65	-
Trawl	19	Squid	0.003	0.006	58	-
Total	**-**	**-**	**0.167**	**3.586**	**5**	**-**

5.31 Chatham petrel (PTAX)

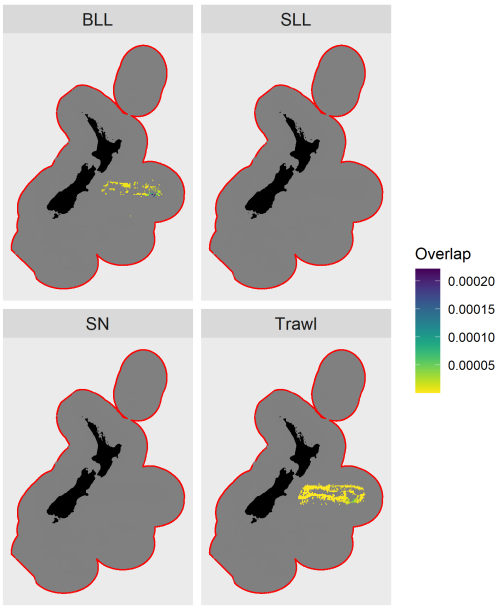

Figure 54: Sum of observed density overlap per method for Chatham petrel (PTAX) between 2006/07 and 2019/20, with captures per event.

Table 44: Density overlap and captures for Chatham petrel (PTAX). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.001	0.002	39	-
BLL	2	Large Autoline	0.002	0.043	5	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.081	-	-
BLL	4	Small Autoline	0.005	0.510	1	-
BLL	5	Small Manual (heavy)	0.000	0.032	-	-
BLL	6	Small Manual (light)	0.000	0.001	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.003	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.018	0.066	27	-
Trawl	12	Large Freezer	0.009	0.042	22	-
Trawl	13	Large Fresher	0.002	0.051	4	-
Trawl	14	Mackerel	0.001	0.002	78	-
Trawl	15	Scampi	0.002	0.021	8	-
Trawl	16	Small inshore (17-28m)	0.000	0.004	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.001	0.001	68	-
Total	**-**	**-**	**0.041**	**0.858**	**5**	**-**

5.32 Mottled petrel (XMP)

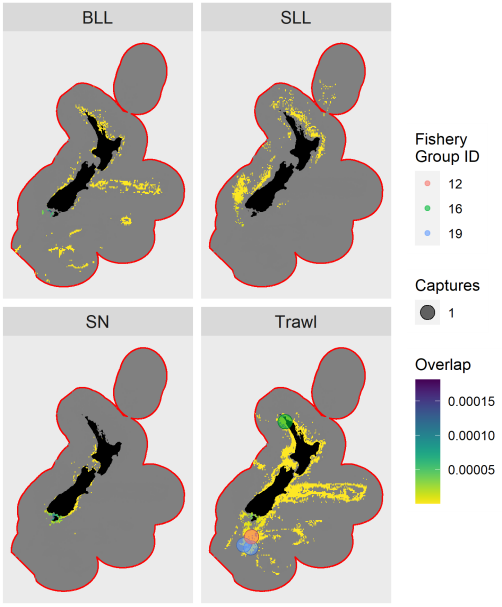

Figure 55: Sum of observed density overlap per method for Mottled petrel (XMP) between 2006/07 and 2019/20, with captures per event.

Table 45: Density overlap and captures for Mottled petrel (XMP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.030	0.274	11	-
BLL	2	Large Autoline	0.000	0.006	5	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.003	2	-
BLL	4	Small Autoline	0.000	0.002	2	-
BLL	5	Small Manual (heavy)	0.000	0.013	-	-
BLL	6	Small Manual (light)	0.000	0.006	4	-
BLL	7	Small Manual (LIN, RIB)	0.002	0.020	11	-
SLL	8	Large SLL	0.001	0.001	87	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	6	-
SN	10	SN (unclassified)	0.034	0.243	14	-
Trawl	11	Deepwater	0.001	0.005	28	-
Trawl	12	Large Freezer	0.038	0.093	41	1
Trawl	13	Large Fresher	0.000	0.018	2	-
Trawl	14	Mackerel	0.004	0.005	74	-
Trawl	15	Scampi	0.000	0.002	9	-
Trawl	16	Small inshore (17-28m)	0.003	0.249	1	1
Trawl	17	Small inshore (less than 17m)	0.006	0.487	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	56	-
Trawl	19	Squid	0.032	0.056	58	2
Total	**-**	**-**	**0.153**	**1.483**	**10**	**4**

5.33 White-naped petrel (PTCE)

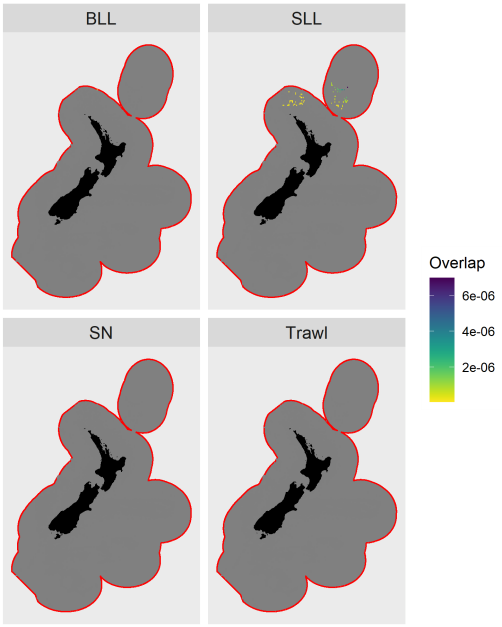

Figure 56: Sum of observed density overlap per method for White-naped petrel (PTCE) between 2006/07 and 2019/20, with captures per event.

Table 46: Density overlap and captures for White-naped petrel (PTCE). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	19	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	25	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.000	0.000	-	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.000**	**0.000**	**23**	**-**

5.34 Kermadec petrel (PTNE)

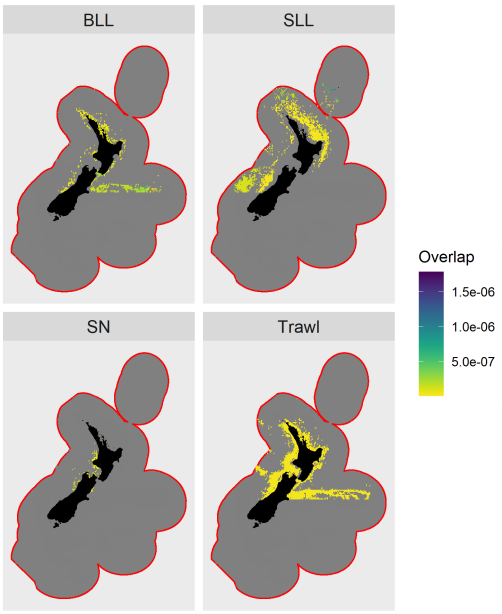

Figure 57: Sum of observed density overlap per method for Kermadec petrel (PTNE) between 2006/07 and 2019/20, with captures per event.

Table 47: Density overlap and captures for Kermadec petrel (PTNE). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.001	22	-
BLL	2	Large Autoline	0.000	0.002	8	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.001	5	-
BLL	4	Small Autoline	0.000	0.001	2	-
BLL	5	Small Manual (heavy)	0.000	0.002	1	-
BLL	6	Small Manual (light)	0.000	0.005	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.002	2	-
SLL	8	Large SLL	0.000	0.000	84	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	9	-
SN	10	SN (unclassified)	0.000	0.005	2	-
Trawl	11	Deepwater	0.000	0.001	27	-
Trawl	12	Large Freezer	0.001	0.003	34	-
Trawl	13	Large Fresher	0.000	0.001	11	-
Trawl	14	Mackerel	0.001	0.001	61	-
Trawl	15	Scampi	0.000	0.001	8	-
Trawl	16	Small inshore (17-28m)	0.000	0.009	4	-
Trawl	17	Small inshore (less than 17m)	0.000	0.008	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	67	-
Total	**-**	**-**	**0.004**	**0.044**	**8**	**-**

5.35 Grey-faced petrel (XGF)

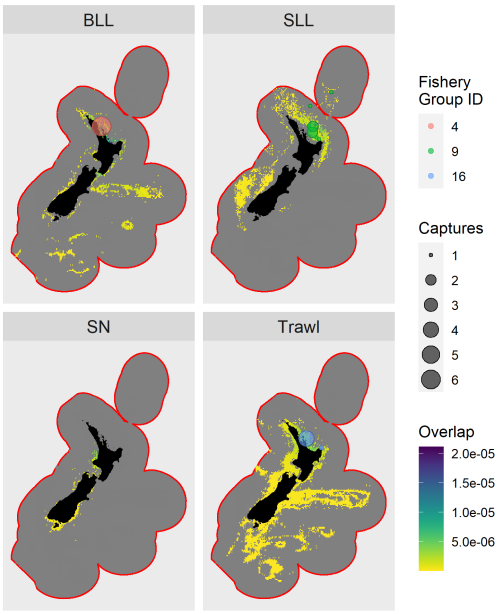

Figure 58: Sum of observed density overlap per method for Grey-faced petrel (XGF) between 2006/07 and 2019/20, with captures per event.

Table 48: Density overlap and captures for Grey-faced petrel (XGF). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.011	19	-
BLL	2	Large Autoline	0.001	0.013	7	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.008	4	-
BLL	4	Small Autoline	0.000	0.017	2	6
BLL	5	Small Manual (heavy)	0.001	0.079	1	-
BLL	6	Small Manual (light)	0.013	0.425	3	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.057	1	-
SLL	8	Large SLL	0.001	0.001	81	-
SLL	9	Small SLL (tuna and swordfish)	0.003	0.038	8	9
SN	10	SN (unclassified)	0.003	0.216	1	-
Trawl	11	Deepwater	0.006	0.025	22	-
Trawl	12	Large Freezer	0.010	0.033	30	-
Trawl	13	Large Fresher	0.005	0.047	11	-
Trawl	14	Mackerel	0.013	0.022	60	-
Trawl	15	Scampi	0.005	0.054	10	-
Trawl	16	Small inshore (17-28m)	0.023	0.390	6	6
Trawl	17	Small inshore (less than 17m)	0.011	0.286	4	-
Trawl	18	Southern Blue Whiting	0.000	0.000	59	-
Trawl	19	Squid	0.003	0.005	62	-
Total	**-**	**-**	**0.102**	**1.724**	**6**	**21**

5.36 Chatham Island taiko (PTMA)

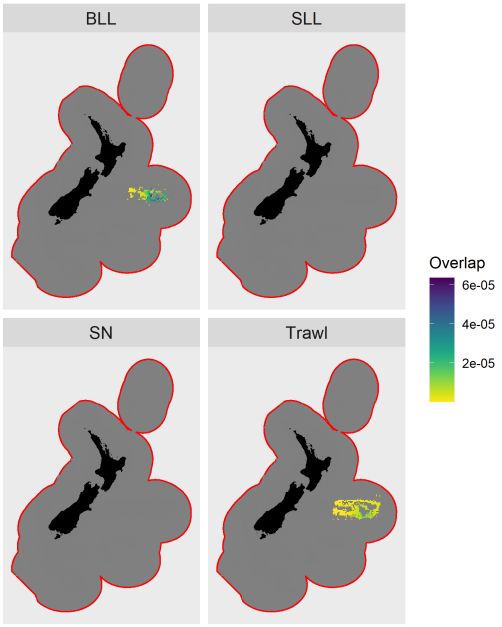

Figure 59: Sum of observed density overlap per method for Chatham Island taiko (PTMA) between 2006/07 and 2019/20, with captures per event.

Table 49: Density overlap and captures for Chatham Island taiko (PTMA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.012	0.045	27	-
BLL	2	Large Autoline	0.007	0.051	14	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.070	2	-
BLL	4	Small Autoline	0.003	0.191	2	-
BLL	5	Small Manual (heavy)	0.000	0.018	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.003	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.023	0.084	28	-
Trawl	12	Large Freezer	0.010	0.034	30	-
Trawl	13	Large Fresher	0.002	0.034	5	-
Trawl	14	Mackerel	0.002	0.002	81	-
Trawl	15	Scampi	0.002	0.019	9	-
Trawl	16	Small inshore (17-28m)	0.000	0.004	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	18	-
Total	**-**	**-**	**0.063**	**0.557**	**11**	**-**

5.37 White-headed petrel (XWH)

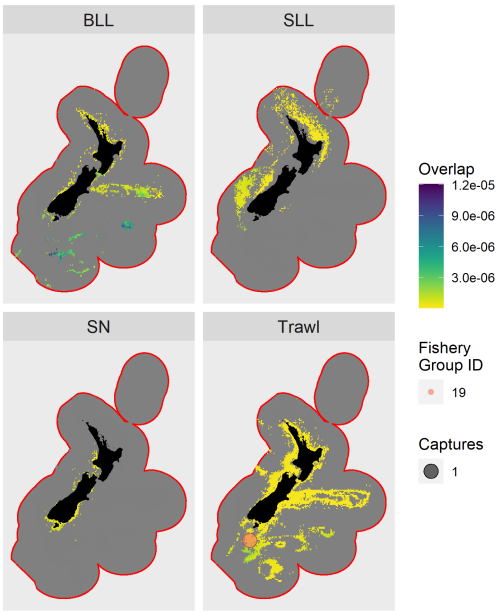

Figure 60: Sum of observed density overlap per method for White-headed petrel (XWH) between 2006/07 and 2019/20, with captures per event.

Table 50: Density overlap and captures for White-headed petrel (XWH). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.008	0.034	25	-
BLL	2	Large Autoline	0.001	0.013	10	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.007	4	-
BLL	4	Small Autoline	0.000	0.007	2	-
BLL	5	Small Manual (heavy)	0.000	0.011	1	-
BLL	6	Small Manual (light)	0.001	0.025	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.011	3	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	9	-
SN	10	SN (unclassified)	0.001	0.029	4	-
Trawl	11	Deepwater	0.005	0.014	36	-
Trawl	12	Large Freezer	0.016	0.043	38	-
Trawl	13	Large Fresher	0.001	0.009	10	-
Trawl	14	Mackerel	0.003	0.005	63	-
Trawl	15	Scampi	0.003	0.029	10	-
Trawl	16	Small inshore (17-28m)	0.002	0.054	3	-
Trawl	17	Small inshore (less than 17m)	0.001	0.065	2	-
Trawl	18	Southern Blue Whiting	0.003	0.004	65	-
Trawl	19	Squid	0.026	0.041	63	1
Total	**-**	**-**	**0.074**	**0.409**	**18**	**1**

5.38 Soft-plumaged petrel (PTMO)

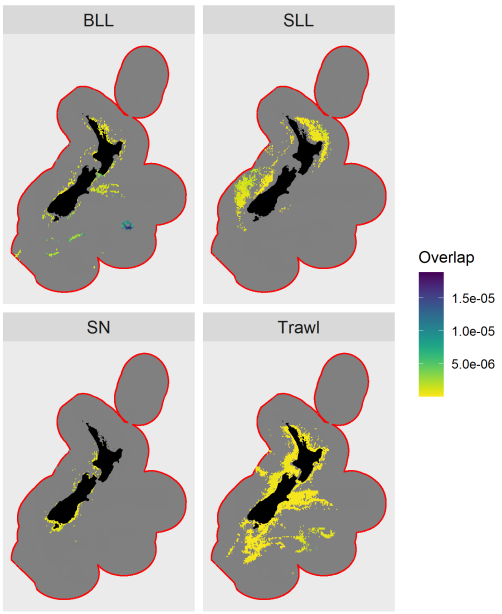

Figure 61: Sum of observed density overlap per method for Soft-plumaged petrel (PTMO) between 2006/07 and 2019/20, with captures per event.

Table 51: Density overlap and captures for Soft-plumaged petrel (PTMO). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.008	0.032	24	-
BLL	2	Large Autoline	0.001	0.009	7	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	6	-
BLL	4	Small Autoline	0.000	0.004	2	-
BLL	5	Small Manual (heavy)	0.000	0.015	1	-
BLL	6	Small Manual (light)	0.001	0.037	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.019	2	-
SLL	8	Large SLL	0.002	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.008	10	-
SN	10	SN (unclassified)	0.002	0.047	4	-
Trawl	11	Deepwater	0.005	0.014	36	-
Trawl	12	Large Freezer	0.019	0.050	38	-
Trawl	13	Large Fresher	0.001	0.012	12	-
Trawl	14	Mackerel	0.004	0.007	60	-
Trawl	15	Scampi	0.002	0.017	10	-
Trawl	16	Small inshore (17-28m)	0.003	0.088	3	-
Trawl	17	Small inshore (less than 17m)	0.002	0.106	2	-
Trawl	18	Southern Blue Whiting	0.001	0.001	52	-
Trawl	19	Squid	0.006	0.010	60	-
Total	**-**	**-**	**0.057**	**0.482**	**12**	**-**

5.39 Common diving petrel (XDP)

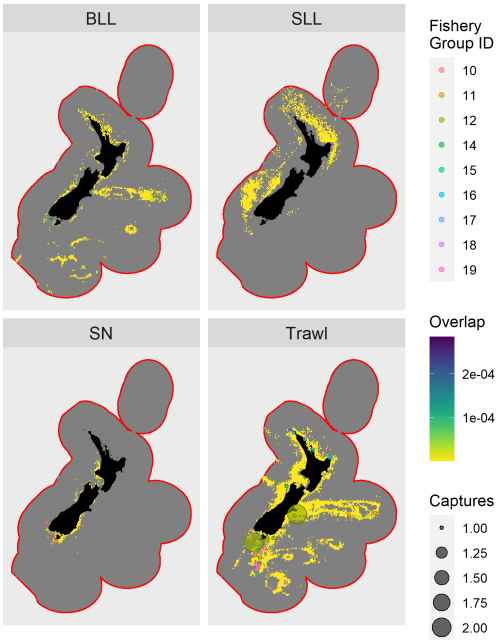

Figure 62: Sum of observed density overlap per method for Common diving petrel (XDP) between 2006/07 and 2019/20, with captures per event.

Table 52: Density overlap and captures for Common diving petrel (XDP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.047	0.313	15	-
BLL	2	Large Autoline	0.003	0.025	10	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.036	1	-
BLL	4	Small Autoline	0.002	0.121	2	-
BLL	5	Small Manual (heavy)	0.000	0.032	1	-
BLL	6	Small Manual (light)	0.003	0.135	3	-
BLL	7	Small Manual (LIN, RIB)	0.002	0.027	8	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.005	8	-
SN	10	SN (unclassified)	0.013	0.143	9	3
Trawl	11	Deepwater	0.009	0.031	28	2
Trawl	12	Large Freezer	0.019	0.060	32	13
Trawl	13	Large Fresher	0.002	0.038	6	-
Trawl	14	Mackerel	0.003	0.004	67	2
Trawl	15	Scampi	0.001	0.014	9	2
Trawl	16	Small inshore (17-28m)	0.005	0.215	2	4
Trawl	17	Small inshore (less than 17m)	0.003	0.317	1	1
Trawl	18	Southern Blue Whiting	0.001	0.001	63	1
Trawl	19	Squid	0.007	0.011	63	10
Total	**-**	**-**	**0.122**	**1.529**	**8**	**38**

5.40 Whenua Hou diving petrel (XSD)

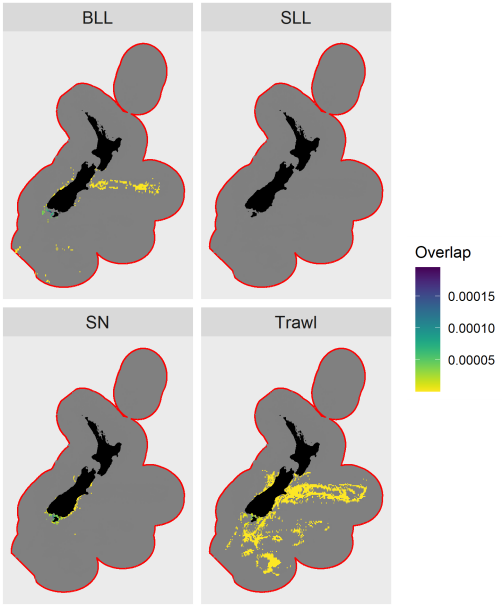

Figure 63: Sum of observed density overlap per method for Whenua Hou diving petrel (XSD) between 2006/07 and 2019/20, with captures per event.

Table 53: Density overlap and captures for Whenua Hou diving petrel (XSD). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.033	0.295	11	-
BLL	2	Large Autoline	0.000	0.006	6	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	1	-
BLL	4	Small Autoline	0.000	0.001	3	-
BLL	5	Small Manual (heavy)	0.000	0.007	6	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.003	0.016	19	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.023	0.171	14	-
Trawl	11	Deepwater	0.001	0.004	27	-
Trawl	12	Large Freezer	0.029	0.076	38	-
Trawl	13	Large Fresher	0.000	0.019	1	-
Trawl	14	Mackerel	0.000	0.001	76	-
Trawl	15	Scampi	0.000	0.002	8	-
Trawl	16	Small inshore (17-28m)	0.001	0.206	1	-
Trawl	17	Small inshore (less than 17m)	0.005	0.385	1	-
Trawl	18	Southern Blue Whiting	0.001	0.001	71	-
Trawl	19	Squid	0.005	0.010	47	-
Total	**-**	**-**	**0.102**	**1.203**	**8**	**-**

5.41 New Zealand white-faced storm petrel (XWF)

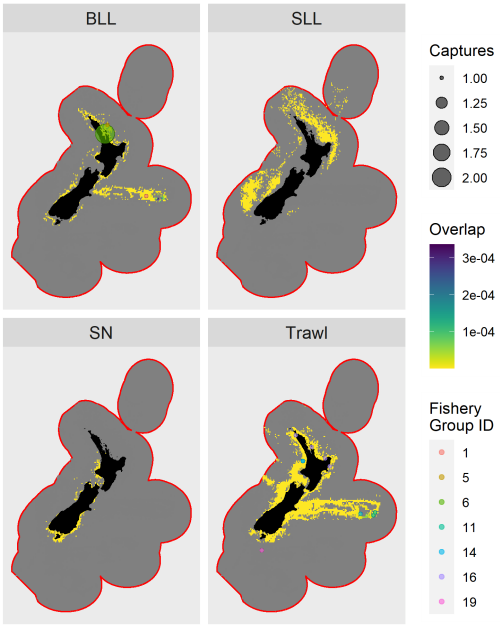

Figure 64: Sum of observed density overlap per method for New Zealand white-faced storm petrel (XWF) between 2006/07 and 2019/20, with captures per event.

Table 54: Density overlap and captures for New Zealand white-faced storm petrel (XWF). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.006	30	1
BLL	2	Large Autoline	0.000	0.022	2	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.103	1	-
BLL	4	Small Autoline	0.007	0.564	1	-
BLL	5	Small Manual (heavy)	0.000	0.050	-	1
BLL	6	Small Manual (light)	0.001	0.035	3	2
BLL	7	Small Manual (LIN, RIB)	0.000	0.011	1	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.003	10	-
SN	10	SN (unclassified)	0.000	0.020	2	-
Trawl	11	Deepwater	0.020	0.082	24	2
Trawl	12	Large Freezer	0.011	0.033	34	-
Trawl	13	Large Fresher	0.004	0.068	5	-
Trawl	14	Mackerel	0.003	0.004	73	3
Trawl	15	Scampi	0.002	0.017	10	-
Trawl	16	Small inshore (17-28m)	0.002	0.035	5	4
Trawl	17	Small inshore (less than 17m)	0.000	0.029	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	53	1
Total	**-**	**-**	**0.055**	**1.085**	**5**	**14**

5.42 White-bellied storm petrel (XWB)

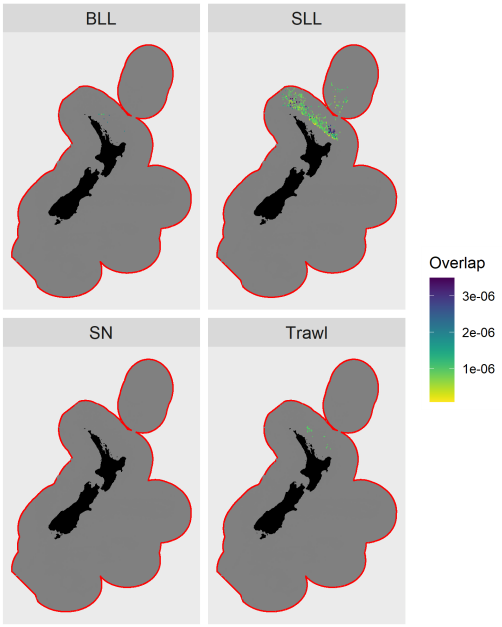

Figure 65: Sum of observed density overlap per method for White-bellied storm petrel (XWB) between 2006/07 and 2019/20, with captures per event.

Table 55: Density overlap and captures for White-bellied storm petrel (XWB). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.001	1	-
BLL	6	Small Manual (light)	0.000	0.000	4	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	81	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.006	11	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	37	-
Trawl	12	Large Freezer	0.000	0.000	6	-
Trawl	13	Large Fresher	0.000	0.000	37	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	10	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	3	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.001**	**0.009**	**13**	**-**

5.43 Black-bellied storm petrel (XFT)

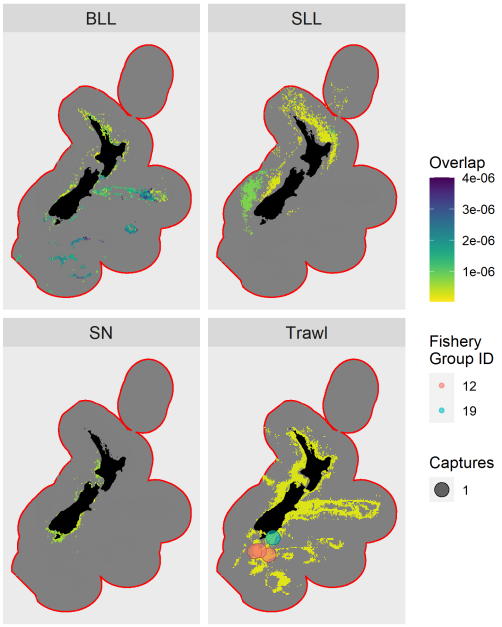

Figure 66: Sum of observed density overlap per method for Black-bellied storm petrel (XFT) between 2006/07 and 2019/20, with captures per event.

Table 56: Density overlap and captures for Black-bellied storm petrel (XFT). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.005	0.023	23	-
BLL	2	Large Autoline	0.002	0.018	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.010	5	-
BLL	4	Small Autoline	0.000	0.011	2	-
BLL	5	Small Manual (heavy)	0.000	0.018	1	-
BLL	6	Small Manual (light)	0.001	0.041	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.017	2	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.008	8	-
SN	10	SN (unclassified)	0.002	0.045	4	-
Trawl	11	Deepwater	0.005	0.015	30	-
Trawl	12	Large Freezer	0.014	0.042	34	3
Trawl	13	Large Fresher	0.001	0.013	10	-
Trawl	14	Mackerel	0.004	0.007	62	-
Trawl	15	Scampi	0.001	0.015	9	-
Trawl	16	Small inshore (17-28m)	0.003	0.083	4	-
Trawl	17	Small inshore (less than 17m)	0.002	0.093	2	-
Trawl	18	Southern Blue Whiting	0.001	0.002	67	-
Trawl	19	Squid	0.006	0.010	60	1
Total	**-**	**-**	**0.052**	**0.473**	**11**	**4**

5.44 Kermadec storm petrel (PEAL)

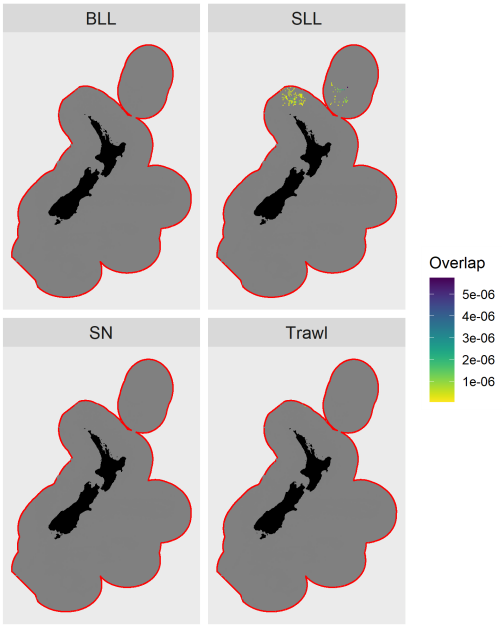

Figure 67: Sum of observed density overlap per method for Kermadec storm petrel (PEAL) between 2006/07 and 2019/20, with captures per event.

Table 57: Density overlap and captures for Kermadec storm petrel (PEAL). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	19	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	75	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	13	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.000	0.000	-	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	100	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.000**	**0.001**	**13**	**-**

5.45 New Zealand storm petrel (PEMA)

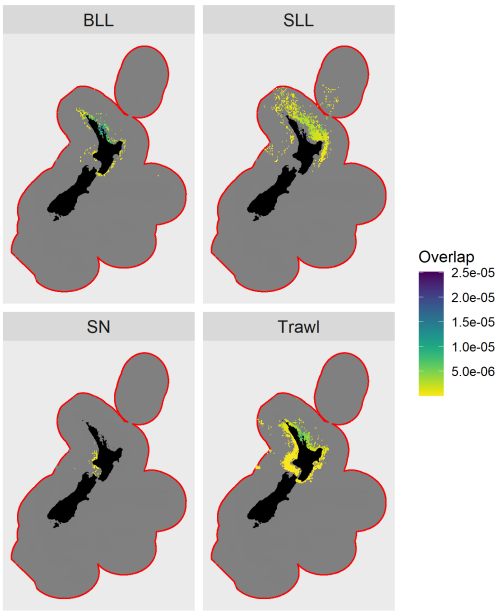

Figure 68: Sum of observed density overlap per method for New Zealand storm petrel (PEMA) between 2006/07 and 2019/20, with captures per event.

Table 58: Density overlap and captures for New Zealand storm petrel (PEMA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.001	10	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.002	3	-
BLL	4	Small Autoline	0.000	0.010	4	-
BLL	5	Small Manual (heavy)	0.002	0.075	2	-
BLL	6	Small Manual (light)	0.017	0.584	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.030	1	-
SLL	8	Large SLL	0.000	0.000	78	-
SLL	9	Small SLL (tuna and swordfish)	0.003	0.040	8	-
SN	10	SN (unclassified)	0.001	0.206	-	-
Trawl	11	Deepwater	0.004	0.016	25	-
Trawl	12	Large Freezer	0.001	0.005	26	-
Trawl	13	Large Fresher	0.003	0.025	13	-
Trawl	14	Mackerel	0.003	0.005	59	-
Trawl	15	Scampi	0.004	0.038	10	-
Trawl	16	Small inshore (17-28m)	0.023	0.314	7	-
Trawl	17	Small inshore (less than 17m)	0.005	0.180	3	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.066**	**1.530**	**4**	**-**

5.46 Yellow-eyed penguin (XYP)

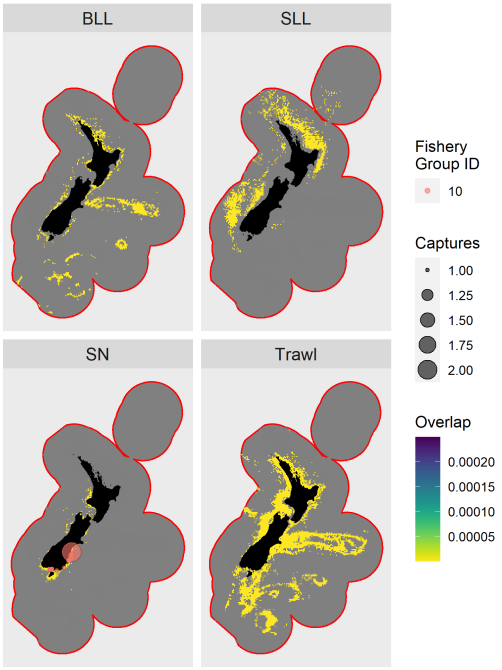

Figure 69: Sum of observed density overlap per method for Yellow-eyed penguin (XYP) between 2006/07 and 2019/20, with captures per event.

Table 59: Density overlap and captures for Yellow-eyed penguin (XYP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	3	-
BLL	2	Large Autoline	0.000	0.000	2	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.001	3	-
SLL	8	Large SLL	0.000	0.000	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.019	0.150	13	17
Trawl	11	Deepwater	0.000	0.000	21	-
Trawl	12	Large Freezer	0.000	0.003	9	-
Trawl	13	Large Fresher	0.000	0.004	-	-
Trawl	14	Mackerel	0.000	0.000	63	-
Trawl	15	Scampi	0.000	0.000	21	-
Trawl	16	Small inshore (17-28m)	0.001	0.144	1	-
Trawl	17	Small inshore (less than 17m)	0.019	1.655	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	92	-
Trawl	19	Squid	0.002	0.003	54	-
Total	**-**	**-**	**0.041**	**1.962**	**2**	**17**

5.47 Northern little penguin (EUIR)

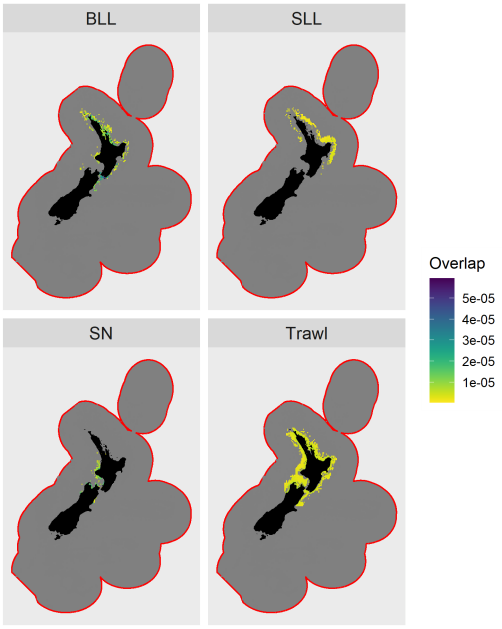

Figure 70: Sum of observed density overlap per method for Northern little penguin (EUIR) between 2006/07 and 2019/20, with captures per event.

Table 60: Density overlap and captures for Northern little penguin (EUIR). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.003	0.017	20	-
BLL	2	Large Autoline	0.000	0.001	9	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.013	6	-
BLL	4	Small Autoline	0.001	0.038	2	-
BLL	5	Small Manual (heavy)	0.002	0.161	1	-
BLL	6	Small Manual (light)	0.030	0.948	3	-
BLL	7	Small Manual (LIN, RIB)	0.002	0.128	2	-
SLL	8	Large SLL	0.000	0.000	68	-
SLL	9	Small SLL (tuna and swordfish)	0.003	0.042	6	-
SN	10	SN (unclassified)	0.020	0.910	2	-
Trawl	11	Deepwater	0.007	0.041	17	-
Trawl	12	Large Freezer	0.012	0.064	19	-
Trawl	13	Large Fresher	0.018	0.175	10	-
Trawl	14	Mackerel	0.032	0.053	60	-
Trawl	15	Scampi	0.006	0.066	9	-
Trawl	16	Small inshore (17-28m)	0.048	1.047	5	-
Trawl	17	Small inshore (less than 17m)	0.027	1.131	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	57	-
Total	**-**	**-**	**0.211**	**4.836**	**4**	**-**

5.48 White-flippered little penguin (EUAL)

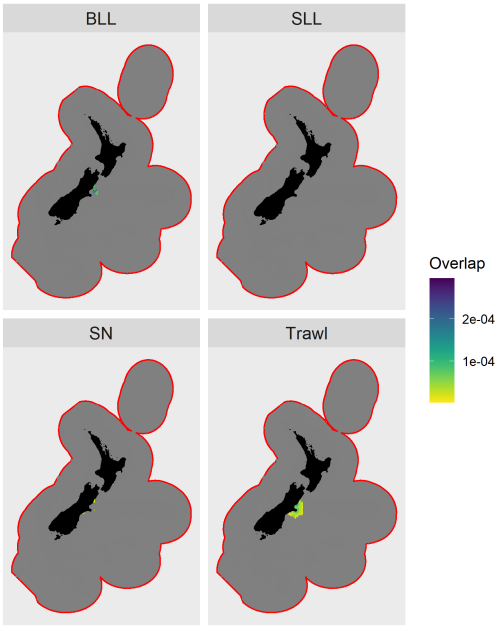

Figure 71: Sum of observed density overlap per method for White-flippered little penguin (EUAL) between 2006/07 and 2019/20, with captures per event.

Table 61: Density overlap and captures for White-flippered little penguin (EUAL). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.003	0.003	100	-
BLL	2	Large Autoline	0.005	0.059	8	-
BLL	3	Small Autoline (LIN, RIB)	0.007	0.066	11	-
BLL	4	Small Autoline	0.000	0.002	-	-
BLL	5	Small Manual (heavy)	0.001	0.010	11	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.007	0.225	3	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.012	0.720	2	-
Trawl	11	Deepwater	0.003	0.038	8	-
Trawl	12	Large Freezer	0.149	0.454	33	-
Trawl	13	Large Fresher	0.000	0.014	1	-
Trawl	14	Mackerel	0.018	0.024	76	-
Trawl	15	Scampi	0.000	0.001	13	-
Trawl	16	Small inshore (17-28m)	0.030	1.528	2	-
Trawl	17	Small inshore (less than 17m)	0.027	1.730	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.004	0.018	25	-
Total	**-**	**-**	**0.268**	**4.893**	**5**	**-**

5.49 Southern little penguin (EUMI)

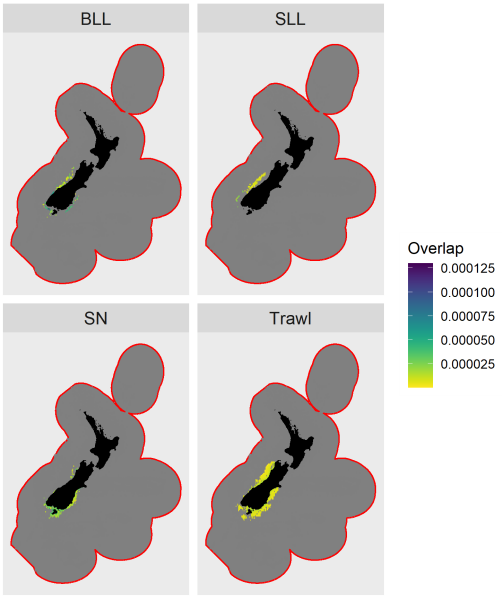

Figure 72: Sum of observed density overlap per method for Southern little penguin (EUMI) between 2006/07 and 2019/20, with captures per event.

Table 62: Density overlap and captures for Southern little penguin (EUMI). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.016	0.123	13	-
BLL	2	Large Autoline	0.000	0.002	2	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.002	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.001	0.057	1	-
BLL	6	Small Manual (light)	0.000	0.001	-	-
BLL	7	Small Manual (LIN, RIB)	0.008	0.214	4	-
SLL	8	Large SLL	0.001	0.001	94	-
SLL	9	Small SLL (tuna and swordfish)	0.002	0.012	14	-
SN	10	SN (unclassified)	0.043	0.426	10	-
Trawl	11	Deepwater	0.002	0.007	31	-
Trawl	12	Large Freezer	0.106	0.236	45	-
Trawl	13	Large Fresher	0.001	0.028	5	-
Trawl	14	Mackerel	0.009	0.014	65	-
Trawl	15	Scampi	0.000	0.000	2	-
Trawl	16	Small inshore (17-28m)	0.017	1.025	2	-
Trawl	17	Small inshore (less than 17m)	0.022	1.968	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.014	0.024	57	-
Total	**-**	**-**	**0.242**	**4.140**	**6**	**-**

5.50 Chatham Island little penguin (EUCH)

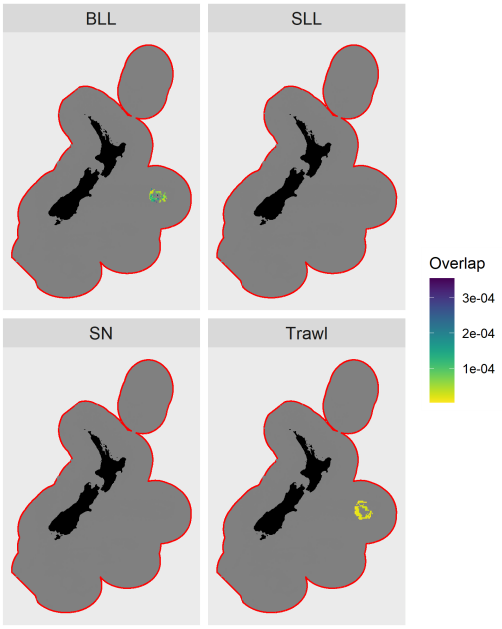

Figure 73: Sum of observed density overlap per method for Chatham Island little penguin (EUCH) between 2006/07 and 2019/20, with captures per event.

Table 63: Density overlap and captures for Chatham Island little penguin (EUCH). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.021	0.041	52	-
BLL	2	Large Autoline	0.008	0.058	15	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.147	-	-
BLL	4	Small Autoline	0.012	0.707	2	-
BLL	5	Small Manual (heavy)	0.000	0.066	-	-
BLL	6	Small Manual (light)	0.000	0.002	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.006	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.016	0.049	32	-
Trawl	12	Large Freezer	0.024	0.064	37	-
Trawl	13	Large Fresher	0.004	0.098	4	-
Trawl	14	Mackerel	0.005	0.007	82	-
Trawl	15	Scampi	0.007	0.083	9	-
Trawl	16	Small inshore (17-28m)	0.000	0.019	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.097**	**1.347**	**7**	**-**

5.51 Eastern rockhopper penguin (EUFI)

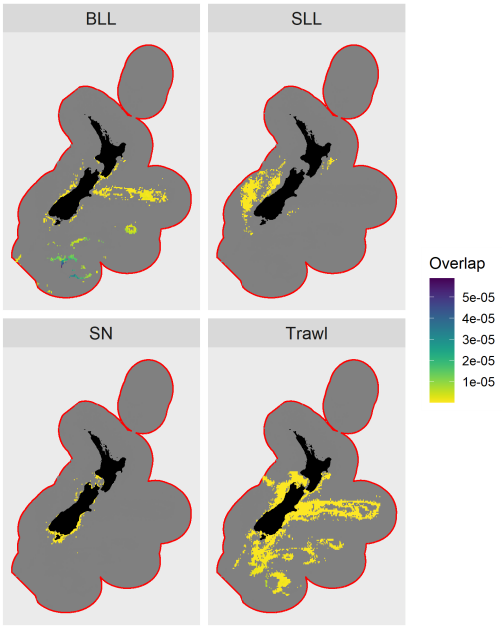

Figure 74: Sum of observed density overlap per method for Eastern rockhopper penguin (EUFI) between 2006/07 and 2019/20, with captures per event.

Table 64: Density overlap and captures for Eastern rockhopper penguin (EUFI). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.014	0.057	25	-
BLL	2	Large Autoline	0.002	0.011	16	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	4	-
BLL	4	Small Autoline	0.000	0.003	1	-
BLL	5	Small Manual (heavy)	0.000	0.003	1	-
BLL	6	Small Manual (light)	0.000	0.000	1	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.004	3	-
SLL	8	Large SLL	0.000	0.001	87	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	10	-
SN	10	SN (unclassified)	0.000	0.007	5	-
Trawl	11	Deepwater	0.003	0.008	38	-
Trawl	12	Large Freezer	0.011	0.029	39	-
Trawl	13	Large Fresher	0.000	0.003	9	-
Trawl	14	Mackerel	0.001	0.002	65	-
Trawl	15	Scampi	0.003	0.027	12	-
Trawl	16	Small inshore (17-28m)	0.000	0.017	2	-
Trawl	17	Small inshore (less than 17m)	0.000	0.027	1	-
Trawl	18	Southern Blue Whiting	0.005	0.008	67	-
Trawl	19	Squid	0.021	0.034	63	-
Total	**-**	**-**	**0.063**	**0.248**	**26**	**-**

5.52 Fiordland crested penguin (XFC)

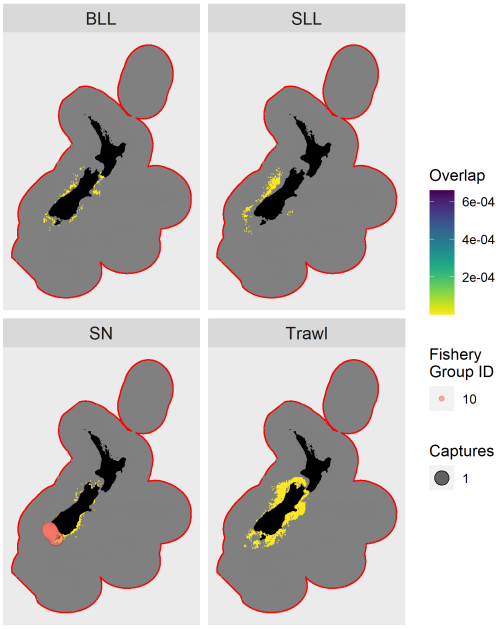

Figure 75: Sum of observed density overlap per method for Fiordland crested penguin (XFC) between 2006/07 and 2019/20, with captures per event.

Table 65: Density overlap and captures for Fiordland crested penguin (XFC). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.006	0.031	21	-
BLL	2	Large Autoline	0.001	0.013	6	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.006	11	-
BLL	4	Small Autoline	0.000	0.001	2	-
BLL	5	Small Manual (heavy)	0.002	0.185	1	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.011	0.512	2	-
SLL	8	Large SLL	0.001	0.001	92	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.011	13	-
SN	10	SN (unclassified)	0.032	0.265	12	5
Trawl	11	Deepwater	0.002	0.010	17	-
Trawl	12	Large Freezer	0.057	0.154	37	-
Trawl	13	Large Fresher	0.003	0.028	12	-
Trawl	14	Mackerel	0.013	0.020	64	-
Trawl	15	Scampi	0.000	0.000	2	-
Trawl	16	Small inshore (17-28m)	0.017	1.134	1	-
Trawl	17	Small inshore (less than 17m)	0.007	1.018	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.006	0.012	53	-
Total	**-**	**-**	**0.161**	**3.402**	**5**	**5**

5.53 Snares crested penguin (EURO)

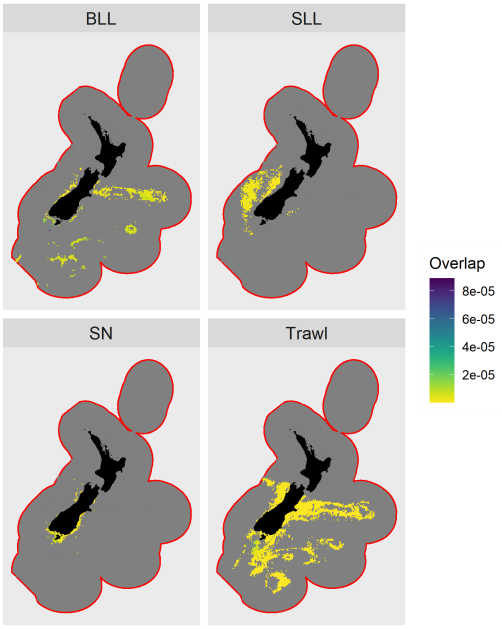

Figure 76: Sum of observed density overlap per method for Snares crested penguin (EURO) between 2006/07 and 2019/20, with captures per event.

Table 66: Density overlap and captures for Snares crested penguin (EURO). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.014	0.061	23	-
BLL	2	Large Autoline	0.003	0.031	10	-
BLL	3	Small Autoline (LIN, RIB)	0.001	0.016	5	-
BLL	4	Small Autoline	0.000	0.014	2	-
BLL	5	Small Manual (heavy)	0.000	0.007	4	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.018	4	-
SLL	8	Large SLL	0.003	0.003	86	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.003	11	-
SN	10	SN (unclassified)	0.003	0.036	8	-
Trawl	11	Deepwater	0.005	0.016	33	-
Trawl	12	Large Freezer	0.051	0.130	40	-
Trawl	13	Large Fresher	0.000	0.008	6	-
Trawl	14	Mackerel	0.004	0.005	71	-
Trawl	15	Scampi	0.002	0.021	10	-
Trawl	16	Small inshore (17-28m)	0.001	0.070	1	-
Trawl	17	Small inshore (less than 17m)	0.001	0.096	1	-
Trawl	18	Southern Blue Whiting	0.003	0.004	65	-
Trawl	19	Squid	0.043	0.074	59	-
Total	**-**	**-**	**0.136**	**0.613**	**22**	**-**

5.54 Erect-crested penguin (EUSC)

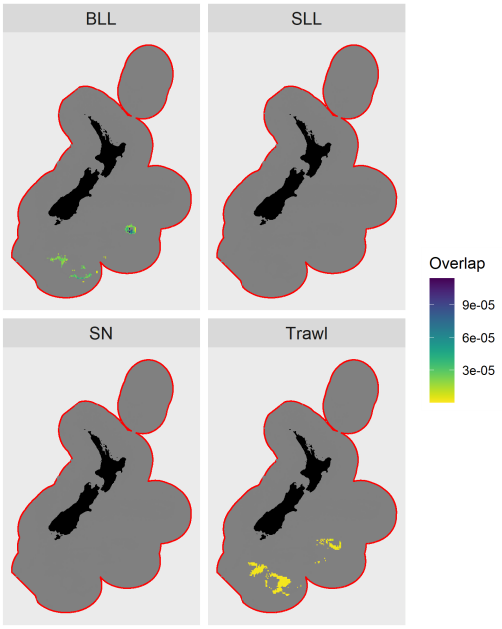

Figure 77: Sum of observed density overlap per method for Erect-crested penguin (EUSC) between 2006/07 and 2019/20, with captures per event.

Table 67: Density overlap and captures for Erect-crested penguin (EUSC). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.027	0.156	17	-
BLL	2	Large Autoline	0.000	0.001	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.001	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.003	0.006	43	-
Trawl	12	Large Freezer	0.001	0.002	43	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.006	0.043	13	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	17	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.010	0.016	63	-
Trawl	19	Squid	0.019	0.030	62	-
Total	**-**	**-**	**0.064**	**0.254**	**25**	**-**

5.55 Australasian gannet (XGT)

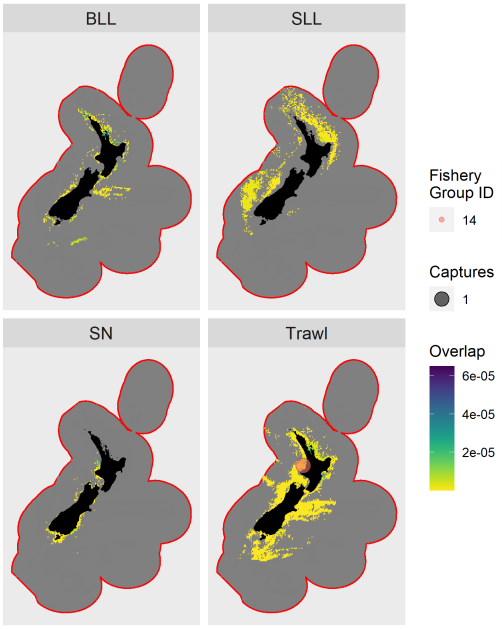

Figure 78: Sum of observed density overlap per method for Australasian gannet (XGT) between 2006/07 and 2019/20, with captures per event.

Table 68: Density overlap and captures for Australasian gannet (XGT). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.012	18	-
BLL	2	Large Autoline	0.001	0.011	5	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.006	7	-
BLL	4	Small Autoline	0.001	0.030	2	-
BLL	5	Small Manual (heavy)	0.002	0.113	2	-
BLL	6	Small Manual (light)	0.038	1.058	4	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.070	1	-
SLL	8	Large SLL	0.003	0.003	86	-
SLL	9	Small SLL (tuna and swordfish)	0.002	0.022	8	-
SN	10	SN (unclassified)	0.004	0.553	1	-
Trawl	11	Deepwater	0.005	0.021	22	-
Trawl	12	Large Freezer	0.021	0.056	37	-
Trawl	13	Large Fresher	0.004	0.077	5	-
Trawl	14	Mackerel	0.015	0.025	61	1
Trawl	15	Scampi	0.006	0.108	6	-
Trawl	16	Small inshore (17-28m)	0.031	0.618	5	-
Trawl	17	Small inshore (less than 17m)	0.037	1.158	3	-
Trawl	18	Southern Blue Whiting	0.000	0.000	61	-
Trawl	19	Squid	0.006	0.010	55	-
Total	**-**	**-**	**0.178**	**3.955**	**4**	**1**

5.56 Masked booby (XMB)

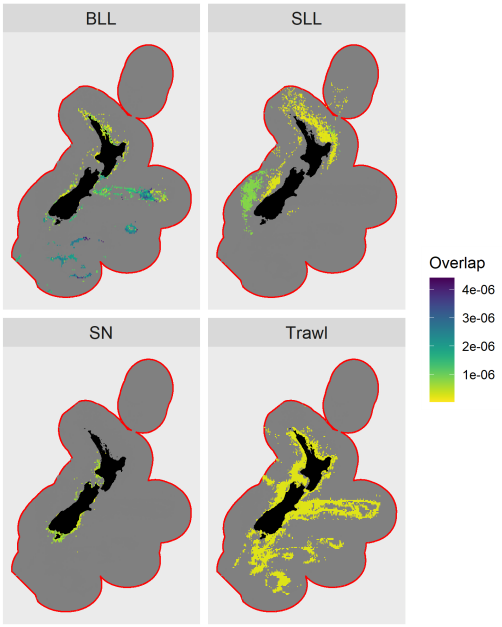

Figure 79: Sum of observed density overlap per method for Masked booby (XMB) between 2006/07 and 2019/20, with captures per event.

Table 69: Density overlap and captures for Masked booby (XMB). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.006	0.025	23	-
BLL	2	Large Autoline	0.002	0.018	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.010	5	-
BLL	4	Small Autoline	0.000	0.011	2	-
BLL	5	Small Manual (heavy)	0.000	0.017	1	-
BLL	6	Small Manual (light)	0.001	0.038	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.017	3	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.008	8	-
SN	10	SN (unclassified)	0.002	0.046	4	-
Trawl	11	Deepwater	0.005	0.016	30	-
Trawl	12	Large Freezer	0.015	0.043	35	-
Trawl	13	Large Fresher	0.001	0.013	10	-
Trawl	14	Mackerel	0.004	0.007	62	-
Trawl	15	Scampi	0.001	0.016	9	-
Trawl	16	Small inshore (17-28m)	0.003	0.081	4	-
Trawl	17	Small inshore (less than 17m)	0.002	0.093	2	-
Trawl	18	Southern Blue Whiting	0.002	0.003	67	-
Trawl	19	Squid	0.007	0.011	60	-
Total	**-**	**-**	**0.053**	**0.471**	**11**	**-**

5.57 Pied shag (XPS)

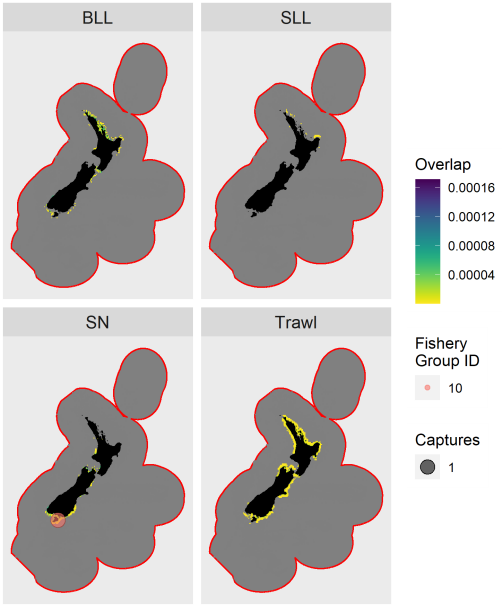

Figure 80: Sum of observed density overlap per method for Pied shag (XPS) between 2006/07 and 2019/20, with captures per event.

Table 70: Density overlap and captures for Pied shag (XPS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.008	0.040	19	-
BLL	2	Large Autoline	0.000	0.001	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	3	-
BLL	4	Small Autoline	0.000	0.003	6	-
BLL	5	Small Manual (heavy)	0.000	0.071	1	-
BLL	6	Small Manual (light)	0.066	2.206	3	-
BLL	7	Small Manual (LIN, RIB)	0.002	0.071	3	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.001	4	-
SN	10	SN (unclassified)	0.036	2.261	2	1
Trawl	11	Deepwater	0.000	0.001	14	-
Trawl	12	Large Freezer	0.007	0.038	19	-
Trawl	13	Large Fresher	0.014	0.116	12	-
Trawl	14	Mackerel	0.000	0.001	60	-
Trawl	15	Scampi	0.002	0.016	12	-
Trawl	16	Small inshore (17-28m)	0.068	1.641	4	-
Trawl	17	Small inshore (less than 17m)	0.062	3.226	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	60	-
Total	**-**	**-**	**0.266**	**9.698**	**3**	**1**

5.58 Little black shag (XBC)

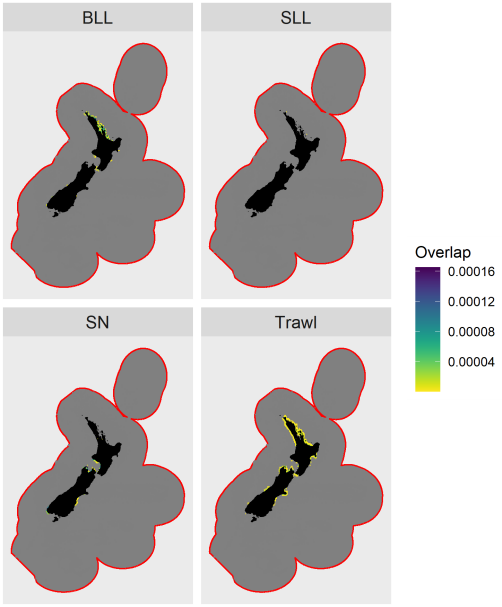

Figure 81: Sum of observed density overlap per method for Little black shag (XBC) between 2006/07 and 2019/20, with captures per event.

Table 71: Density overlap and captures for Little black shag (XBC). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.002	0.005	31	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	1	-
BLL	4	Small Autoline	0.000	0.002	4	-
BLL	5	Small Manual (heavy)	0.000	0.062	-	-
BLL	6	Small Manual (light)	0.092	3.161	3	-
BLL	7	Small Manual (LIN, RIB)	0.001	0.030	4	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.015	2.926	1	-
Trawl	11	Deepwater	0.000	0.000	27	-
Trawl	12	Large Freezer	0.006	0.024	24	-
Trawl	13	Large Fresher	0.010	0.101	10	-
Trawl	14	Mackerel	0.000	0.000	5	-
Trawl	15	Scampi	0.001	0.008	13	-
Trawl	16	Small inshore (17-28m)	0.065	1.567	4	-
Trawl	17	Small inshore (less than 17m)	0.050	3.348	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	100	-
Total	**-**	**-**	**0.242**	**11.239**	**2**	**-**

5.59 New Zealand king shag (XKS)

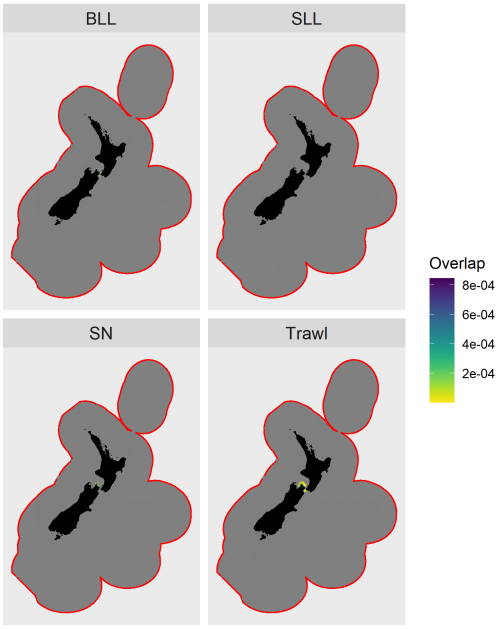

Figure 82: Sum of observed density overlap per method for New Zealand king shag (XKS) between 2006/07 and 2019/20, with captures per event.

Table 72: Density overlap and captures for New Zealand king shag (XKS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.001	0.001	99	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	100	-
BLL	4	Small Autoline	0.000	0.007	-	-
BLL	5	Small Manual (heavy)	0.000	0.354	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.001	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.007	0.741	1	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.003	0.032	10	-
Trawl	13	Large Fresher	0.009	0.062	15	-
Trawl	14	Mackerel	0.004	0.006	60	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.007	1.800	-	-
Trawl	17	Small inshore (less than 17m)	0.009	4.729	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.041**	**7.732**	**1**	**-**

5.60 Otago shag (XSI)

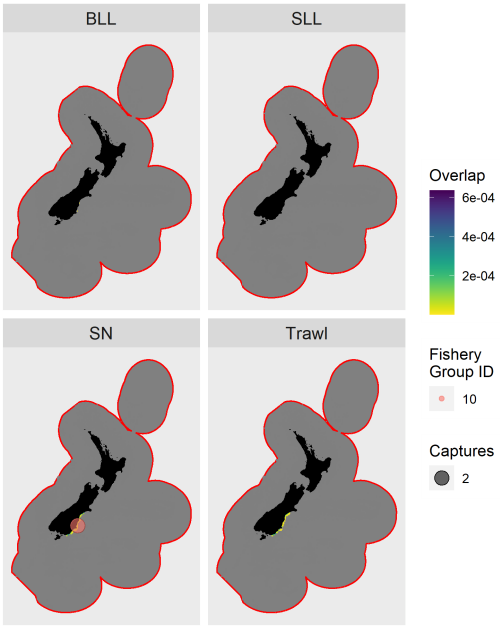

Figure 83: Sum of observed density overlap per method for Otago shag (XSI) between 2006/07 and 2019/20, with captures per event.

Table 73: Density overlap and captures for Otago shag (XSI). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.002	1	-
BLL	6	Small Manual (light)	0.000	0.008	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.001	2	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.077	1.154	7	2
Trawl	11	Deepwater	0.000	0.000	45	-
Trawl	12	Large Freezer	0.001	0.002	36	-
Trawl	13	Large Fresher	0.000	0.012	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.008	1.299	1	-
Trawl	17	Small inshore (less than 17m)	0.183	14.460	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.001	0.001	61	-
Total	**-**	**-**	**0.270**	**16.939**	**2**	**2**

5.61 Foveaux shag (XFX)

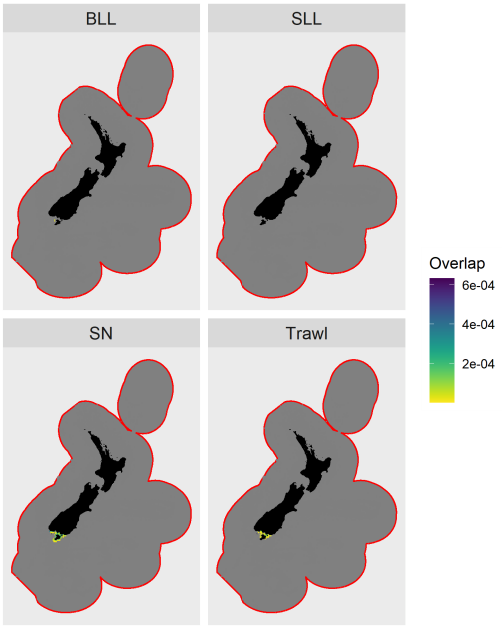

Figure 84: Sum of observed density overlap per method for Foveaux shag (XFX) between 2006/07 and 2019/20, with captures per event.

Table 74: Density overlap and captures for Foveaux shag (XFX). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.007	2	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.011	-	-
BLL	6	Small Manual (light)	0.000	0.001	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.004	6	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.139	1.205	12	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.001	0.010	9	-
Trawl	13	Large Fresher	0.000	0.018	-	-
Trawl	14	Mackerel	0.000	0.000	100	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.005	0.669	1	-
Trawl	17	Small inshore (less than 17m)	0.024	3.212	1	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.169**	**5.138**	**3**	**-**

5.62 Chatham Island shag (XCS)

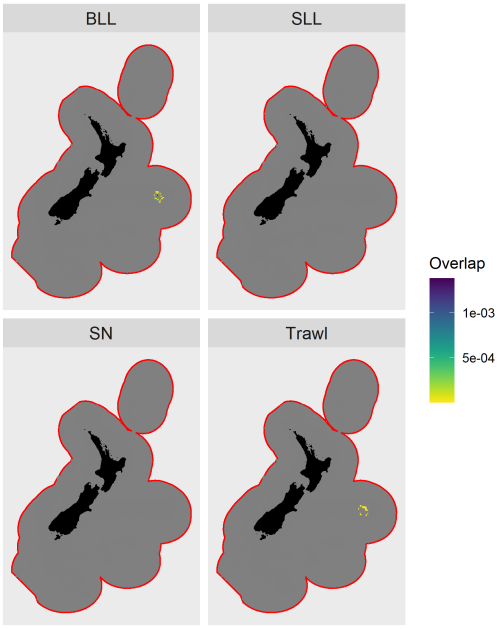

Figure 85: Sum of observed density overlap per method for Chatham Island shag (XCS) between 2006/07 and 2019/20, with captures per event.

Table 75: Density overlap and captures for Chatham Island shag (XCS). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.003	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.013	-	-
BLL	4	Small Autoline	0.009	0.737	1	-
BLL	5	Small Manual (heavy)	0.000	0.085	-	-
BLL	6	Small Manual (light)	0.000	0.006	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.002	0.006	31	-
Trawl	13	Large Fresher	0.000	0.083	-	-
Trawl	14	Mackerel	0.001	0.001	86	-
Trawl	15	Scampi	0.000	0.005	9	-
Trawl	16	Small inshore (17-28m)	0.000	0.019	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.012**	**0.958**	**1**	**-**

5.63 Bounty Island shag (LERA)

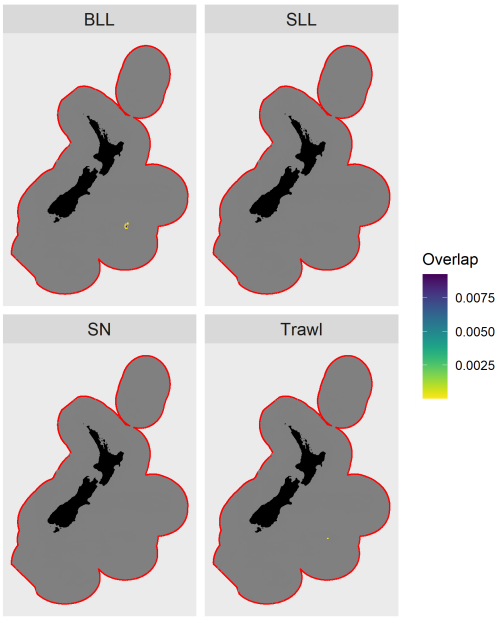

Figure 86: Sum of observed density overlap per method for Bounty Island shag (LERA) between 2006/07 and 2019/20, with captures per event.

Table 76: Density overlap and captures for Bounty Island shag (LERA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.051	0.265	19	-
BLL	2	Large Autoline	0.000	0.002	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.000	0.000	-	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.001	68	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.051**	**0.269**	**19**	**-**

5.64 Auckland Island shag (LECO)

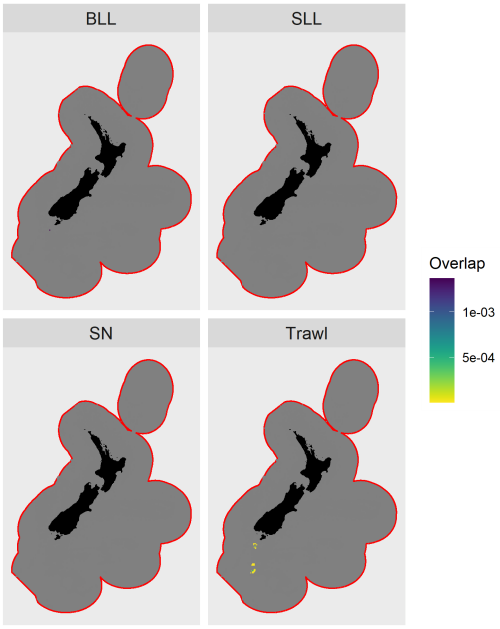

Figure 87: Sum of observed density overlap per method for Auckland Island shag (LECO) between 2006/07 and 2019/20, with captures per event.

Table 77: Density overlap and captures for Auckland Island shag (LECO). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.001	0.003	54	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.001	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.001	0.002	37	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	41	-
Trawl	15	Scampi	0.001	0.015	10	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	100	-
Trawl	19	Squid	0.017	0.029	59	-
Total	**-**	**-**	**0.021**	**0.049**	**42**	**-**

5.65 Campbell Island shag (LECA)

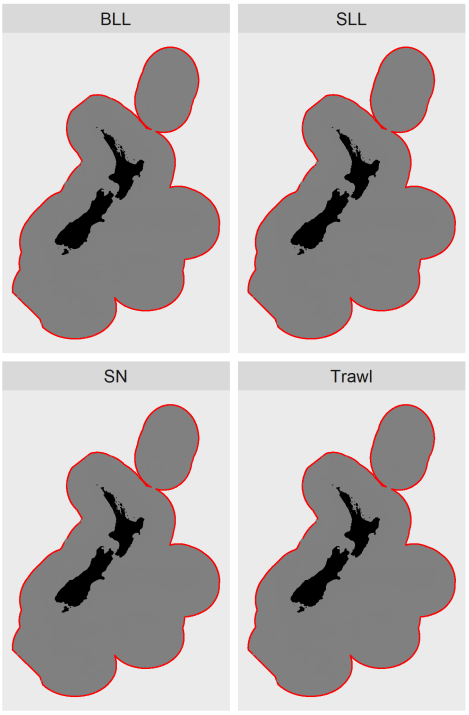

Figure 88: Sum of observed density overlap per method for Campbell Island shag (LECA) between 2006/07 and 2019/20, with captures per event.

Table 78: Density overlap and captures for Campbell Island shag (LECA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.000	-	-
BLL	4	Small Autoline	0.000	0.000	-	-
BLL	5	Small Manual (heavy)	0.000	0.000	-	-
BLL	6	Small Manual (light)	0.000	0.000	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.000	0.000	-	-
Trawl	13	Large Fresher	0.000	0.000	-	-
Trawl	14	Mackerel	0.000	0.000	-	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.000	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.000**	**0.000**	**-**	**-**

5.66 Spotted shag (XPP)

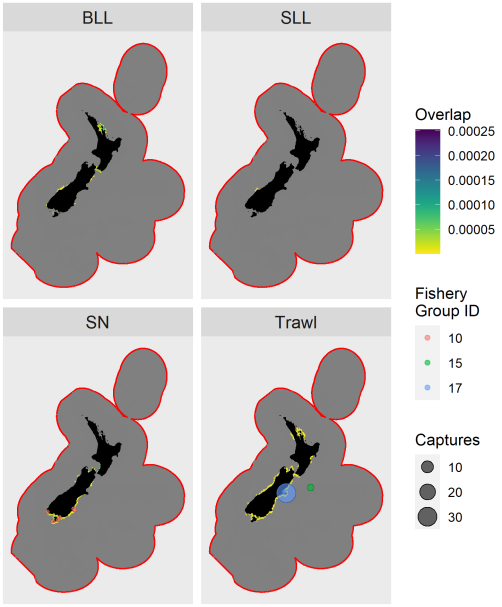

Figure 89: Sum of observed density overlap per method for Spotted shag (XPP) between 2006/07 and 2019/20, with captures per event.

Table 79: Density overlap and captures for Spotted shag (XPP). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.003	0.012	26	-
BLL	2	Large Autoline	0.000	0.000	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.004	3	-
BLL	4	Small Autoline	0.000	0.002	4	-
BLL	5	Small Manual (heavy)	0.000	0.077	1	-
BLL	6	Small Manual (light)	0.050	1.590	3	-
BLL	7	Small Manual (LIN, RIB)	0.003	0.088	4	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	14	-
SN	10	SN (unclassified)	0.051	2.532	2	6
Trawl	11	Deepwater	0.000	0.001	15	-
Trawl	12	Large Freezer	0.003	0.031	10	-
Trawl	13	Large Fresher	0.006	0.071	8	-
Trawl	14	Mackerel	0.000	0.000	51	-
Trawl	15	Scampi	0.000	0.001	8	2
Trawl	16	Small inshore (17-28m)	0.042	1.686	2	-
Trawl	17	Small inshore (less than 17m)	0.043	4.873	1	32
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	61	-
Total	**-**	**-**	**0.202**	**10.970**	**2**	**40**

5.67 Pitt Island shag (XPF)

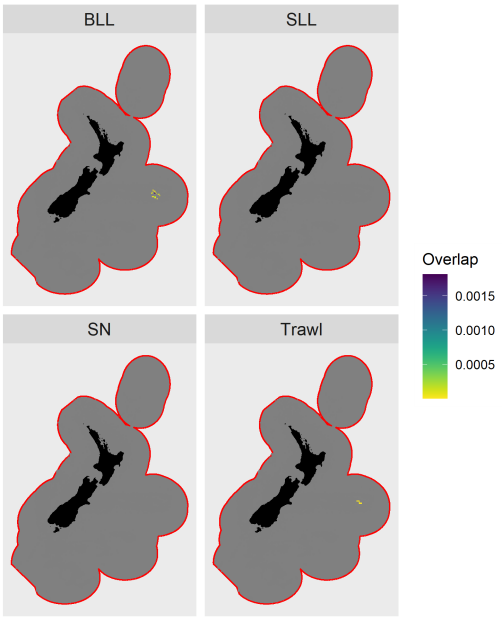

Figure 90: Sum of observed density overlap per method for Pitt Island shag (XPF) between 2006/07 and 2019/20, with captures per event.

Table 80: Density overlap and captures for Pitt Island shag (XPF). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.000	0.000	-	-
BLL	2	Large Autoline	0.000	0.002	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.012	-	-
BLL	4	Small Autoline	0.006	0.650	1	-
BLL	5	Small Manual (heavy)	0.000	0.088	-	-
BLL	6	Small Manual (light)	0.000	0.006	-	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.000	-	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.000	-	-
SN	10	SN (unclassified)	0.000	0.000	-	-
Trawl	11	Deepwater	0.000	0.000	-	-
Trawl	12	Large Freezer	0.000	0.002	27	-
Trawl	13	Large Fresher	0.000	0.060	-	-
Trawl	14	Mackerel	0.000	0.000	89	-
Trawl	15	Scampi	0.000	0.000	-	-
Trawl	16	Small inshore (17-28m)	0.000	0.015	-	-
Trawl	17	Small inshore (less than 17m)	0.000	0.000	-	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.000	-	-
Total	**-**	**-**	**0.007**	**0.836**	**1**	**-**

5.68 Subantarctic skua (CALO)

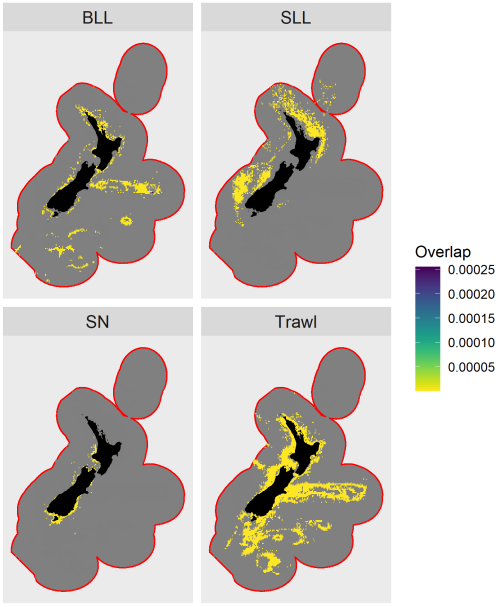

Figure 91: Sum of observed density overlap per method for Subantarctic skua (CALO) between 2006/07 and 2019/20, with captures per event.

Table 81: Density overlap and captures for Subantarctic skua (CALO). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.005	0.019	26	-
BLL	2	Large Autoline	0.001	0.012	8	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.010	4	-
BLL	4	Small Autoline	0.001	0.081	1	-
BLL	5	Small Manual (heavy)	0.000	0.016	2	-
BLL	6	Small Manual (light)	0.001	0.025	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.011	3	-
SLL	8	Large SLL	0.001	0.002	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.006	9	-
SN	10	SN (unclassified)	0.002	0.035	6	-
Trawl	11	Deepwater	0.003	0.010	32	-
Trawl	12	Large Freezer	0.011	0.030	36	-
Trawl	13	Large Fresher	0.001	0.009	9	-
Trawl	14	Mackerel	0.002	0.004	62	-
Trawl	15	Scampi	0.001	0.010	10	-
Trawl	16	Small inshore (17-28m)	0.002	0.055	4	-
Trawl	17	Small inshore (less than 17m)	0.001	0.067	2	-
Trawl	18	Southern Blue Whiting	0.001	0.001	63	-
Trawl	19	Squid	0.005	0.008	60	-
Total	**-**	**-**	**0.040**	**0.411**	**10**	**-**

5.69 Southern black-backed gull (XBG)

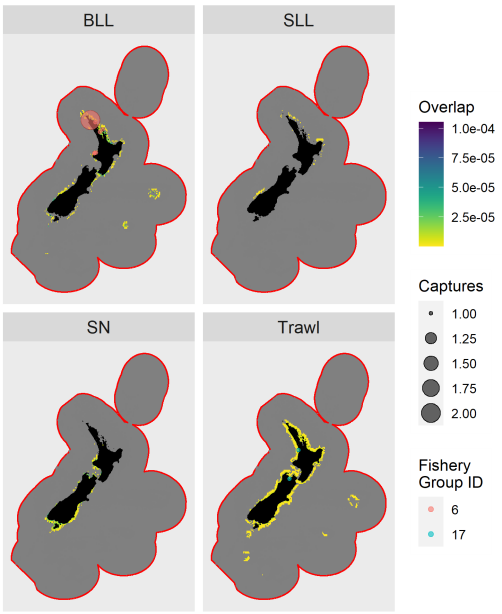

Figure 92: Sum of observed density overlap per method for Southern black-backed gull (XBG) between 2006/07 and 2019/20, with captures per event.

Table 82: Density overlap and captures for Southern black-backed gull (XBG). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.007	0.041	17	-
BLL	2	Large Autoline	0.000	0.001	-	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.008	5	-
BLL	4	Small Autoline	0.001	0.053	2	-
BLL	5	Small Manual (heavy)	0.001	0.084	1	-
BLL	6	Small Manual (light)	0.045	1.418	3	8
BLL	7	Small Manual (LIN, RIB)	0.003	0.127	3	-
SLL	8	Large SLL	0.000	0.000	-	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.002	7	-
SN	10	SN (unclassified)	0.046	1.602	3	-
Trawl	11	Deepwater	0.000	0.003	10	-
Trawl	12	Large Freezer	0.007	0.035	19	-
Trawl	13	Large Fresher	0.011	0.126	9	-
Trawl	14	Mackerel	0.001	0.002	62	-
Trawl	15	Scampi	0.002	0.020	12	-
Trawl	16	Small inshore (17-28m)	0.051	1.474	3	-
Trawl	17	Small inshore (less than 17m)	0.047	2.810	2	2
Trawl	18	Southern Blue Whiting	0.000	0.000	63	-
Trawl	19	Squid	0.002	0.003	60	-
Total	**-**	**-**	**0.226**	**7.810**	**3**	**10**

5.70 Caspian tern (HYCA)

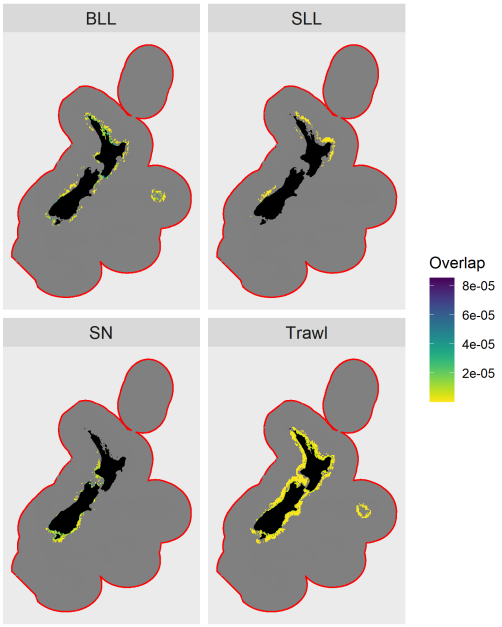

Figure 93: Sum of observed density overlap per method for Caspian tern (HYCA) between 2006/07 and 2019/20, with captures per event.

Table 83: Density overlap and captures for Caspian tern (HYCA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.008	0.052	15	-
BLL	2	Large Autoline	0.000	0.002	2	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.012	4	-
BLL	4	Small Autoline	0.001	0.069	2	-
BLL	5	Small Manual (heavy)	0.001	0.097	1	-
BLL	6	Small Manual (light)	0.040	1.227	3	-
BLL	7	Small Manual (LIN, RIB)	0.004	0.155	3	-
SLL	8	Large SLL	0.000	0.000	73	-
SLL	9	Small SLL (tuna and swordfish)	0.000	0.004	7	-
SN	10	SN (unclassified)	0.043	1.382	3	-
Trawl	11	Deepwater	0.001	0.007	11	-
Trawl	12	Large Freezer	0.013	0.056	23	-
Trawl	13	Large Fresher	0.014	0.151	9	-
Trawl	14	Mackerel	0.004	0.007	63	-
Trawl	15	Scampi	0.003	0.034	10	-
Trawl	16	Small inshore (17-28m)	0.054	1.500	4	-
Trawl	17	Small inshore (less than 17m)	0.045	2.558	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.001	0.002	57	-
Total	**-**	**-**	**0.232**	**7.316**	**3**	**-**

5.71 White tern (GYCA)

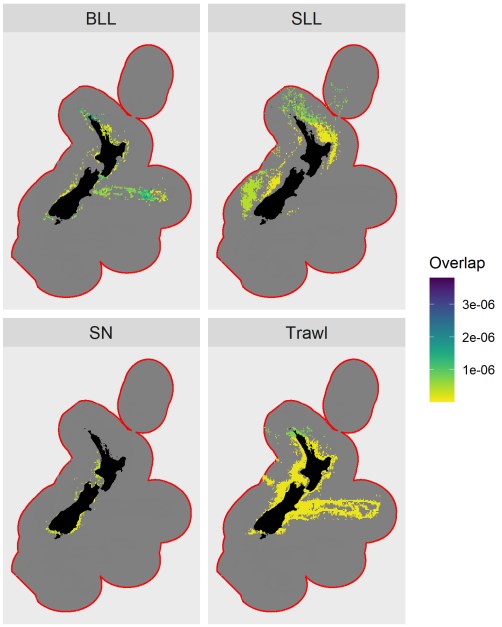

Figure 94: Sum of observed density overlap per method for White tern (GYCA) between 2006/07 and 2019/20, with captures per event.

Table 84: Density overlap and captures for White tern (GYCA). Observed overlap and total commercial overlap are summed across all months and years between 2006/07 and 2019/20. Observer coverage is calculated from the ratio of observed to total overlap.

Method	ID	Fishing Group	Obs. Overlap	Tot. Overlap	Obs. Coverage (%)	Captures
BLL	1	Large Autoline with IWL	0.001	0.005	27	-
BLL	2	Large Autoline	0.001	0.009	9	-
BLL	3	Small Autoline (LIN, RIB)	0.000	0.005	5	-
BLL	4	Small Autoline	0.000	0.006	2	-
BLL	5	Small Manual (heavy)	0.000	0.016	1	-
BLL	6	Small Manual (light)	0.001	0.047	3	-
BLL	7	Small Manual (LIN, RIB)	0.000	0.010	2	-
SLL	8	Large SLL	0.001	0.001	86	-
SLL	9	Small SLL (tuna and swordfish)	0.001	0.009	9	-
SN	10	SN (unclassified)	0.001	0.031	2	-
Trawl	11	Deepwater	0.003	0.009	31	-
Trawl	12	Large Freezer	0.006	0.018	33	-
Trawl	13	Large Fresher	0.001	0.009	12	-
Trawl	14	Mackerel	0.002	0.004	61	-
Trawl	15	Scampi	0.000	0.006	8	-
Trawl	16	Small inshore (17-28m)	0.003	0.052	5	-
Trawl	17	Small inshore (less than 17m)	0.001	0.050	2	-
Trawl	18	Southern Blue Whiting	0.000	0.000	-	-
Trawl	19	Squid	0.000	0.001	56	-
Total	**-**	**-**	**0.023**	**0.288**	**8**	**-**

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